Mechanically-Activated Microcapsules Deliver Chondroprotective Agents and Prevent Degeneration in an Inflammatory Microenvironment

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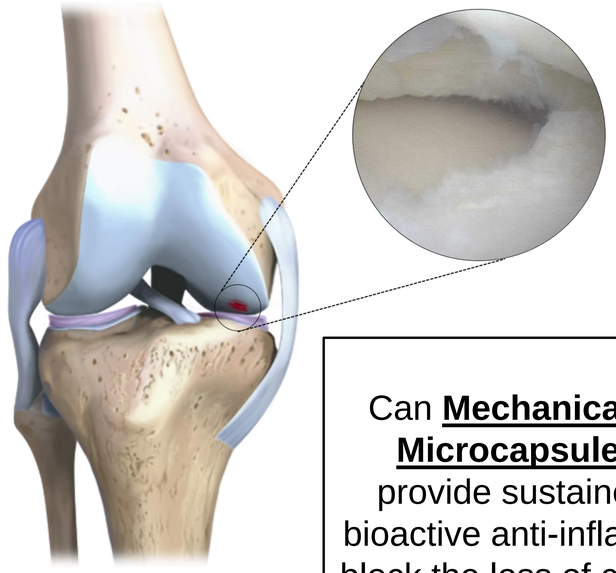
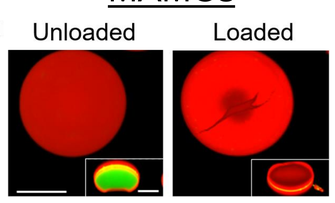
Unmet Need



- Intra-articular injections of anti-inflammatory drugs to prevent the loss of matrix after cartilage injury are inefficient, due to rapid drug clearance from the joint.

Can **Mechanically-Activated Microcapsules (MAMCs)** provide sustained delivery of bioactive anti-inflammatories and block the loss of cartilage matrix?



[Mohanraj + 2019]

MAMC Delivery to Treat Inflammation

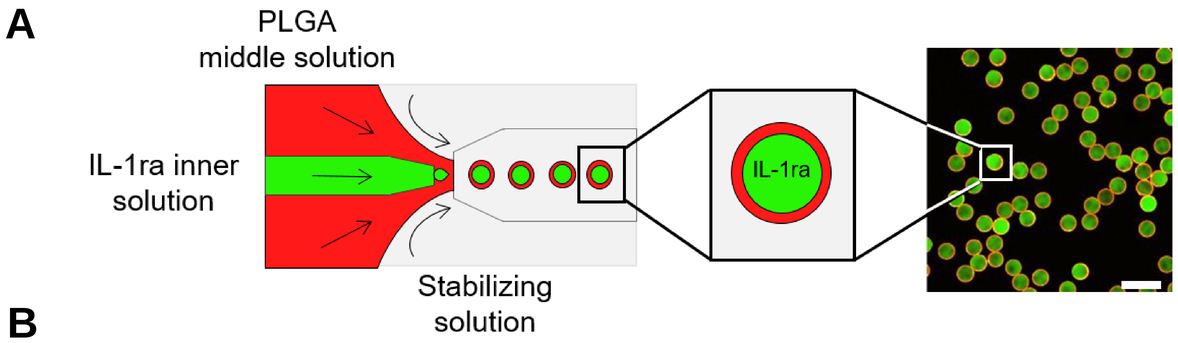
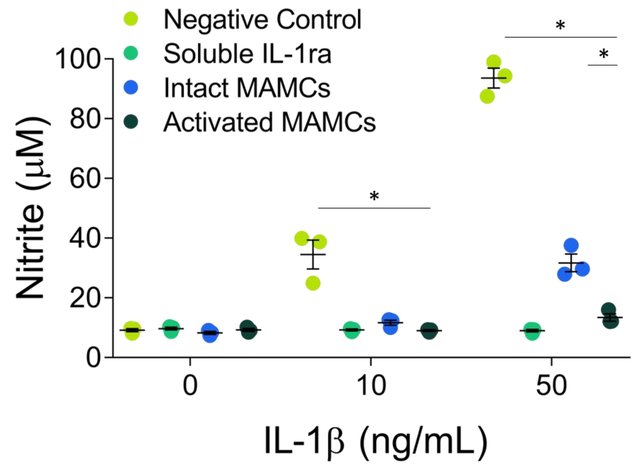


Figure 1. (A) MAMCs were fabricated using a microfluidic device with an IL-1ra-containing inner solution, a poly(lactic-co-glycolic) acid (PLGA) middle solution, and a polyvinyl alcohol stabilizing solution (scale bar = 100μm. (B) Study design for assessment of anti-inflammatory agent delivery via MAMC activation.

