PhD Open Days

A novel biomimetic platform for cartilage tissue engineering and *in vitro* disease modelling

PHD Bioengineering- Cell Therapies and Regenerative Medicine

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"la Caixa" Foundation

Acknowledgement: *This PhD project is possible thanks to the support of a INPhINIT (Incoming) fellowship from the "la Caixa" Foundation (ID 100010434). The fellowship code is ""LCF/BQ/DI23/11990049". This research was funded by dedicated funding from FCT-Portuguese Foundation for Science and Technology (FCT/MCTES) through projects InSilico4OCReg (PTDC/EME-SIS/0838/2021). The authors also acknowledge FCT/MTES for funding provided through iBB (UID/BIO/04565/2022) and Laboratório-Associado I4HB (LA/P/0140/2020).*

Impact

1-2.5 % GDP

>600 million worldwide

pain, immobility, secondary diseases

Neogi, T. (2013), Leifer et al. (2021)

Problem

no nerves - *late disease detection*

no vascularization – *slow / no natural regeneration*

no cure

Influenced by

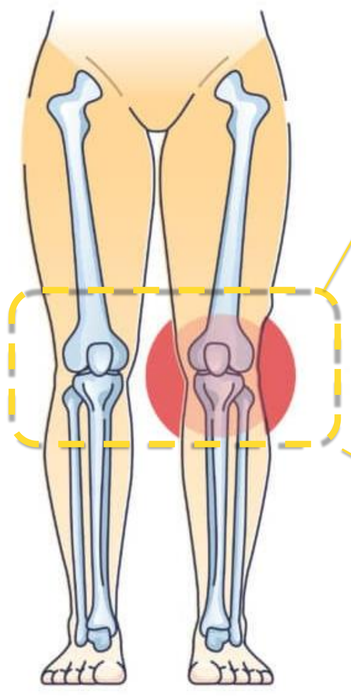
gender and age

genetics

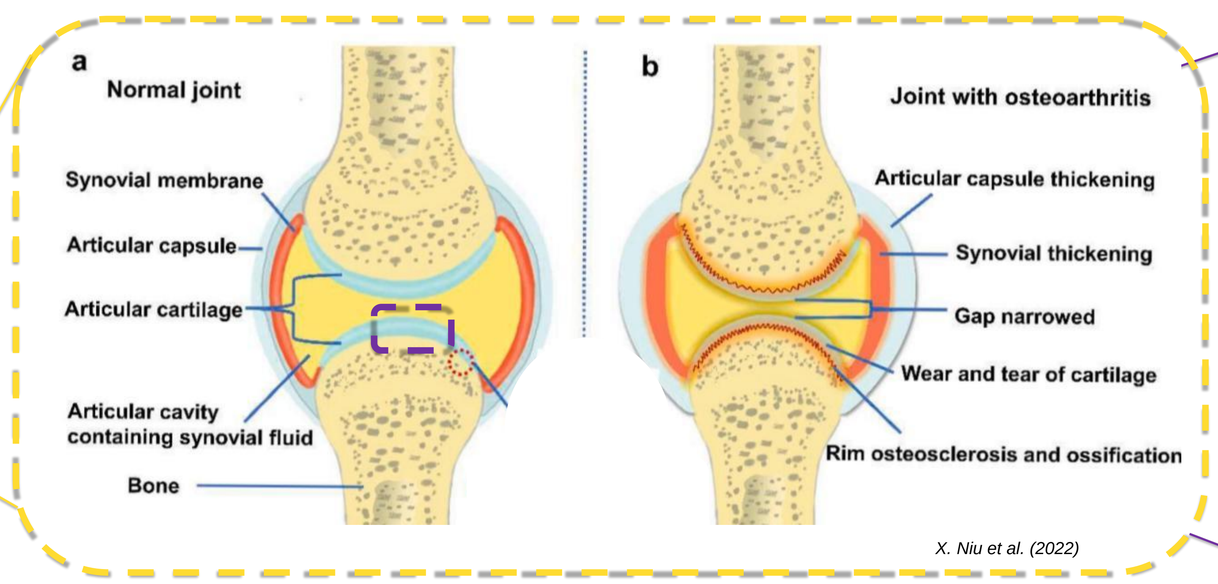
mechanical load

Neogi, T. (2013), I. Bartolotti et al. (2021)

