Alternation in the Gap-junctional Intercellular Communication Capacity during the Maturation of Osteocytes in the Embryonic Chick Calvaria

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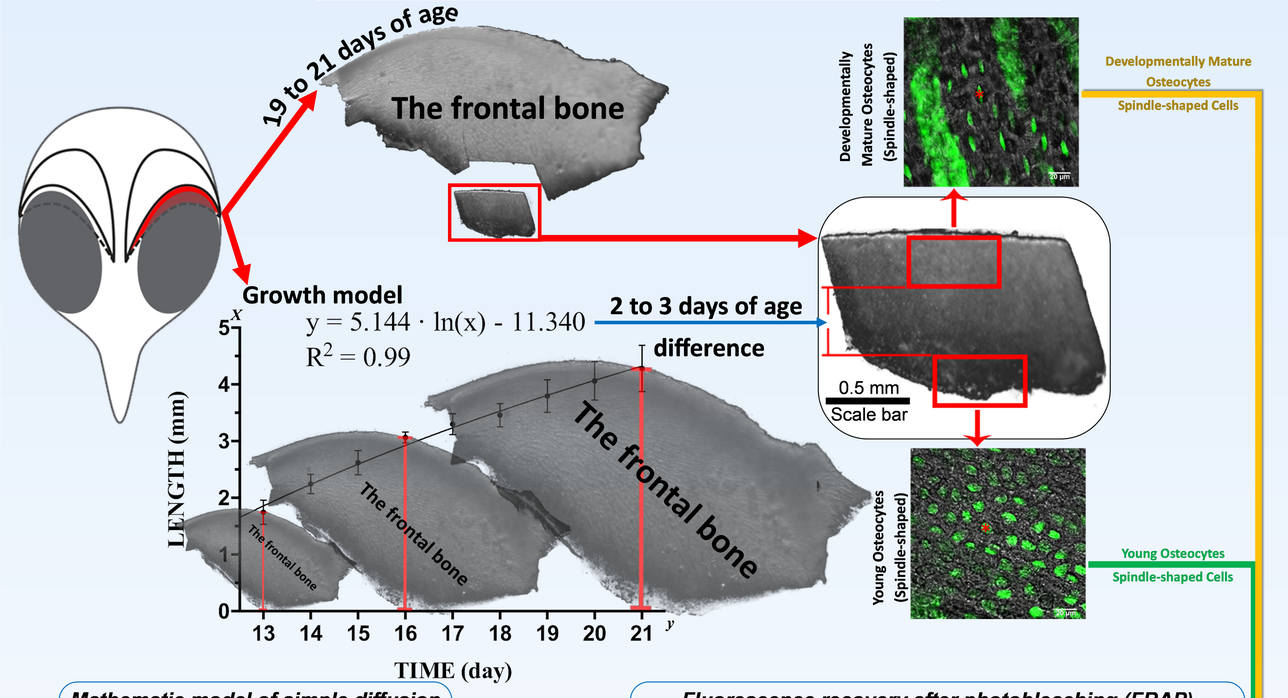
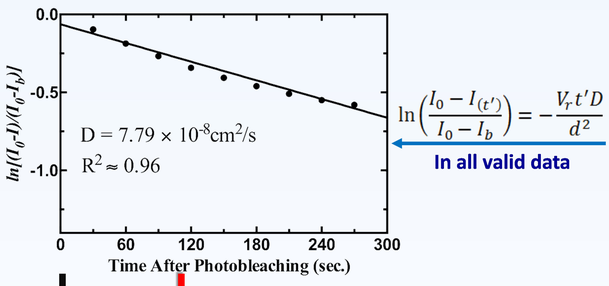
Introduction

To further understand the mechanism of bone development, it is therefore important to quantify the difference in Gap-Junctional Intercellular Communication (GJIC) capacity between young and developmentally mature osteocytes. For this aim, we established an embryonic chick calvaria growth model, which reflected the growth of the calvaria in embryos at 13 to 21 days of age. This model can also reveal the relationship between the osteocyte location and its age. So this model actually quantified and confirmed our previous finding that different aged osteocytes have different morphologies, with the young osteocytes having a more spherical shape and developmentally mature osteocytes being more spindle shaped. Next, the FRAP technique was applied to calculate the dye displacement ratio in cell bodies and permeability in the cellular process network. In addition, a comparison was made between the young and developmentally mature osteocytes.

