MATTHIAS WALLE

McCaig Institut, University of Calgary, Canada

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EDUCATION

ETH Zurich (ETH)
Doctoral studies (Dr. Sc.) Department of Health Sciences and Technology
supervised by Prof. Dr. Ralph Müller　　　　　　　　　　　　　　　*03/2020 – 09/2023*

Technical University Munich (TUM)
Master of Science (M.Sc., Dipl.-Ing.) Mechanical Engineering　　　*08/2017 – 02/2020*
Bachelor of Science (B.Sc.) Mechanical Engineering　　　　　　　*10/2013 – 07/2017*

Research Stays abroad
University of Calgary, McCaig Institute　　　　　　　　　　　*06/2023 – 09/2023*
University of Sheffield, Mellanby Centre for Musculoskeletal Research　*11/2022 – 11/2022*
IBM Research Zurich, Artificial Intelligence and Automation　　*08/2021 – 12/2021*
Harvard Medical School, Beth Israel Deaconess Medical Center　*08/2019 – 01/2020*
University of Technology Sydney, Faculty of Science　　　　　*03/2019 – 07/2019*
ETH Zurich, Department of Health Sciences and Technology　　*08/2018 – 12/2018*

RESEARCH EXPERIENCES

Mechanoregulation of bone remodelling in diabetes mellitus using high-resolution peripheral quantitative computed tomography *in vivo* patient data
Marie Sklodowska-Curie doctoral fellow, Institute for Biomechanics, ETH Zurich　　*03/2020 – 09/2023*

· I am developing bone imaging and computational methods for mechanobiological bone remodelling studies that can be run on desktop computers in the hospital/laboratory environment.
· The project aims to investigate the effects of diabetes on local mechanoregulation of bone remodelling in patients, identify its relationship to bone fragility, and candidate biomarkers.
· These precise diagnostic tools may be used to tailor medical treatment of diabetic patients to bone health individually.

Effects of Microscopic Spatial Complexity and Heterogeneity on Trabecular Bone Modulus
Master's Thesis, Beth Israel Deaconess Medical Center, Harvard Medical School　　*08/2019 – 01/2020*

· I conducted this project to describe continuity within the trabecular bone network, to possibly further the understanding of the intrinsic material properties of trabecular bone, by combining local morphology and micro-finite element analysis.

Lung Cancer Classification using Convolutional Neural Networks
Term Project, Faculty of Science, University of Technology Sydney　　*03/2019 – 07/2019*

· I built a computational pipeline employing a convolutional neural network (CNN) and data from the Lung Image Database Consortium (LIDC) database to aid clinicians in the quantification and classification of cancerous lung nodules.

Spatial dynamics of microscale bone remodelling following a tissue injury
Term Project, Department of Health Sciences and Technology, ETH Zurich　　*08/2018 – 12/2018*

· I have assisted conducting two in vivo animal studies using a mouse model of vertebral bone defects and in vivo micro-CT imaging to model the spatial and temporal dynamics of mechanical strain and bone remodelling on a microscopic level.

Computational Assessment of Abdominal Aortic Aneurysm Rupture Risk
Academic Assistant, Mechanics and High Performance Computing Group, TU Munich　　*11/2017 – 02/2018*

· I assisted with tasks related to finite element simulations of patient-specific aneurysms to predict the risk of failure based on micro-CT scans.

Medical Device Certification for Ebenbuild, a TU Munich spin-off
Academic Assistant, Institute for Computational Mechanics, TU Munich　　*01/2019 – 03/2019*

· I worked on the medical device certification for a digital health startup (Ebenbuild) for an artificial intelligence (AI) software providing mechanical characterization of patients' lungs and deliver individualised therapy to treat acute respiratory distress syndrome.

A Relational Database for Medical Device Certification

Bachelor's Thesis, Institute of Micro Technology and Medical Device Technology, TU Munich   *11/2017 – 02/2018*

· This project aimed to support small to medium businesses by providing a database tool to guide them through the medical device approval process according to international and national regulations.

