Understanding Molecular Pathways of Fin Regeneration in the Zebrafish

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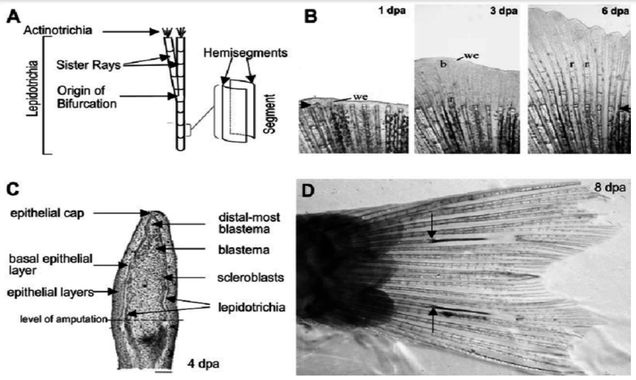
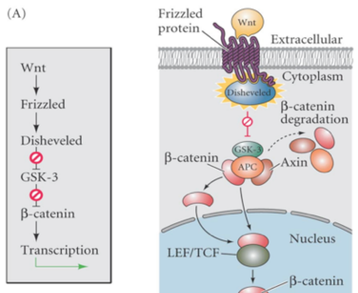
Main Objective: Researchers have long been searching for a way to help humans regenerate tissues and organs lost due to injury, disease, or issues during development. This study investigates the role of the Wnt signaling pathway during regeneration of caudal fins in the Zebrafish by inhibiting expression using two concentrations of Lithium Chloride (LiCl).

Regeneration



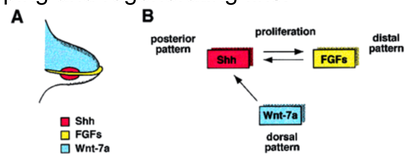
- Wnt signaling controls pattern formation during development, and the growth of stem cells during healing.
- With the addition of LiCl, we will see how regeneration in zebrafish is affected by the absence of typical Wnt signaling.



Lithium Chloride

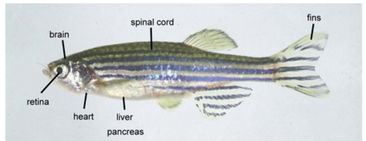
Why LiCl?

- Lithium Chloride is known to inhibit the activity of the protein Glucose Synthase Kinase-3 (GSK-3), which is an important repressor in Wnt signaling - one of several factors that play a key role in axis formation and cell proliferation in both developing and regenerating fins.

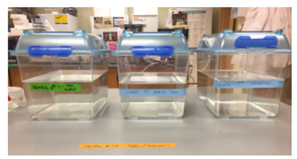


Why zebrafish?

- Like humans, Zebrafish have endoskeleton boney structures that have a mesodermal origin, creating a powerful model for the study of mammalian limb regeneration.

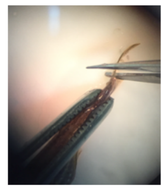


Methods

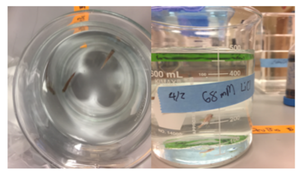


Zebra fish placed in groups: control, 28 mM, and 68 mM

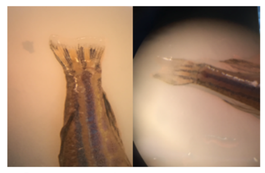
Sedated with MS-222



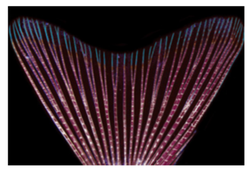
Caudal fins amputated



Exposed to different treatments of LiCl: 3 hours a day for 9 dpa



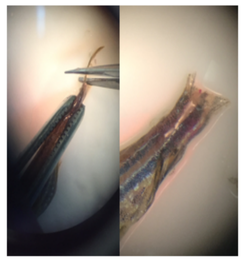
Observed fin regeneration 6, 9, and 14 dpa

