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Evaluation of an articular cartilage degradation level with use of Raman spectroscopy

Osteoarthritis, a leading cause of disability worldwide, causes permanent alterations in joint tissue structure. The diagnosis with existing methods usually occurs at an advanced stage, where tissue damage is extensive, leaving joint replacement as the only viable treatment. An early diagnosis could facilitate the initiation of drug therapies to decelerate joint degradation [1-3]. Our research group is focusing on creating an osteoarthritis diagnostic technique through Raman spectroscopy. Additionally, we're developing novel copolymers with a molecular bottlebrush structure for application at various levels of advancement of the degenerative disease. These proposed copolymers aim to act as lubricants in the affected joint, minimizing friction and warding off further damage.
This study aims to explore the link between the structure of articular cartilage and the progression of osteoarthritis. Through Raman spectroscopy analysis of cartilage tissue samples from several patients undergoing joint replacement surgery, we aim to investigate the association between various spectral parameters and the chemical compositional changes in cartilage as it degrades. Identifiable Raman bands of hydroxyapatite, chondroitin sulfate, and amide III groups were used to gauge the level of mineralization and remodeling in the cartilage tissue [4]. The insights gained will contribute to creating an index to measure osteoarthritis severity. Future work entails conducting in vivo experiments using a portable Raman spectrometer equipped with an endoscopic fiber optic probe. This device will allow for the direct evaluation of the joint interior during arthroscopic surgery.

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References

[1] R. Kumar, et al., International Journal of Molecular Sciences, 16 (2015) 9341.
[2] K.J.I. Ember, et al., Regenerative Medicine, 2 (2017) 12.
[3] L. Rieppo, et al., Applied Spectroscopy Reviews, 52 (2016) 249.
[4] E. Pavlou, et al., Annals of Joint, 3 (2018) 83.