SINAPSE

16th Annual Scientific Meeting
Wednesday 12th June 2024

Pathfoot Building
University of Stirling

Programme and Abstracts Booklet

SINAPSE
ASM 2024

Welcome to the 16th SINAPSE Annual Scientific Meeting

Contents

Venue

Location

The Pathfoot Building is on the campus of the University of Stirling. The address is University of Stirling - Pathfoot Building, 9 Pathfoot Road, Stirling, FK9 4LU.

Train

Stirling campus is a 40-minute walk from Stirling city centre or train station, and 30 minutes from Bridge of Allan train station. Stirling train station is the easiest option to complete the journey by bus or taxi. Bridge of Allan train station is the easiest option to complete the journey by walking or cycling.

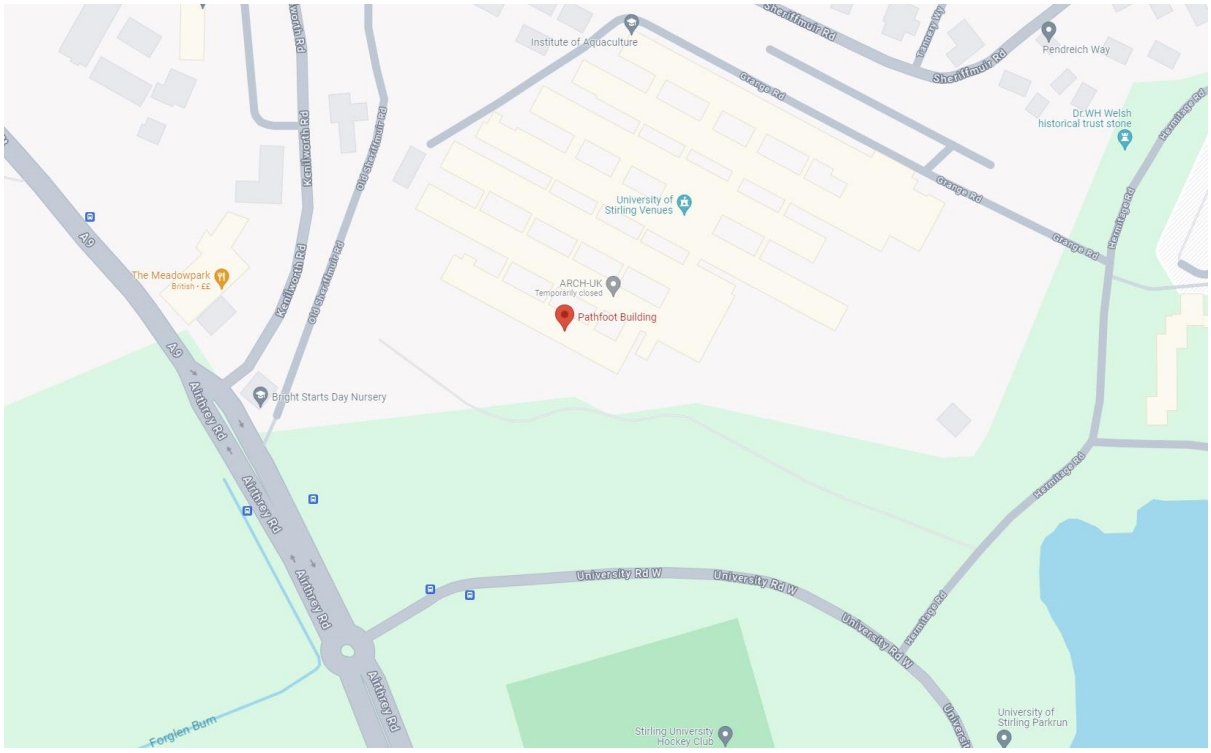
Bus

The Unilink shuttle bus between Stirling centre, the train station and the main University campus is one of the handiest and most regular services. Most bus services to the campus run from either just outside Stirling's Rail Station or a two-minute walk away, in Murray Place.

Visit the [Midland Bluebird website] for the most up-to-date timetable information.