INDUSTRY POSITIONS

Intern at Aesculap AG, Front End Innovation   04/2017 – 10/2017

· Worked on a sterile technology system including prototype design, testing, and negotiations with suppliers.

Technical Support Engineer at MathWorks, Technical Support   10/2016 – 03/2017

· Advertised internal and external clients on the application of the computing software MATLAB and Simulink.

TECHNICAL STRENGTHS

Methods	finite element analysis, volumetric image processing, parallel computing, digital topology, neural networks, statistical models.
Programming Languages	Python 3.6, C, C++, MATLAB R202023a, R, Image Processing Language (IPL)
Software & Tools	MS Office, Paraview, GitHub, Latex, Insight Toolkit (ITK)

Language Certificates

Participated in DAAD English proficiency test, result: C1, TU Munich.   *2019*

Completed diplome d'etudes en langue francaise, result: B1, Überlingen.   *2011*

MAJOR GRANTS AND FELLOWSHIPS

A-MEDICO Grant, University of Calgary   01/2024 – 12/2025
Role: Grant Writing   *C$77200*

· Developing a novel tool for non-invasive vertebral strength assessment at the spine based on computed tomography.

Alberta Spine Foundation Grant, University of Calgary   01/2024 – 12/2025
Role: Grant Writing   *C$75000*

· Developing a machine learning model of the spine for clinical applications from computed tomography.

Alberta Innovates Postdoctoral Fellowship, University of Calgary   10/2023 – 09/2025
Role: Fellow   *C$140000*

· Enhanced Digital Analysis of Bone Remodelling to Understand the Effects of High-Dose Vitamin D Supplementation.

Marie Sklodowska-Curie Action (MSCA), Horizon 2020   01/2020 – 12/2024
Role: Early Stage Researcher ESR8   *€187000*

· Innovative Training network for research into bone Fragility In Diabetes in Europe – towards a personaLised medIcine approach. FIDELIO (EU 860989).

AWARDS AND ACHIEVEMENTS

Special Training Opportunities Fund, McCaig Institute, University of Calgary   08/2023
Role: Awardee   *C$1000*

· Workshop on Open Data in Musculoskeletal Imaging.

Best Poster Award, 26th Congress of the European Society of Biomechanics   07/2020
Role: Presenting Author   *€300*

· Plate and Rod networks describe load transfer in trabecular bone.

Swiss-European Mobility Programme SEMP, Erasmus+   08/2018 – 12/2018
Role: Mobility Student   *CHF 2200*

· For the development of an in vivo mouse model of vertebral defects combined with time-lapsed micro-CT imaging and real-time micro-finite element analysis.

MATLAB Student Ambassador Scholarship, Mathworks   04/2018 – 07/2019
Role: Head of STUDLab group   *€3600*

· MATLAB student ambassador scholarship honouring leadership of the student group STUDLab

TEACHING EXPERIENCE

Teaching Assistant, Imaging and Computing in Medicine   03/2020 – present
Institute for Biomechanics, ETH

· Preparation, implementation and instruction of six flipped classroom sessions, co-supervision and coordination of undergraduate tutors for the execution of the active learning sequences and managing the course moodle page.

Examiner, Orthopaedic Biomechanics   Sept 2021 – 12/2021
Institute for Biomechanics, ETH

· Oral examination of bachelor students on topics in mechanical and structural engineering of the musculoskeletal system alongside the analysis and design of orthopaedic solutions to musculoskeletal failure.

Teaching Assistant, Principles of Modern Information Technology I and II   10/2016 – 03/2017
Institute of Automation and Information Systems, TU Munich

· Developed and presented exercises on modern information technology to engineering students in the first and second semester.

