UNDERSTANDING STEM CELL REGULATION FOR HAIR FOLLICLE REGENERATION

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ABSTRACT

Hair loss represents a prevalent condition with significant socioeconomic impact. My clinical background as a medical doctor has underscored the profound patient burden of this and similar conditions, motivating an investigation into the fundamental biological mechanisms governing tissue regeneration. Despite its biological importance, the precise cellular activators of hair regeneration and the regulatory mechanisms governing stem cell regenerative capacity are not fully elucidated, hindering the development of targeted therapies.[1] Here, we investigate the spatiotemporal regulatory pathways controlling stem cell function during hair follicle cycling focusing on stem cell activation.

My doctoral research, conducted in Professor Sung Jan Lin's Tissue Engineering and Regeneration Lab, focuses on uncovering these regulatory mechanisms, particularly during the critical telogen-to-anagen transition, when dormant follicles reactivate for new hair production.[2] This work integrates in vivo study, imaging and single-cell multiomics. We perform time-course sampling of murine dorsal skin during induced synchronous hair cycling. Following flow cytometry-based cell sorting, single-cell multiomics approaches are employed to generate a detailed spatiotemporal map of genetic and epigenetic alterations accompanying stem cell activation.

By profiling these transcriptional changes, we aim to delineate the interplay between key developmental signaling networks and their roles in both physiological hair regeneration and pathological responses. This research is designed to provide fundamental insights into stem cell regulatory dynamics within a regenerating tissue context. The generated spatiotemporal atlas and mechanistic understanding will contribute to identifying novel therapeutic targets and informing personalized regenerative medicine strategies for a range of tissue disorders, including chronic wounds, fibrotic diseases, and age-related tissue decline.

REFERENCES

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