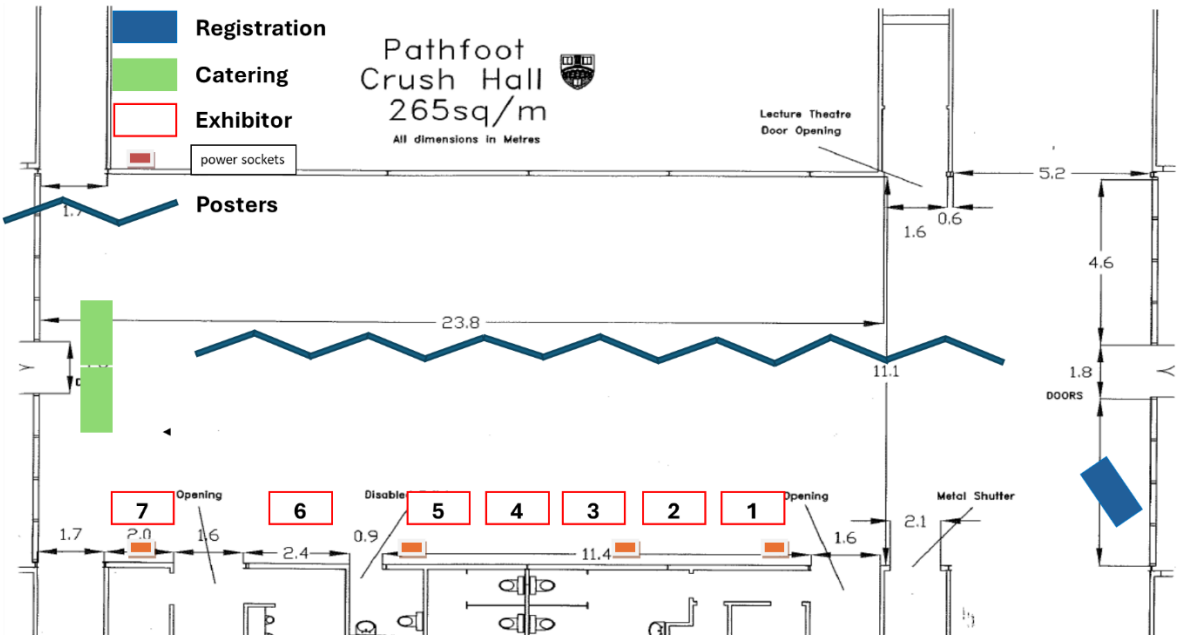
Car Parking

There a number of car parks on the campus, one outside the Pathfoot Building. The first 2 hours of parking are free, but extra time can be paid for through the RingGo app. Further details about all aspects of parking on campus are available here: https://www.stir.ac.uk/about/getting-here/parking/



Exhibition, Posters, and Catering

All catering, posters, and the exhibition can be found in **the Crush Hall**



Exhibitors

E1 – NordicNeuroLab

E2 – Tayside Innovation Medtech Ecosystem (TIME)

E3 – HIC

E4 – Canon MRE

E5 – Brain Health ARC

E6 – Siemens Healthineers

E7 - Life MI

Exhibitors

SIEMENS Healthineers

Nordic Neuro Lab

Life Molecular Imaging
HEALTH CARE

Tayside Innovation Medtech Ecosystem
University of Dundee

Health Informatics Centre

BRAIN HEALTH ARC
Scottish Funding Council,
Alliance for Research Challenges in Brain Health