Guest Lectures

· **M. Walle**. Bones Under Pressure: How Mechanical Forces Influence Bone Remodelling in Diabetes. Guest Lecture, ME 602 Boise State University, Boise, Idaho, USA, 11/2023.
· **M. Walle**. Bones Under Pressure: How Mechanical Forces Influence Bone Remodelling in Diabetes. Invited Speaker, McCaig Seminar Series 2023-24, Calgary, Canda, 11/2023.
· **M. Walle**. Please Don't Move: Assessing and Addressing Motion Challenges in High-Resolution CT imaging In Vivo with Deep Learning. Invited Speaker, Advanced Medical Imaging Seminar Series 2023-24, Calgary, Canda, 10/2023.
· **M. Walle**. Are bones with diabetes less responsive to mechanical loading? Invited Speaker, FIDELIO annual meeting 2023, Sheffield, UK, 04/2023.
· **M. Walle**. Advanced Computionatal Tools for HR-pQCT image analysis, Invited Speaker, FIDELIO annual meeting 2022, Dresden, Germany, 06/2022.
· **M. Walle**. Mechanoregulation of bone remodelling in type 2 diabetes using HR-pQCT in vivo patient data, FIDELIO annual meeting 2021, online, 07/2021.

ADVISORY AND SUPERVISORY RESPONSIBILITIES

Teaching assistants

1. Vinzenz Tütsch, M.Sc. Health Science and Technology ETH, 2021/2022, ETH Zurich

2. Dominique Windisch, M.Sc. Health Science and Technology ETH, 2021/2022, ETH Zurich

3. Vasil Kecheliev, M.Sc. Health Science and Technology ETH, 2021/2022, ETH Zurich

4. Alessandra Arizzi, M.Sc. Health Science and Technology ETH, 2021, ETH Zurich

5. Jack Kendall, M.Sc. Mechanical Engineering ETH, 2021, ETH Zurich

Scientific supervision

1. Mirthe Kamphuis, Research Internship, MSc Biomedical Engineering, University of Technology Eindhoven, 2022, "Human bone mechanoregulation based on high-resolution quantitative computed tomography"

2. Marianna Marzetta, Bachelor Thesis, B.S. Computational Science and Engineering ETH, 2022, ETH Zurich, "An automated registration approach for multi-stack time-lapsed imaging using high- resolution peripheral quantitative computed tomography"

3. Dominique Windisch, Research Internship, M.S. Health Sciences and Technology ETH, 2022, ETH Zurich, "Automated mechanoregulation pipeline for human studies: image registration module"

4. Catherine Weidlich, M.S. Mechanical Engineering ETH, 2022, ETH Zurich, "Validation of mechanoregulation methods of human studies: impact of cortical and trabecular segmentation"

5. Akanksha Sachan, Bachelor Thesis, B.Tech., 2022, IIT Bombay, India, "Agent-based simulations of the effects of treatment on diabetic vs non-diabetic bone"

6. Dominique Windisch, Practical Internship, M.S. Health Sciences and Technology ETH, 2022, ETH Zurich, "Automated mechanoregulation pipeline for human studies: image registration module"

7. Jana Heim, M.S. Biomedical Engineering ETH, 2021, ETH Zurich, "Quality Control of HR-pQCT-based bone mechanoregulation analysis"

8. Philipp Steiner, M.S. Mechanical Engineering ETH, 2021, ETH Zurich, "Suppression of subject motion induced artefacts in HR-pQCT scans using deep neural networks"

9. Akanksha Sachan, B.Tech., 2021, Third Year, IIT Bombay, India, "Multiphysics simulations of diabetic bone and procedure for inclusion of new pathways"

10. Catherine Weidlich, Semester Project, M.S. Mechanical Engineering ETH, 2021, ETH Zurich, "Digital biopsy representative region extraction in human radii"

11. Dominic Eggemann, Semester Project, M.S. Electrical Engineering ETH, 2021, ETH Zurich, "Characterisation of image quality in HR-pQCT scans using a deep-learning-based classification method"

OUTREACH

FIDELIO Webinar   12/2022
YouTube.com

· Matthias Walle. Time-lapsed HR-pQCT and Bone Mechanoregulation. FIDELIO Webinar.

Project Video   02/2022
YouTube.com

· Matthias Walle. Mechanobiology in diabetes patients - Matthias Walle.

