Research Field And Department	Tissue engineering and Regenerative medicine
Supervisor	Maarten van Os
Title of the Work	Development of a psoriasis on chip model

Abstract:
Psoriasis is an immune related skin disease with a prevalence between 2-11%, dependent on skin demographics [1]. Psoriasis leads to red, flaky and itchy skin that has severe side effects on the persons mental wellbeing, in addition to many physiological side effects and elevated overall disease risks due to the ever-present inflammation in psoriasis (increased chance for cancer, diabetes etc). To improve the ability to study psoriasis and eventually offer better means for novel drug discovery and advance personalized medicine, in vitro psoriatic models are being developed. In vitro psoriatic models are developed in conventional 2D models and 3D skin constructs. 2D models are typically developed in culture plates and are easy to work with while 3D constructs aim to include the epidermis and the dermis mimicking some of the most important skin features [2].

Current developments are working to include vascularization into the models to further mimic the in vivo conditions as the cell growth and organ development are highly influenced by the cell's direct environment. In addition, the skin-on-chip can be used as platform to grow patient cells who are suffering from psoriasis to analyze how they would react to drug treatments to create a personalized medicine platform capable of screening many drugs simultaneously [3].

During the students work, they will acquire knowledge in cell culture techniques for both 2D models and 3D constructs specifically in studying psoriasis. The student will develop skins in biomolecular analysis techniques like PCR and Immunofluorescence for gene expression, conventional and fluorescence microscopy and tissue processing for histological assessment of psoriatic (and healthy) skin models. In addition, they will gain insight in working in a cell lab, skin physiology, psoriasis pathophysiology and treatment. In the end the student will have experienced and be familiarized with commonly used terms and techniques in biomedical engineering and tissue engineering.

Main Tasks to Carry Out:
Cell culture
Growth and maintenance of immortalized cell line and working in the biolab

- Cell passage
- Cell counting
- Sterile working in the cell laboratory

In vitro skin models

Development of 2D and 3D in vitro skin models

- Psoriatic cell culture mode in 2D
- Development of Reconstructed Human Epidermis as 3D skin construct
- Soft lithography for development of a microfluidic device

Cytokine induced psoriasis

Psoriatic induction into the in vitro skin models using cytokines

Analysis of genetic profile using PCR to test for psoriasis related genes
Analysis of protein expression using Immunofluorescence and western blot
Analysis of 3D skin constructs using histology and immunohistology

References/Bibliography if required

[1] Rendon, A., & Schäkel, K. (2019). Psoriasis pathogenesis and treatment. *International journal of molecular sciences*, *20*(6), 1475.

[2] Quílez, C., Bebiano, L. B., Jones, E., Maver, U., Meesters, L., Parzymies, P., ... & Velasco, D. (2024). Targeting the complexity of in vitro skin models: a review of cutting-edge developments. *Journal of Investigative Dermatology*, *144*(12), 2650-2670.

[3] Cho, S. W., Malick, H., Kim, S. J., & Grattoni, A. (2024). Advances in skin-on-a-chip technologies for dermatological disease modeling. *Journal of Investigative Dermatology*, *144*(8), 1707-1715.