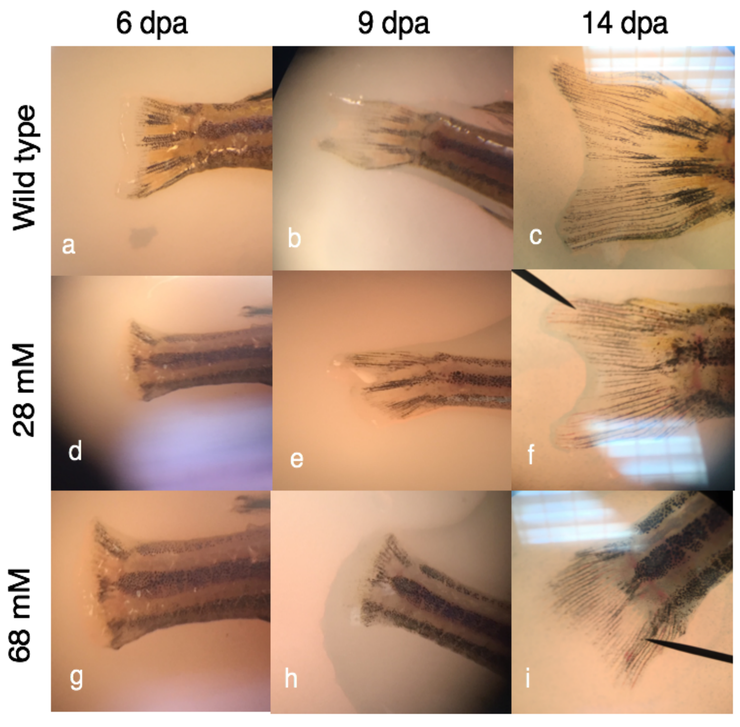


Caudal fin staining for bone and cartilage formation

Results

Amputation





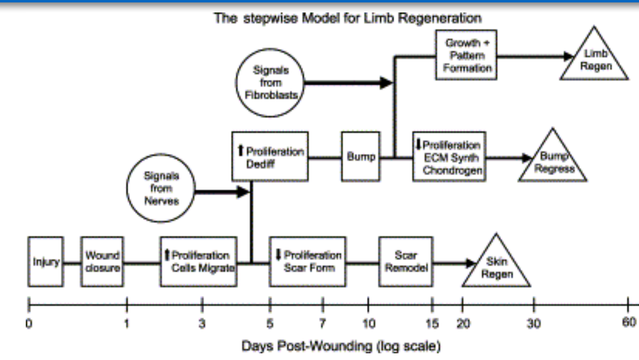
Results

Regeneration was more complete and extensive in the control group compared with the LiCl treatment groups.

- Those receiving the LiCl treatment resulted in decreased amounts of blastema formation compared to the control.
- Continued for an additional 5 days without LiCl treatment, showing a regeneration increase.

This finding, combined with previous studies, suggests that modification of the Wnt pathway may be a key component of inducing regeneration in human limbs.

Human Significance



- Human tissues are individually able to regenerate, which suggests that regrowing complex body parts is a realistic goal.
- Learning how to control the process in natural regenerators and then how to trigger similar mechanisms in non-regenerative animals is moving us closer to redirecting human wound-healing responses.

- Regenerating whole limbs will require changing the signals cells receive in the wound so regrowth isn't stopped, and our innate regeneration would be activated.

Acknowledgements: **1.** UGA IACUC Guidelines & Procedures. 2010. **2.** Otilia Zarnescu, Simona Stavri, Lucia Moldovan. Inhibition of Caudal Fin Regeneration in Corydoras Aeneus by Lithium Chloride. 2013. **3.** ResearchGate. 2007. **4.** Jung Choi. Gallus gallus (Chick) – Limb Development. **5.** Otilia Zarnescu. Inhibition of caudal fin regeneration in Corydoras aeneus by lithium chloride. 2013. **6.** Ken Muneoka, Manjong Han and David M. Gardiner. The Road to Regeneration. 2008.