DMP title

Project Name EOS_2021_UNITE - DMP title

Grant Title EOS 40007553

Principal Investigator / Researcher Harry van Lenthe

Project Data Contact 016 32 25 95; harry.vanlenthe@kuleuven.be

Description In this Excellence of Science (EOS) project (acronym UNITE), fundamental biomechanical and mechanobiological aspects of subchondral bone, mineralized cartilage and hyaline cartilage will be investigated, with particular emphasis on the bone-cartilage interface. We will use in vivo imaging in an animal model (mouse), experimental mechanical testing, and computational modeling with the goal: 1) to characterize in vivo spatio-temporal remodelling processes in subchondral bone as well as changes in cartilage morphology following the time course of PTOA in mice; 2) to measure heterogeneous tissue-level properties of the complex region anchoring cartilage to bone and to correlate composition and structure with biomechanical function; 3) to quantify load transfer mechanisms from cartilage to bone at multiple length scales, highlighting the role of the bone-cartilage junction; 4) to describe the LCN of subchondral bone and to unravel the hidden links between bone and cartilage cells through the LCN and bone-cartilage interface; 5) to investigate the mechanobiology of subchondral bone and the osteochondral junction by simulating fluid flow in the LCN and across the bone-cartilage interface.

Institution KU Leuven

1. General Information

Name applicant

Harry van Lenthe

FWO Project Number & Title

Excellence of Science (EOS), grant ID: 40007553, "Understanding joint health: biomechanical and mechanobiological characterization of the bone-cartilage interface"

Affiliation

- KU Leuven

2. Data description

Will you generate/collect new data and/or make use of existing data?

- Generate new data

Describe in detail the origin, type and format of the data (per dataset) and its (estimated) volume. This may be easiest in a table (see example) or as a data flow and per WP or objective of the project. If you reuse existing data, specify the source of these data. Distinguish data types (the kind of content) from data formats (the technical format).

Deliverable	Responsible	Type of data	How created	Format	File size	Total volume
D1.1	UM	microCT images	measurements: ex vivo microCT of murine knees	.rsq .aim	3 GB	100 GB
D1.2	UM	microCT images	measurements: in vivo microCT of murine knees	.rsq .aim	3 GB	1.8 TB
D1.3	KUL	microCT images	Processed data: segmented images based on the images obtained in D1.2	.aim, .bmp	10 MB	6 GB

D1.3	KUL	histological images	measurements: histological sections of bone-cartilage specimens	.tiff	25 MB	1 GB
D2.1	ULG	mechanical properties (visco-elastic properties)	measurements: nano-indentation of bone-cartilage specimens	.hys, .xls	500 KB	2 GB
D2.2	ULG	material composition (mineral, collagen, proteoglycans)	measurements: Raman spectroscopy of bone-cartilage specimens	.tiff, .xls	30 MB	3 GB
D2.2	ULG	material composition (mineral content)	measurements: quantitative backscatter eletron imaging (qBEI)	.tiff	50 MB	5 GB
D2.2	ULG	material composition (collagen orientation)	measurements: second harmonic generation imaging (SHG)	.tiff	250 MB	25 GB
D2.3	ULG	mechanical properties (local fracture resistance)	measurements: High-load scanning probe microscopy	.hdf, .bmp	300 KB	1 GB
D3.1	UM	in vivo mechanical data (stress relaxation)	measurements: in vivo mechanical loading	.txt	3 MB	2 GB
D3.2	KUL	high-resolution microCT images	measurements: ex vivo microCT of murine knees udner mechanical load	.bmp	50 GB	1 TB
D3.2	KUL	Ex vivo mechanics (load-displacement)	measurements: load as measured inside an ex vivo microCT scanner	.xls	1 MB	25 MB
D3.3	US	strain inside a murine knee under mechanical load	Processing: digital volume correlation using boneDVC based on data from D3.1 and D3.2	.txt, .cdb, .rst	1 GB	100 GB
D3.4	KUL	stresses and strains inside a murine knee	Simulation: finite element analyses of data collected in D2 and D3.1-3.	.odb	10 GB	250 GB

D4.1	KUL	high-resolution microCT images	Measurements: microCT of samples taken from murine knees	.bmp	50 GB	1 TB
D4.2	KUL	high-resolution microCT images	Measurements: microCT of samples taken from murine knees	.bmp	50 GB	1 TB
D4.3	ULG	microscopy images	Measurements: confocal laser scanning microscopy (CLSM) of samples taken from murine knees	.tiff	200 MB	20 GB
D4.3	ULG	microscopy images	Measurements: Focused-ion beam scanning electron microscopy (FIB-SEM) of samples taken from murine knees	.tiff	1 GB	50 GB
D4.4	KUL	processed microCT data	Processing: segmentation and image registration of data collected in D4.1-3	.bmp	1 GB	50 GB
D5.1	KUL	simulation data	Simulation: fluid flow network analysis	.txt	0.1 GB	5 GB
D5.2	KUL	simulation data	Simulation: CFD analyses	.cdb	1 GB	50 GB
D1-D5	KUL, ULG, UM, US	scripts	Processing: scripts for model creation and data analysis.	.txt	10 kb	1 Mb
					Total size:	5.5 TB

3. Legal and ethical issues

Will you use personal data? If so, shortly describe the kind of personal data you will use. Add the reference to your file in KU Leuven's Register of Data Processing for Research and Public Service Purposes (PRET application). Be aware that registering the fact that you process personal data is a legal obligation.