Scientifica: Zurich Science Days   09/2021
scientifica.ch

· Demonstration and tour through the Laboratory for Bone Biomechanics to give young children and teenagers insights into simulations of cellular processes in bone.

The Globe Article   09/2021
eth.ch

· Article advertising the Scientifica science days. C. Ledoux, M.Walle, R. M"uller, C.J. Collins. Insights into bone processes. The Globe No. 2/2021, pg. 14-15.

HubLE Exchange Interview, International Federation of Muscoskeletal Research   June 2021
huble.org

· Andreasen, Christina Møller, and Matthias Walle. Tissue-Level Mechanical Stimuli Drive Bone Formation and Resorption in Humans and Mice. HubLE Exchange Interview, 4 June 2021.

ACADEMIC CITIZENSHIP

Scientific Committees

International Federation of Muscoskeletal Research Societies (IFMRS): HubLE-Editor   *2022-Present*
International Society of Bone Morphometry (ISBM): Young investigator committee   *2022-Present*

Professional society membership

Orthopaedic Research Society (ORS)   *2022-Present*
European Society of Biomechanics (ESB)   *2020-Present*
European Calcified Tissue Society (ECTS)   *2020-Present*
American Society of Bone and Mineral Research (ASBMR)   *2020-Present*

Active reviewer for the following journals

Bone, Elsevier   *2023-Present*
Nature Communications   *2023-Present*
Frontiers in Endocrinology   *2023-Present*
The Journal of Bone and Mineral Research (JBMR and JBMR+)   *2022-Present*
Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, Dove Medical   *2022-Present*
Annals of Biomedical Engineering, Springer   *2022-Present*

INVITED RESEARCH TALKS

1. **M. Walle**. Mechanoregulation of bone remodelling in diabetes using HR-pQCT in vivo patient data. Invited Speaker, 50th Annual European Calcified Tissue Society Congress (ECTS 2023), Open Forum: Type 1 and 2 diabetes and bone health - results from the FIDELIO research training network, Liverpool, UK, 05/2023.

PEER-REVIEWED PUBLICATIONS

Original Articles

1. D.E. Whittier*, **M. Walle***, D. Schenk, P.R. Atkins, C.J. Collins, P. Zysset, K. Lippuner, R. Müller. A multi-stack registration technique to improve measurement accuracy and precision across longitudinal HR-pQCT scans. Bone, 2023. (*equal contribution*).

2. **M. Walle**, D.E. Whittier, D. Schenk, P.R. Atkins, P. Christen, M. Blauth, P. Zysset, K. Lippuner, R. Müller, C.J. Collins. Precision of bone mechanoregulation assessment using longitudinal HR-pQCT. Bone, 2023.

3. F C. Marques, D Boaretti, **M. Walle**, A C. Scheuren, F A. Schulte, R. Müller. Mechanostat parameters estimated from time-lapsed in vivo micro-computed tomography data of mechanically driven bone adaptation are logarithmically dependent on loading frequency. Front. Bioeng. Biotechnol. Volume 11.

4. **M. Walle**, D. Eggemann, P.R. Atkins, K. J.J. Kendall, Stock, R. Müller, C.J. Collins. Motion grading of high-resolution quantitative computed tomography supported by deep convolutional neural networks. Bone, 2022.

5. **M. Walle**, D.E. Whittier, M. Frost, R. Müller, C.J. Collins. Meta-analysis of Diabetes Mellitus-Associated Differences in Bone Structure Assessed by High-Resolution Peripheral Quantitative Computed Tomography. Curr Osteoporos Rep (2022).

6. **M. Walle**, F. C. Marques, N. Ohs, M. Blauth, R. Müller and C. J. Collins. Bone mechanoregulation allows subject-specific load estimation based on time-lapsed micro-CT and HR-pQCT in Vivo. Front. Bioeng. Biotechnol. 9:677985. doi: 10.3389/fbioe.2021.677985

7. A. Malhotra, **M. Walle**, G. R. Paul, G. A. Kuhn and R. Müller. Application of subject-specific adaptive mechanical loading for bone healing in a mouse tail vertebral defect. Sci. Rep., 11:1861, 2021.

