

Doctoral study program: Biomedical Sciences

Form: *doctoral (present)*

Department: Department of Histology and Embryology

Supervisor: doc. Mgr. Jan Křivánek, Ph.D.; <https://histology.med.muni.cz/jan-krivanek> ;
<https://x.com/KrivanekLab>

Ph.D. position: Cellular basis of dental healing

Annotation:

Teeth are living structures that can actively respond to their own damage. There are several ways how teeth can heal and thus naturally prolong their functionality and lifespan. Although the reparative capabilities of the tooth are well known, the processes behind them are far from being understood. This project will comprehensively investigate the principles of tooth healing, from damage detection, through cellular and molecular responses, to the study of microstructure of the resulting newly formed hard tissues inside the tooth. To achieve this, a combination of state-of-the-art approaches will be used. These include our newly developed method for monitoring hard tissue growth dynamics in time and space (BEE-ST), single-cell RNA-sequencing, spatial transcriptomics, genetically-induced lineage tracing methods, reporter mouse strains, and advanced microscopic techniques. The results will provide new insights into mechanisms of the healing process, which will help to accelerate the advent of regenerative dentistry. This project is based on numerous international collaborations (University of Sheffield, Medical University of Vienna, Karolinska Institutet and others). Selected PhD candidate will be an active part of this network and will have the opportunity to do internships at these institutions.

Funding of the research:

This project is funded by GA CR (The Czech Science Foundation).

Information on funding PGS positions:

The student will have a 0,5 FTE covered by the grant support + scholarship + will have full support in applying for other sources of funding (Brno PhD talent, travel grants, individual research projects etc.). Student will have a possibility to present his/her results on various international conferences.

Requirements for the student according to the Doctoral Board:

The student's minimum publication activity within the course of study is one first-author publication with an IF value above the median in the field or 2 first-author publications in journals with an IF value in the 3rd quartile in the field (Q3). A condition for successful completion of the studies is also a foreign internship of at least 1 month, which is an inseparable part of the studies. As part of their studies, students will also participate in the teaching.

Information about supervisor:

The supervisor of this project is a developmental biologist who is interested in various aspects of developmental and dental biology with a particular focus on tissue regeneration, stem cell plasticity, mechanosensation or micropatterning and hard tissues. During his scientific career he has gained

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international research experience at several distinguished institutions (Karolinska Institutet, Medical University of Vienna, University of Connecticut, University of Helsinki and others) and collaborates with many research teams worldwide. For research, we mainly use *in vivo* approach utilizing diverse genetically modified mouse strains, a wide range of modern experimental approaches, and in collaboration, for example, the mathematical *in silico* modelling of development and tissue repair. We are international research team consisting of colleagues at all stages of their research careers, ranging from high school students, undergrad and PhD students to postdocs. We are committed to fair access, an equality and work closely together as a team. We socialize outside the work environment and organize lab retreats. Our team is focused on publishing larger and meaningful research papers in highly visible journals.

Selected publications:

- Gonzalez Lopez, M., Huteckova, B., Lavicky, J., Zezula, N., Rakultsev, V., Fridrichova, V., Tuaima, H. R. A., Nottmeier, C., Petersen, J., Kavkova, M., Zikmund, T., Kaiser, J., Lav, R., Star, H., Bryja, V., Henys, P., Vorechovsky, M., Tucker, A. S., Harnos, J., Buchtova, M., Krivanek, J. Spatiotemporal Monitoring of Hard Tissue Development Reveals Unknown Features of Tooth and Bone Development. Aug 2;9(31):eadi0482.
Science Advances, 2023. IF: 13,6
- Petersen, J., Englmaier, L., Artemov, A. V., Poverennaya, I., Mahmoud, R., Boudierlique, T., Tesarova, M., Deviatarov, R., Szilvasy-Szabo, A., Akkuratov, E. E., Pajuelo Reguera, D., Zeberg, H., Kaucka, M., Kastriti, M. E., Krivanek, J., et al. Previously Uncharacterized Factor Associated with Metabolism and Energy (FAME/C14orf105/CCDC198/1700011H14Rik) is Related to Evolutionary Adaptation, Energy Balance, and Kidney Physiology. May 29;14(1):3092.
Nature Communications, 2023. IF: 16,6
- Kastriti, M. E., Faure, L., Ahsen, D., Boudierlique, T. G., Boström, J., Solovieva, T., Jackson, C., Bronner, M., Meijer, D., Hadjab, S., Lallemand, F., Erickson, A., Kaucka, M., Dyachuk, V., Perlmann, T., Lahti, L., Krivanek, J., Brunet, J. F., Fried, K., Adameyko, I. Schwann cell precursors represent a neural crest-like state with biased multipotency. Sep 1;41(17):e108780.
EMBO J. 2022. IF: 11,6
- Krivanek, J., Soldatov, R. A., Kastriti, M. E., Chontorotzea, T., Herdina, A. N., Petersen, J., Szarowska, B., Landova, M., Kovar Matejova, V., Izakovicova Holla, L., Kuchler, U., Zdrilic, I. V., Balic, A., Marangoni, P., Klein, O. D., Neves, V. C. M., Yianni, V., Sharpe, P. T., Harkany, T., Metscher, B. D., Bajenoff, M., Mina, M., Fried, K., Kharchenko, P. V., Adameyko, I. Dental cell type profiling reveals new stem and differentiated cell types in mouse and human teeth. Sep 23;11(1):4816.
Nature Communications. 2020. IF: 14,9
- Lavicky, J., Kolouskova, M., Prochazka, D., Rakultsev, V., Gonzalez, M., Steklikova, K., Bartos, M., Vijaykumar, A., Kaiser, J., Porizka, P., Hovorakova, M., Mina, M., Krivanek, J. The Development of Dentin Microstructure Is Controlled by the Type of Adjacent Epithelium. Res. 37, 323–339.
J Bone Miner Res. 2022. IF: 6.7

Selected research grants

The Czech Science foundation (GACR), standard projects, Cellular basis of dental healing (2025-2027)

The Czech Science foundation (GACR), standard projects, Fluctuation of the stem cell niche as a source of tissue adaptability in health and disease (2023 – 2025)

The Czech Science foundation (GACR), standard projects, Mechanosensing as a control mechanism for tooth growth and dental tissue repair (2022-2024)

Grant Agency of Masaryk University, High risk/High gain individual research project: Understanding of tooth developmental trajectories as a novel approach for dental regeneration (2019-2021)