- Engineered cartilage constructs were treated with low (10ng/mL) or high (50ng/mL) IL-1β and received treatments 1-4. IL-1ra, which blocks IL-1β signaling, was delivered via activation of MAMCs and compared to direct molecule delivery, intact MAMC delivery and untreated controls.
- Nitrite quantification, matrix retention, histology, and mechanical integrity were assessed.

MAMCs Deliver Chondroprotective Agents



- IL-1ra delivery via MAMC activation suppresses the increase in nitrite production caused by IL-1β.
- Delivery of IL-1ra via MAMC activation had a similar anti-inflammatory effect as direct delivery of the molecule.

Figure 2. Nitrite quantification as a readout for cellular inflammatory signaling. $p<0.05$

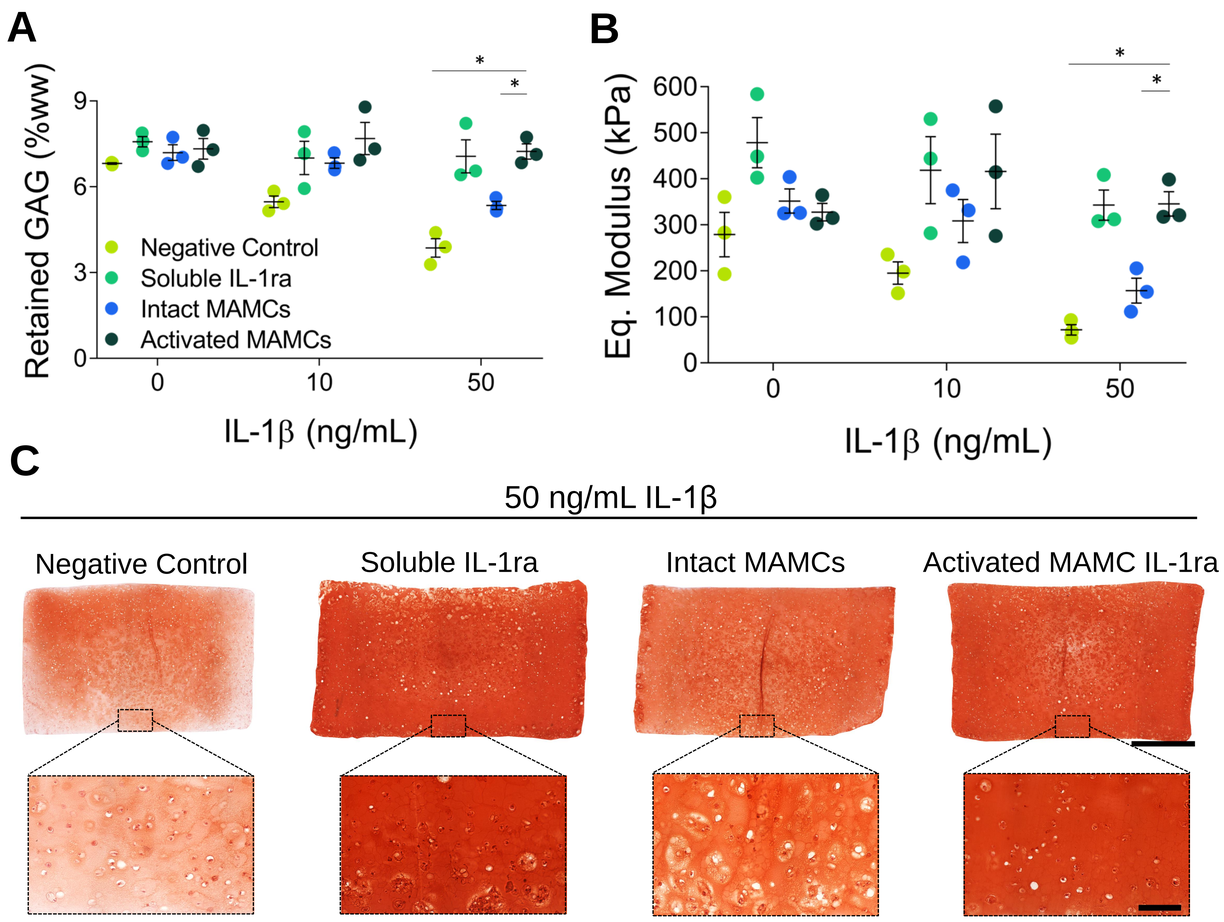


Figure 3. (A) Quantification of retained glycosaminoglycans (GAGs) and (B) construct equilibrium moduli. (C) Histological staining for GAGs using Safranin O. * $p<0.05$

- IL-1ra delivery via MAMC activation retains cartilage construct GAGs and mechanical integrity in inflammatory environments.

Take Home Message

MAMCs enable **local delivery of bioactive anti-inflammatory molecules** and **help retain matrix and mechanical integrity** of engineered cartilage constructs in inflammatory environments. This study presents a novel therapeutic approach for the treatment of joint diseases.

Acknowledgements

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