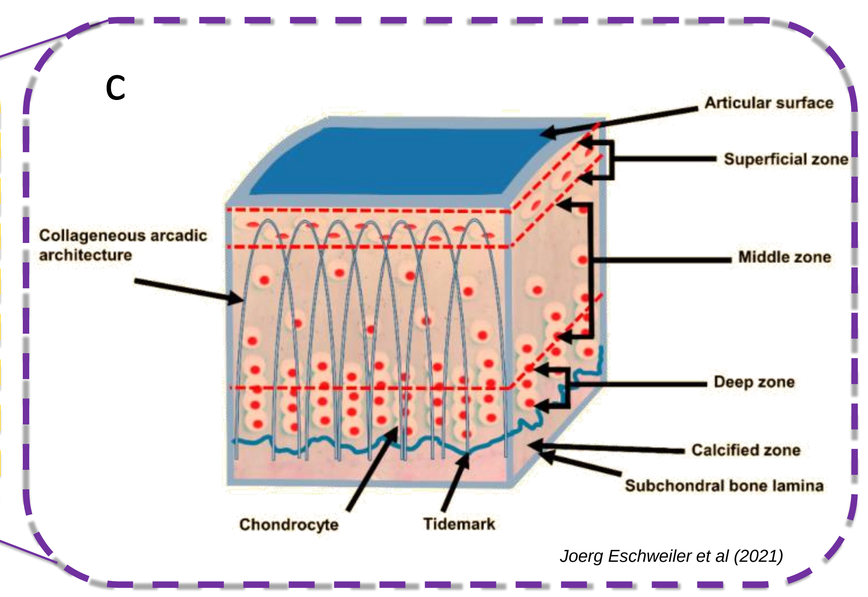
OSTEOARTHRITIS



Heiden Orthopedics USA (2023):



X. Niu et al. (2022)



Joerg Eschweiler et al (2021)

Fig. 1. Osteoarthritis in comparison with a healthy cartilage – (a) the composition of a healthy joint in comparison with (b) an OA diseased joint, and (c) the hierarchical structure of cartilage with collagen type II arcades

OUR SOLUTION: MULTIDISPLINARY APPROACH

Mechanical engineering

Bioreactor *– design, prototyping, simulation, process finding and optimization*

3D (bio) printing *– printing method (extrusion, DLP printing), printing parameters*

Bioink characterisation *– rheology, mechanical testing*

Material selection for bioreactor *– translucent, biocompatible*

Material science

(Bio)-Ink development *– adequate viscosity, shape fidelity, light cross-linkable, biocompatible, cell-adhesive, stable over time*

Physiological *in vitro* disease model

High socio-economical impact

Complex model for knowledge creation

No animal testing

Advanced culture conditions - *with hypoxia, mechanical loading*

Bio-instructive scaffold – *for physiological matrix deposition*

Extra cellular matrix (ECM) *– cell derived, used as bioink / coating*

Macromolecular crowder *– enhanced ECM deposition*

Biology

Primary human cells *– patient-synovial derived mesenchymal stem cells*

CRISPR *– cell engineering for increased cartilage-specific (collagen, aggrecan) matrix production*

https://icons8.com/

X. Niu et al. (2022): Integrated gradient tissue-engineered osteochondral scaffolds: Challenges, current efforts and future perspectives; Joerg Eschweiler et al (2021): The Biomechanics of Cartilage—An Overview; Heiden Orthopedics USA (2023): What Is Osteoarthritis?; https://heidenortho.com/osteoarthritis/; Neogi, T. (2013): The epidemiology and impact of pain in Osteoarthritis; I. Bartolotti et al. (2021): A Roadmap of In Vitro Models in Osteoarthritis: A Focus on Their Biological Relevance in Regenerative Medicine; Leifer et al. (2021): Chapter 1: The Burden of OA-Health Services and Economics

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