Researchers advocate for tissue-engineering approach for arthritis relief

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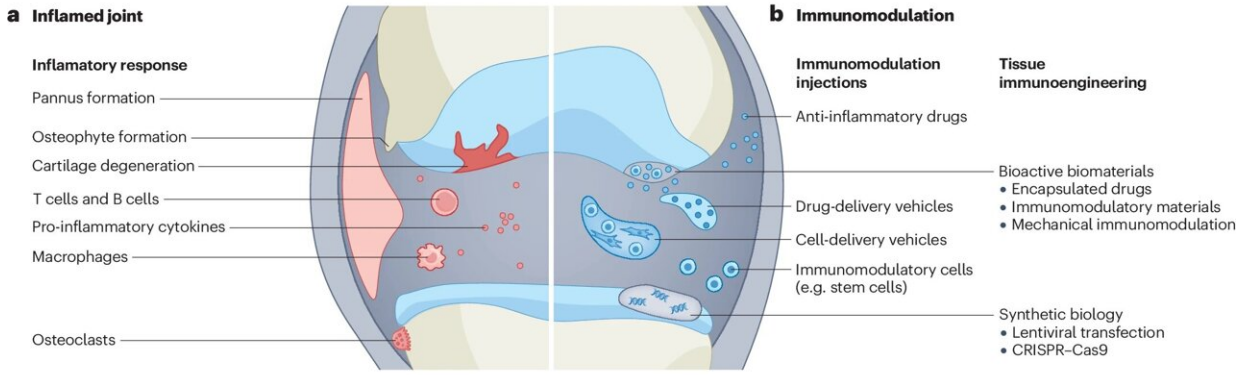

Approaches for tissue engineering cartilage in an inflammatory environment. The presence of inflammation in affected joints in osteoarthritis and rheumatoid arthritis affects joint physiology, and if inflammation is not reduced it is likely to affect cartilage-based joint treatments. Immunomodulatory approaches in combination with tissue engineering might be needed to treat these inflamed joints. **a**, In inflamed joints that are affected by osteoarthritis or rheumatoid arthritis, various degenerative and pathological changes occur, and immune cells invade. **b**, Several immunomodulatory techniques have been used to modulate the immune response within inflamed joints. Drug- and cell-based immunomodulatory injections, with or without a carrier, have been used to modulate inflammation but do not repair the underlying cartilage damage. As an alternative to injection-based approaches, tissue immunoengineering involves the deployment of a mechanically robust implant with immunomodulatory properties. Two categories of treatment developed within the field of tissue immunoengineering are the use of immunomodulatory biomaterials and

synthetic biology. Credit: *Nature Reviews Rheumatology* (2024). DOI: 10.1038/s41584-024-01118-4

Various forms of arthritis afflict nearly 600 million people worldwide and add $16.5 billion to the United States' health care bill, yet there are few engineered cartilage tissue therapies available to sufferers.

In *Nature Reviews Rheumatology*, University of California, Irvine biomedical engineers have shared insights into the effective treatment of severe osteoarthritis and rheumatoid arthritis and the clinical trial and regulatory efforts that are going to be necessary to bring products to market.

In their review article, researchers in the DELTAi laboratory headed by Kyriacos Athanasiou, Distinguished Professor of biomedical engineering, discussed a variety of technologies developed to address articular cartilage diseases and disorders in the knee, temporomandibular joint, hip joint and others. Despite substantial research efforts, no treatments to date have been made specifically to treat severe osteoarthritis or rheumatoid arthritis.

The team delved into new methods of helping tissue-engineered cartilage implants survive inflammatory environments using immunomodulatory biomaterials and synthetic biology, and they highlighted clinical development of allogeneic cells from donors versus autologous cells from the person being treated.

"Researchers have expected the successful application of tissue engineering toward articular cartilage for decades, but the process is arduous. Cartilage repair products have been slow to reach the marketplace and exhibit significant limitations," said lead co-author

Benjamin Bielajew, a postdoctoral scholar in biomedical engineering. "But despite past setbacks, we remain optimistic. We believe that with these recent advances in cartilage tissue engineering, the field is poised to develop better treatments for the millions of people suffering debilitating joint deficiencies."

Rachel Nordberg, a research specialist in biomedical engineering, who served as the primary lead co-author of the review article, said that recent innovations in tissue engineering spotlight the need for researchers to master the ins and outs of translation and commercialization of these new products.

"For academic researchers, it is not enough to develop these technologies in the laboratory, we also need to fully understand and navigate in the 'translational vector'—engaging with regulatory agencies such as the FDA, understanding funding opportunities from academia for clinical use, and working toward commercialization and widespread use," said Nordberg. "Through this bilateral approach—this academic translation—there is great potential to bring forth a new generation of cartilage therapies."

More information: Rachel C. Nordberg et al, Recent advancements in cartilage tissue engineering innovation and translation, *Nature Reviews Rheumatology* (2024). DOI: 10.1038/s41584-024-01118-4

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