- No

Privacy Registry Reference:
Short description of the kind of personal data that will be used:

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? If so, add the reference to the formal

approval by the relevant ethical review committee(s)

- Yes

Animal experiments will be performed at U.Melbourne. Ethical approval has been obtained (SLA-1, Ethics ID 2022-24339-29717-4). A notification has been made to the Ethical Committee for Animal Experimentation at KU Leuven, who have acknowledged and approved it (M016/2022).

Does your work possibly result in research data with potential for tech transfer and valorisation? Will IP restrictions be claimed for the data you created? If so, for what data and which restrictions will be asserted?

- No

Do existing 3rd party agreements restrict dissemination or exploitation of the data you (re)use? If so, to what data do they relate and what restrictions are in place?

- No

4. Documentation and metadata

What documentation will be provided to enable reuse of the data collected/generated in this project?

Most data is collected/generated in a device and software-specific format. Where appropriate, the data will be converted to a widely used standard. A minimum requirement before archiving will be that generic software to read and convert the data will be stored with the archived data.

Will a metadata standard be used? If so, describe in detail which standard will be used. If no, state in detail which metadata will be created to make the data easy/easier to find and reuse.

- Yes
- No

Metadata will be stored for all archived data. Where available we will store the metadata generated during data collection using the manufacturers' implementation. For all other data for which no metadata standards are available, we intend to follow the guidelines as published in scientific literature. Since there is no formally acknowledged metadata standard specific to our discipline, the DDI standard (Data Documentation Initiative) will be used. Scripts for model generation and data analyses will be accompanied by a ReadMe file describing the organization and the content of the scripts. Every file is clearly documented in the code by means of in-line comments.

5. Data storage and backup during the FWO project

Where will the data be stored?

The PI’s of the collaborating groups (van Lenthe, Ruffoni, Stok and Dall’Ara) will ensure that all data generated or re-used in their group will be stored in a safe, secure and sustainable way for purposes of reproducibility, verification, and potential reuse. We will archive the raw/input data as well as the final data sets after. Scripts will be archived such that all processing and analysis steps can be repeated and all intermediate data can be reproduced if needed.

How is backup of the data provided?

The data will be stored on central servers of the universities involved (KU Leuven, U.Liege, U.Melbourne, U.Sheffield) with automatic daily back-up procedures.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely. If no or insufficient storage or backup capacities are available then explain how this will be taken care of.

- No

Data storage will be acquired prior to data collection. Sufficient data storage will be available

What are the expected costs for data storage and back up during the project? How will these costs be covered?

Costs are covered as part of the project.

Data security: how will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

The data will be stored on secure university servers with access only to project collaborators.

6. Data preservation after the FWO project

Which data will be retained for the expected 5 year period after the end of the project? In case only a selection of the data can/will be preserved, clearly state the reasons for this (legal or contractual restrictions, physical preservation issues, ...).

For all data, we will archive the raw/input data as well as the final data sets after processing (e.g. segmented microCT data; output files of FE analyses). Intermediate data will only be stored if generation of these data would take substantial effort (time-wise or money-wise). All scripts will be archived such that all processing and analysis steps can be repeated and all intermediate data can be reproduced if needed.

Where will the data be archived (= stored for the longer term)?

The data will be stored on central servers of the participating universities (KU Leuvenm, U.Liege, U.Melbourne, U.Sheffield) for at least 10 years, conform the KU Leuven RDM policy. All servers provided with automatic back-up procedures.

What are the expected costs for data preservation during the retention period of 5 years? How will the costs be covered?

The expected size of the database will be 5.5 TB. However, actively accesible data is expected to be less than 100 GB. For the remainder of the data archive storage will suffice. Estimated cost will be 100 euro/year.

7. Data sharing and reuse

Are there any factors restricting or preventing the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)?

- No

Which data will be made available after the end of the project?

The full dataset will become available under a CC-BY license. We will work with KU Leuven library staff to determine the best way to open up the large dataset.

Where/how will the data be made available for reuse?

- Other (specify):

Data will be available on request after signing a data sharing agreement. We will work with KU Leuven library staff to determine the best way to implement this.

When will the data be made available?

- Upon publication of the research results

The datasets will be made availabe after journal publication of the research results.

Who will be able to access the data and under what conditions?

The full dataset will be made available as an open access dataset under a CC-BY license. Therefore, it will be available to anyone for any purpose, provided that they give appropriate credit to the creators.

What are the expected costs for data sharing? How will the costs be covered?

All data will archived properly and temporarily made available upon request through university infrastructure. No additional costs are expected.

8. Responsibilities

Who will be responsible for data documentation & metadata?

The PIs will be responsible for data documentation and metadata for work done under their supervision. End responsibility will be with Harry van Lenthe.

Who will be responsible for data storage & back up during the project?

The PIs will be responsible for data storage and backup for work done under their supervision. End responsibility will be with Harry van Lenthe.

Who will be responsible for ensuring data preservation and reuse ?

The PIs will be responsible for data preservation reuse for work done under their supervision. End responsibility will be with Harry van Lenthe.

Who bears the end responsibility for updating & implementing this DMP?

Harry van Lenthe (PI)