



Master 2 Reproduction et Développement
Stage de recherche 2025-2026

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Prénom et NOM du/de la responsable d'équipe : Antoine Zalc

Intitulé de l'équipe d'accueil : Destin, plasticité et reprogrammation cellulaire

Site internet de l'unité : <https://institutcochin.fr>

Prénom et NOM du/de la directeur-riche du Laboratoire ou de l'Unité : Florence Niedergang

Adresse du Laboratoire ou de l'Unité : 24 Rue du Faubourg St Jacques, 75014, Paris

Résumé du thème de recherche de l'équipe d'accueil (une dizaine de lignes maximum) :

During early development, cells progressively restrict their differentiation potential, especially during the formation of the three embryonic germ layers, the endoderm, the mesoderm and the ectoderm. Within these layers, cells can only give rise to certain derivatives, specific to each layer. However, a cell population called **cranial neural crest cells (CNCC)** does not respect this rule. Originating from the ectoderm, CNCC not only give rise to neurons and glial cells, but they also generate cell types such as facial bones and cartilage, tissues normally formed by cells originating from the mesoderm. We showed this unique property of CNCC is linked with the re-expression of pluripotency programs, which allows this cell population to increase its differentiation potential.

By combining state-of-the art sequencing approaches with in vivo and in vitro functional validations, we hope to identify the key factors that allow CNCC to expand their cellular plasticity. This will allow us to elucidate how to stimulate these mechanisms in adults to increase cell potency and improve the regenerative capacities of craniofacial tissues.

Titre du projet de stage : Understanding how OCT4 enhances cranial neural crest cells differentiation potential

Projet de stage : (une vingtaine de lignes maximum)

Control of cell differentiation potential is essential to embryo development. Pluripotent embryonic cells can generate all somatic cell types. However, development permanently restricts this capacity, in particular during gastrulation and the formation of the three germ layers – the endoderm, the mesoderm and the ectoderm – each giving rise to distinct lineages. Uniquely among vertebrates, an ectoderm-derived cell population arising in the embryo rostral part – called cranial neural crest cells (CNCC) – challenges this paradigm. CNCC possess a broader differentiation potential than their germ layer of origin as they not only give rise to ectoderm derivatives such as neurons and glia, but also to cell types canonically associated with the mesoderm such as bone and cartilage of the face – also called ectomesenchyme. CNCC exceptional differentiation potential is due to the transient re-expression of pluripotency transcription factors NANOG, KLF4, SOX2 and OCT4 specifically in CNCC. OCT4 plays a central role in this process since preventing its reactivation impairs ectomesenchyme specification, yet how this impacts cell fate decision during craniofacial development is unclear.

In this project, the student will study how OCT4 molecularly orchestrates CNCC differentiation potential expansion. To this end, the student will profile chromatin accessibility changes and identify OCT4 downstream transcriptional networks regulating CNCC plasticity expansion. This will clarify OCT4 function during CNCC in vivo reprogramming and indicate molecular programs controlling cell fate decision and plasticity expansion during CNCC development.



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Techniques mises en œuvre par le stagiaire :

Cell culture, organoids, immunofluorescence, confocal microscopy, FACS, qRT-PCR, Western Blot, ChIP-seq, ATAC-seq

Publications du Responsable de stage au cours des 5 dernières années :

- Fortunato S., Deschemin J.C., Zalc A.
Cranial Neural Crest Cells Three-Dimensional In Vitro Differentiation Protocol for Multiplexed Assay.
J. Vis. Exp. JoVE (2025) doi:10.3791/67695
- Smeriglio P, Zalc A.
Cranial Neural Crest Cells Contribution to Craniofacial Bone Development and Regeneration.
Curr Osteoporos Rep. (2023) doi:10.1007/s11914-023-00804-8
- Savina A., Jaffredo T., Saldmann F., Faulkes C.G., Moguelet P., Leroy C., Marmol D.D., Codogno P., Foucher L., Zalc A., Viltard M., Friedlander G., Aractingi S., Fontaine R.H.
Single-cell transcriptomics reveals age-resistant maintenance of cell identities, stem cell compartments and differentiation trajectories in long-lived naked mole-rats skin.
Aging, 2022 May 4;14(9):3728-3756.
- Zalc A., Sinha R., Gulati G.S., Wesche D.J., Daszczuk P., Swigut T., Weissman I.L., Wysocka J.
Reactivation of the pluripotency program precedes formation of the cranial neural crest.
Science (2021) doi:10.1126/science.abb4776

Autres informations:

Etudiants actuellement en thèse ou en M2 dans l'équipe d'accueil. Pour chaque étudiant indiquez le nom du responsable de thèse, l'année du début de la thèse et l'Ecole Doctorale de rattachement

Saverio Fortunato: Etudiant en these
Responsable de these: Antoine Zalc
Debut these: Octobre 2023
Ecole Doctorale: BioSPC

Alexandre Salamitou : Etudiant en M2
Responsable de these: Antoine Zalc
Debut these: Octobre 2025
Ecole Doctorale: BioSPC

Etudiants ayant préparé ou soutenu leur thèse ou leur M2 dans l'équipe d'accueil au cours des six dernières années. Pour chaque étudiant indiquez le nom du responsable de l'étudiant, l'année du début de la thèse et de fin de la thèse, l'Ecole Doctorale de rattachement et le devenir de l'étudiant.

- Sacha Delabrousse : Etudiant en M2 (2022)
- Saverio Fortunato: Etudiant en these
Responsable de these: Antoine Zalc
Debut these: Octobre 2023
Ecole Doctorale: BioSPC
- Martina Maggiore: Etudiante en M2 (2023)



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Responsable de these: Antoine Zalc

- Amélie Brun : Etudiante en M2 (2024)
Actuellement IE au laboratoire
- Alexandre Salamitou : Etudiant en M2 (2025)
Responsable de these: Antoine Zalc
Debut these: Octobre 2025
Ecole Doctorale: BioSPC

Cette proposition de stage s'adresse-t-elle spécifiquement à un étudiant scientifique, médecin ou vétérinaire ou bien est-il ouvert à tous les profils ?

Ouvert à tous les profils

Ce sujet peut-il donner lieu à une thèse ?

Oui