

Internship offer
M2 Musculo-Skeletal system, Locomotion, Exercise (MuSkLE)

Title of the Internship: Deciphering the cellular secretome of skeletal muscle contraction

Laboratory: Institut NeuroMyoGène - Physiopathologie et Génétique du Neurone et du Muscle (PGNM) - CNRS 5261 – INSERM U1315 - UCBL1. <https://pgnm.inmg.fr/en/>

Research team: Stem cell environment and skeletal muscle homeostasis (<https://pgnm.inmg.fr/en/chazaud/>)

Supervisor to contact: Julien GONDIN (DR CNRS) - julien.gondin@univ-lyon1.fr

Project description including a short introduction, aim/objectives and methods/approach to be used

Intro: Skeletal muscle functions both as a contractile organ, producing force upon neural stimuli, and as an endocrine organ, releasing signaling molecules. Our recent work has demonstrated that mild contractile activity induced by neuromuscular electrical stimulation exerts beneficial effects on the regulation of muscle stem cells, fibroblasts, and immune cells, as well as on myofiber hypertrophy in both healthy (1) and cachectic muscles (2). However, the molecular effectors underlying these effects remain to be identified

Objectives: The aim is to identify the cellular secretome of skeletal muscle contraction and characterize the biological effects of these molecules in healthy and cachectic muscles.

Methods: The project will rely on an original experimental setup developed by our team, enabling the electrical stimulation of mouse plantar flexor muscles while concomitantly recording force (1). Proteomic analyses will be performed on extracellular fluid collected from resting and contracting muscles (3). Once the secreted molecules are identified, their biological effects will be assessed on various cell types, including muscle stem cells, fibroblasts, immune cells, and myofibers.

References:

1. Fessard A, Zavoriti A, Boyer N, Guillemaud J, Rahmati M, Del Carmine P, Gobet C, Chazaud B, Gondin J. Neuromuscular electrical stimulation training induces myonuclear accretion and hypertrophy in mice without overt signs of muscle damage and regeneration. *Skelet Muscle*. 2025 Feb 5;15(1):3. doi: [10.1186/s13395-024-00372-0](https://doi.org/10.1186/s13395-024-00372-0).
2. Zavoriti A, Fessard A, Boyer N, Moulin E, Koenig C, Del Carmine P, Juban G, Chazaud B, Gondin J. Neuromuscular electrical stimulation limits muscle weakness, atrophy, modulates satellite cell function and reduces inflammation in cancer cachexia. <https://doi.org/10.64898/2026.04.24.720589>
3. Mittenbühler MJ, Jedrychowski MP, Van Vranken JG, Sprenger HG, Wilensky S, Dumesic PA, Sun Y, Tartaglia A, Bogoslavski D, A M, Xiao H, Blackmore KA, Reddy A, Gygi SP, Chouchani ET, Spiegelman BM. Isolation of extracellular fluids reveals novel secreted bioactive proteins from muscle and fat tissues. *Cell Metab*. 2023 Mar 7;35(3):535-549.e7. doi: [10.1016/j.cmet.2022.12.014](https://doi.org/10.1016/j.cmet.2022.12.014)

Skills required: animal experiments, cell culture, immunostaining, microscopy...