Original Articles in Submission   (manuscripts can be provided on request)

1. **M. Walle**, A. Duseja, D.E. Whittier, T. Vilaca, M. Paggiosi, R. Eastell, R. Müller, C.J. Collins. Bone remodelling and responsiveness to mechanical stimuli in type 1 diabetes mellitus: the role of neuropathy. Journal of Bone Mineral Research, *M23080453*

2. V. B. Kassey, **M. Walle**, J. Egan, D. Yeritsyan, I. Beeram, Y. Wu , B. D. Snyder, E. K. Rodriguez, J. L. Ackerman, A. Nazarian. Quantitative 1H Magnetic Resonance Imaging on pathologic rat bones by solid-state 1H ZTE sequence with water and fat suppression. Journal of Magnetic Resonance Imaging, *Under internal review*.

3. V. B. Kassey, **M. Walle**, J. Egan, D. Yeritsyan, I. Beeram, Y. Wu , B. D. Snyder, E. K. Rodriguez, J. L. Ackerman, A. Nazarian. Quantitative 31P Magnetic Resonance Imaging on Pathologic Rat Bones by ZTE Sequence at 7T. Bone Journal, *Under internal review*.

PEER-REVIEWED CONFERENCE ABSTRACTS

Oral podium presentations

1. **M. Walle**, D.E. Whittier, S.K. Boyd, R. Müller and C. J. Collins. Measuring Bone Remodelling *In Vivo*: Does Voxel Size Really Matter? Annual Alberta Biomedical Engineering Conference 2023, Banff, Alberta, Canada, 2023.

2. **M. Walle**, D. Eggemann, P.R. Atkins, K. Stock, R. Müller, C.J. Collins. Integration of artificial intelligence into diagnostic imaging: Convolutional Neural Network-supported HR-pQCT visual grading. 9th World Congress of Biomechanics, July 10-14, 2022, Taipei, Taiwan.

3. P. Y. Steiner, **M. Walle**, M. Rigotti, D.E. Whittier, C. McLennan, P. R. Atkins, R. Müller, C. J. Collins. Correction of Motion Artefacts in HR-pQCT using Cycle-consistent Adversarial Networks. Abstracts 27th Congress of the European Society of Biomechanics (ESB), Porto, Portugal, June 26-29, submitted, 2022.

4. D.E. Whittier, **M. Walle**, P. Christen, P.R. Atkins, C. Collins, M. Blauth, K. Lippuner, R. Müller. Changes in loading during fracture healing do not impact bone microarchitecture of the unfractured wrist. Abstracts 27th Congress of the European Society of Biomechanics (ESB), Porto, Portugal, June 26-29, submitted, 2022.

5. **M. Walle**, D.E. Whittier, C. Weidlich, D.O. Windisch, P.R. Atkins, P. Christen, M. Blauth, K. Lippuner, R. Müller, C.J. Collins. Time-lapsed HR-pQCT allows monitoring local bone remodelling events at various follow-up time-points in vivo. The 23rd International Workshop on Quantitative Musculoskeletal Imaging (QMSKI), June 13-17, 2022, Noordwijk, Netherlands.

6. **M. Walle**, F. C. Marques, N. Ohs, M. Blauth, R. Müller and C. J. Collins. Bone mechanoregulation allows subject-specific in vivo estimation of microstructural tissue loading history. 26th Congress of the European Society of Biomechanics, July 11-14, 2021, Milan, Italy.

Flash-podium/hybrid Presentations

1. D.E. Whittier, **M. Walle**, C. Ledoux, P.R. Atkins, C.J. Collins, J.A. Holtmann, M.A. Zumstein, P. Christen, K. Lippuner, R. Müller.Fracture Healing Leads to Localized Structural Bone Loss Quantified using Void Space Analysis. Abstracts ASBMR 2023 Annual Meeting, Vancouver, Canada, J. Bone Miner. Res., 2023.

