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Development of HA-modified hydrogel for adipose derived stem cells based articular cartilage regeneration

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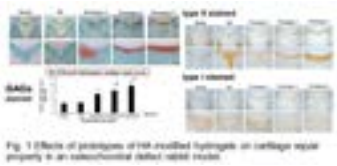
Regenerating the damaged articular cartilage to be a functional hyaline cartilage has been a clinically unmet need. Although several current treatment methods, micro-fracture, osteo-chondral grafting and autologous chondrocytes implantation, have been used to repair the damaged cartilage, the most concerned issue is the formation of unwanted fibrous cartilage rather than hyaline cartilage in the repaired tissue. The most difficult challenge in cartilage regeneration is that the tissue mainly possesses differentiated chondrocytes to maintain extra-cellular matrix homeostasis, which lacks of *in situ* and circulatory stem cells. One of the current approaches to solve this clinically unmet need is the stem cell-based tissue engineering. Adipose-derived stem cells (ADSCs) have been thought to be beneficial for use because of easy harvest, higher yield numbers and multi-potent differentiation. To make it possible for ADSCs-based articular cartilage regeneration, the most important thing to be solved is the *in situ* chondral-induction for ADSCs. We have conducted a series of studies to develop biomaterials that can provide the extra-cellular micro-environment, including chemical and physical cues, to optimize the ADSC chondrogenesis in the repair site of articular cartilage. We found that hyaluronan (HA) enriched micro-environment can initiate and enhance ADSC chondrogenesis via CD44 mediation. On the other hand, matrix stiffness has been indicated to direct stem cell differentiation into different tissues. We further developed the chondral-induction biomaterials by ways of adjusting chemical and physical cues. We found that the modified cross-linked HA products can be optimized by tuning the HA molecular weight and matrix stiffness. Most importantly, the cartilage regeneration effect of the newly developed HA-modified hydrogel product has been confirmed in an osteo-chondral defect rabbit model (Fig.1). The findings and biomaterial development from these studies provide the important information to persuade the possibility for the future clinical use of ADSCs-based articular cartilage regeneration.



Recent publications

1. Wu S C, Chen C H, Wang J Y, Lin Y S, Chang J K, et al. (2018) Hyaluronan size alters chondrogenesis of adipose-derived stem cells via the CD44/ERK/SOX-9 pathway. Acta Biomater 15(66):224-237.
2. Teong B, Wu S C, Chang C M, Chen J W, Chen H T, et al. (2018) The stiffness of a cross-linked hyaluronan hydrogel affects its chondro-induction activity on hADSCs. J Biomed Mater Res. B 106(2):808-816.
3. Wang Y H, Rajalakshmanan E, Wang C K, Chen C H, Fu Y C, et al. (2016) PLGA-linked alendronate enhances bone repair in diaphysis defect model. J Tissue Eng Regen M. 11(9):2603-2612.
4. Fu Y C, Wang Y H, Chen C H, Wang C K, Wang G J, et al. (2015) Combination of calcium sulfate and a simvastatin-controlled release microsphere enhances bone repair in critical-sized calvarial bone defects. Int J Nanomed 10:7231-7240.
5. Wu S C, Chen C H, Chang J K, Fu Y C, Wang C K, et al. (2013) Hyaluronan initiates chondrogenesis mainly via CD44 in human adipose derived stem cells. J Appl Physiol 114(11):1610-8.

Biography

Mei-Ling Ho has focused her study on Regenerative Medicine, especially Tissue Engineering of articular cartilage and bone, as well as degenerative diseases like osteoarthritis and osteoporosis, in the recent 20 years. In the field of research, she has published her study results in high ranking journals including *Biomaterials, Acta Biomaterialia, Journal of Tissue Engineering and Regenerative Medicine* and as well as *Journal of Applied Physiology*. Besides, she has also studied the stem cell biology for searching effect mechanism of drugs, nature products and physical agents, magnetic field and laser therapy. She also studied the novel gene effects on bone and cartilage by gene knock animals for searching the new drugs in future.

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