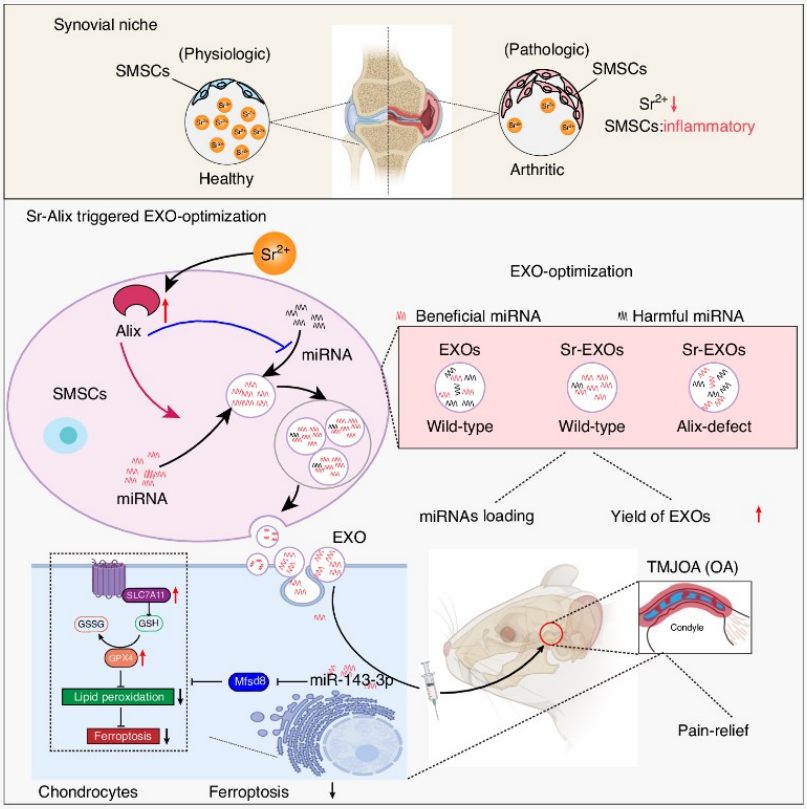
Strontium-boosted exosomes: a new frontier in treating degenerative joint diseases

GA, UNITED STATES, February 28, 2025 /EINPresswire.com/ -- This new study explores the potential of strontium (Sr)-enhanced exosomes, derived from synovial mesenchymal stem cells (SMSCs), as a promising therapeutic approach for temporomandibular joint osteoarthritis (TMJOA). Researchers have found that Sr pretreatment not only increases the production of SMSC-derived exosomes but also optimizes their miRNA profile, enriching them with beneficial miRNAs while reducing harmful ones. These enhanced exosomes showed remarkable effectiveness in alleviating cartilage degeneration, reducing joint pain, and inhibiting osteoclast activity in TMJOA rat models, offering fresh insights into the future of exosome-based therapies for degenerative joint diseases.



Schematic diagram shows a potential strategy, utilizing a niche cell-guided work pattern, to optimize the miRNA compositions in therapeutic SMSC-EXOs and boost the yield of the EXOs.

Temporomandibular joint osteoarthritis (TMJOA) is a debilitating condition that causes severe joint pain, restricted mobility, and progressive cartilage degradation. Despite its significant impact on patients' quality of life, the underlying pathological mechanisms of TMJOA remain incompletely elucidated, and current therapeutic interventions often provide only limited or transient relief. Exosomes, tiny vesicles released by cells, have garnered attention as potential therapeutic agents due to their role in tissue repair and inflammation modulation. However, challenges such as limited exosome yield and inconsistent therapeutic outcomes have hindered their clinical translation. To overcome these obstacles, researchers have been actively exploring innovative strategies to optimize exosome production and enhance their therapeutic effects.

In a paper (DOI: 10.1038/s41368-024-00329-5) published in the International Journal of Oral Science on February 1, 2025 researchers from Sichuan University introduced a novel approach to improve exosome efficacy for TMJOA treatment. Their study investigates how pretreating synovial mesenchymal stem cells (SMSCs) with strontium (Sr) enhances exosome production and miRNA selectively loading, leading to improved therapeutic results in animal models of TMJOA.

The research provides a detailed analysis of how Sr pretreatment boosts the yield and therapeutic potential of SMSC-derived exosomes for treating TMJOA. The team found that Sr pretreatment increases exosome production while selectively enriching miRNA profiles. Notably, Sr treatment elevates the levels of beneficial miRNAs, such as miR-143-3p, which targets Mfsd8 and inhibits chondrocyte ferroptosis—a process contributing to cartilage degradation. At the same time, harmful miRNAs linked to disease progression are significantly reduced. In TMJOA animal models, Sr-enhanced exosomes were far more effective in preventing cartilage degradation, alleviating joint pain, and reducing osteoclast activity compared to untreated exosomes. Furthermore, the study underscores the important role of the Alix protein in Sr-induced miRNA selectively loading, pointing to Alix-mediated mechanisms as critical for optimizing exosome therapy. This research not only addresses the limitations of exosome yield and therapeutic efficacy but also proposes a novel strategy for improving treatments for TMJOA and other types of osteoarthritis.

Dr. Jun Wang, the study's lead researcher, emphasized, "Our findings demonstrate the powerful role of trace elements like Sr in enhancing the therapeutic properties of exosomes. By optimizing miRNA loading through Alix, we are able to significantly increase the effectiveness of exosome-based treatments for TMJOA and potentially other degenerative joint diseases."

This research opens up exciting new possibilities for the development of targeted therapies for TMJOA and other osteoarthritis-related conditions. By improving exosome yield and selectively loading beneficial miRNAs, these advancements could lead to more effective, minimally invasive treatments. Looking ahead, future studies will aim to translate these promising findings into clinical applications, including trials in larger animal models, and investigate the broader therapeutic potential of Alix-mediated miRNA loading for other diseases.

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