2. **M. Walle**, D.E. Whittier, D. Schenk, M. Blauth, P. Zysset, K. Lippuner, R. Müller, C.J. Collins. In vivo repeatability of bone mechanoregulation assessment using longitudinal high-resolution peripheral quantitative computed tomography. Abstracts 50th Annual European Calcified Tissue Society Congress (ECTS 2023), Liverpool, UK, 05/15-18, Bone Rep., 2023.

3. D.E. Whittier, **M. Walle**, C. Ledoux, J. Holtmann, C.J. Collins, K. Lippuner, R. Müller. Early bone remodelling during fracture healing measured by HR-pQCT is a determinant of long-term bone mineral density. Abstracts 50th Annual European Calcified Tissue Society Congress (ECTS 2023), Liverpool, UK, 05/15-18, Bone Rep., 2023.

4. **M. Walle**, D. Whittier, R. Müller, C.J. Collins. HR-pQCT Measures of Bone Microarchitecture in Type 1 and Type 2 Diabetes Mellitus: Systematic Review and Meta-analysis. ECTS Congress 2022, 07-10 May, 2022, Helsinki, Finland.

5. **M. Walle**, M. Abbasian, D. Yeritsyan, R. Oftadeh, A. Nazarian. Plate and Rod networks describe load transfer in trabecular bone. 26th Congress of the European Society of Biomechanics, July 11-14, 2021, Milan, Italy.

6. **M. Walle**, F. C. Marques, N. Ohs, R. Müller, and C. J. Collins. 3D physiological load estimation based on time-lapsed HR-pQCT images. Abstracts ASBMR 2020 Annual Meeting, Seattle, USA, J. Bone Miner. Res., 35(1):143-144, 2020.

Poster Presentations

1. **M. Walle**, A. Duseja, D.E. Whittier, T. Vilaca, M. Paggiosi, R. Eastell, R. Müller, C.J. Collins. Bone remodelling and responsiveness to mechanical stimuli in type 1 diabetes mellitus: the role of neuropathy. Abstracts ASBMR 2023 Annual Meeting, Vancouver, Canada, J. Bone Miner. Res., 2023.

2. V. Kassey, **M. Walle**, J. Egan, D. Yeritsyan, Y. Wu, B.D. Snyder, E.K. Rodriguez, J.L. Ackerman and A. Nazarian. A Versatile MRI Post-Processing Package with Graphical User Interface in MATLAB. 63rd ENC, April 24-29, 2022, Orlando, Florida, USA.

3. **M. Walle**, D. Eggemann, P.R. Atkins, K. Stock, Müller, C.J. Collins. Operator-independent Characterisation of Image Quality in HR-pQCT Scans using a Fully Automated Convolutional Neural Network-based Classification Method. ORS 2022 Annual Meeting, February 4 8, 2022, Tampa, Florida, USA.

4. V. Kassey, **M. Walle**, J. Egan, D. Yeritsyan, Y. Wu, B. Snyder, E. Rodriguez, J. Ackerman, A. Nazarian. A Combined Solid-State 1H and 31P Magnetic Resonance Imaging to Assess Bone Mineral and Matrix Densities in Rat bones. Abstracts 2021 ISMRM & SMRT Annual Meeting, International Society for Magnetic Resonance in Medicine.

5. D. Eggemann, **M. Walle**, P. Atkins, K. Stock, R. Müller, and C. J. Collins. Operator-independent Characterization of Image Quality in HR-pQCT Scans using a Fully Automated Convolutional Neural Network-based Classification Method. Abstracts ASBMR 2021 Annual Meeting, Toronto, Canada, J. Bone Miner. Res., 2021.

6. **M. Walle**, F. C. Marques, N. Ohs, M. Blauth, R. Müller and C. J. Collins. Tissue-level mechanical stimuli drive bone formation and resorption in humans and mice. Digital Congress of the European Calcified Tissue Society, 05/6-8, 2021, online.