Materials and Methods

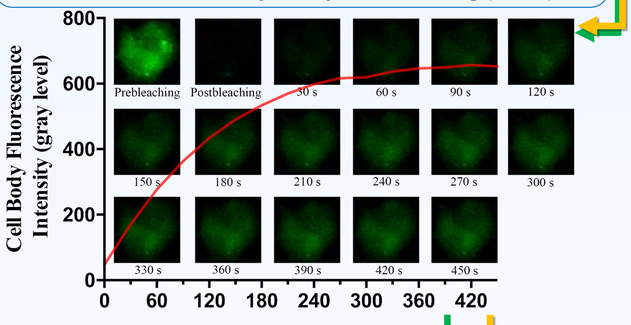


Mathematic model of simple diffusion



$$\ln\left(\frac{I_0 - I_{(t')}}{I_0 - I_b}\right) = -\frac{V_r t' D}{d^2}$$

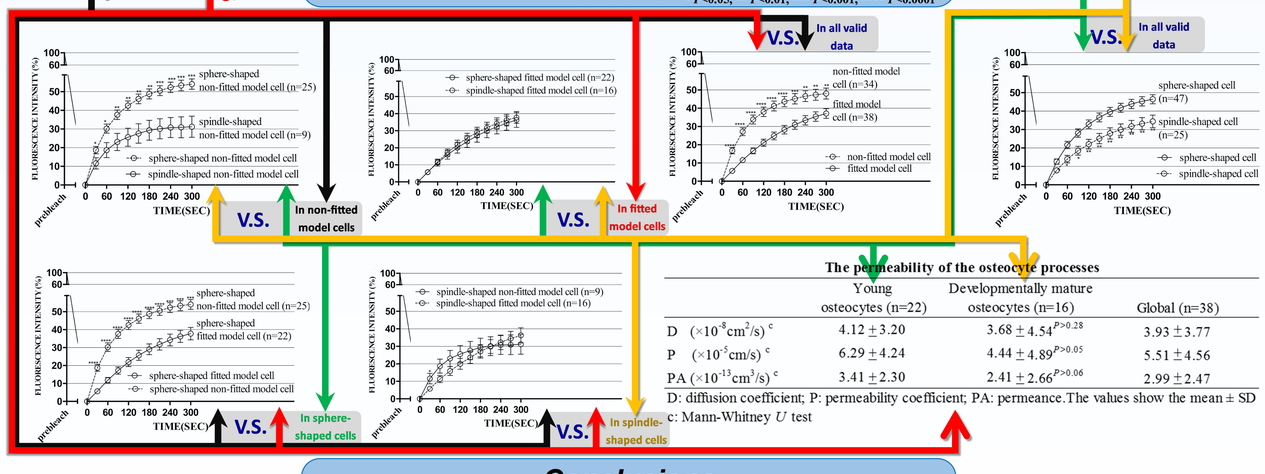
Fluorescence recovery after photobleaching (FRAP)



Non Fitted R< 0.96 | Fitted R≥ 0.96

Results

* $P<0.05$, ** $P<0.01$, *** $P<0.001$, **** $P<0.0001$



The permeability of the osteocyte processes

	Young osteocytes (n=22)	Developmentally mature osteocytes (n=16)	Global (n=38)
D ($\times 10^{-8}$cm^2/s) [c]	4.12 ± 3.20	3.68 ± 4.54 ($P>0.28$)	3.93 ± 3.77
P ($\times 10^{-5}$cm/s) [c]	6.29 ± 4.24	4.44 ± 4.89 ($P>0.05$)	5.51 ± 4.56
PA ($\times 10^{-13}$cm^3/s) [c]	3.41 ± 2.30	2.41 ± 2.66 ($P>0.06$)	2.99 ± 2.47

D: diffusion coefficient; P: permeability coefficient; PA: permeance. The values show the mean ± SD
c: Mann-Whitney *U* test

Conclusions

1. GJIC was decreased during the developmental maturation of osteocytes.
2. GJIC between osteocytes could be regulated and almost half of the gap junction channels have the same permeability as the cell processes for Calcein transfer.
3. Indirect evidence of the active transduction of molecules through the Cx43 channel.

Scan it for more details

Acknowledgements

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