Canon

Agenda

Wednesday 12th June 2024			
Pathfoot Building, University of Stirling			
0900	Registration – Crush Hall		
Plenary Session 1 Chair: Dr Magdalena Ietswaart, University of Stirling			
0930	Welcome – Dr Magdalena Ietswaart, University of Stirling		
0935	Welcome – Dr Jennifer Macfarlane, SINAPSE Director, NHS Tayside		
0940	Keynote 1: *Implementation of a National Total Body PET platform in the UK: How will NPIP use Total Body PET in research?* Dr Ian Wilson, National PET Imaging Platform		
1030	Introducing the Centre for Adaptable MRI Technology Dr Najat Salameh and Dr Mathieu Sarracanie, University of Aberdeen		
1100	*Imaging Projects and Initiatives with Optos* Alan Anderson, Senior Director of R&D, Optos		
1130	Tea Break and Posters (30 mins) – Crush Hall		
Parallel Sessions – See Next Pages for Details on Talks			
1200	Session 1 – Pathfoot Lecture Theatre	Session 2 – Room D1	Session 3 – Room D3
1300	Lunch and Posters (60 mins) – Crush Hall		
Parallel Sessions – See Next Pages for Details on Talks			
1400	Session 4 – Pathfoot Lecture Theatre	Session 5 – Room D3	
1500	Tea Break and Posters (30 mins) – Crush Hall		
Plenary Session 2 Chair: Dr Jennifer Macfarlane, NHS Tayside			
1530	ECR Rising Star: *Mobile brain imaging in Parkinson's Disease* Dr Magda Mustile, Université Catholique de Louvain		
1600	Keynote 2: *Advancing Brain-Computer Interfaces from bench to bedside for neurorehabilitation using TMS-Neurofeedback* Dr Kathy Ruddy, Queen's University Belfast		
1640	Closing Remarks and Prize Giving – Dr Jennifer Macfarlane, NHS Tayside		
1700	Drinks Reception – Crush Hall		
1800	Close		

Parallel Sessions (1200-1300)

Session 1 – Methods Development, Pathfoot Lecture Theatre Chair: Dr Sergio Dall'Angelo, University of Aberdeen, Assisted by Hamzeh Norouzi			
1200	*Radiomics and Artificial Intelligence in Predicting Heterogeneity and Tumour Grade in Clear Cell Renal Cell Carcinoma: Comparison with Percutaneous Biopsy*	Abeer J. Alhussaini, University of Dundee	O01
1212	*Accurate and non-contact intraocular pressure assessment using corneal geometry and biomechanics with surface acoustic wave optical coherence elastography (SAW-OCE)*	Yilong Zhang, University of Dundee	O02
1224	*Assessing sensitivity and count-rate performance in Geant4 simulation for total-body PET with different crystals and isotopes*	Hanna Borecka-Bielska, University of Edinburgh	O03
1236	*Cerebrovascular reactivity repeatability and analysis method comparison for measurements using 3T BOLD MRI and fixed inhalation gas challenge*	Edward Thomson, University of Edinburgh	O04
1248	*Exploring the impact of input function approaches on kinetic modelling for [18F]SynVesT-1 in mice*	Bernadette Andrews, University of Edinburgh	O05

Session 2 – Clinical Applications, Room D1 Chair: Dr Isla Barnard, University of Dundee, Assisted by Danishta Kaul			
1200	*Peak-width skeletonised microstructural MRI changes and fatigue in relapsing-remitting multiple sclerosis*	Rozanna Meijboom, University of Edinburgh	O06
1212	*Cerebrovascular Reactivity Delay in Small Vessel Disease: A Cross-Sectional Study*	Keelin Ridge, University of Edinburgh	O07

Session 3 – Psychology/Psychiatry, Room D3 Chair: Dr William McGeown, University of Strathclyde, Assisted by Claire Rogers			
1200	*Neural Correlates of Children with Avoidant Restrictive Food Intake Disorder (ARFID) Symptoms: Large-Scale Neuroanatomical Analysis of a Paediatric Population*	Michelle Sader, University of Aberdeen	O08
1212	*"Is it not the collective that's most important?": Identifying perceptions, motivators, and barriers of older adult research participants in cognitive neuroscience*	Gemma Learmonth, University of Glasgow	O09
1224	*Examining the impact of efference and afference on saccade-induced EEG Modulation*	Christopher Turner, University of Glasgow	O10
1236	*Around the Clock: Physiological Markers of Lapses in Attention During Sustained Task Performance*	Emily Cunningham, University of Stirling	O11

Parallel Sessions (1400-1500)

Session 4 – Image Analysis, Pathfoot Lecture Theatre Chair: Dr Nicholas Senn, University of Aberdeen, Assisted by Yilong Zhang			
1400	*Temporal enhancement features on Contrasted Enhanced Mammography (CEM) accounting for background enhancement: Comparison with breast MRI*	Sarah Savaridas, University of Dundee	O12
1412	*Enhancing Medical Imaging and Surgical Precision with Machine Learning: A Case Study on MRgFUS Thalamotomy*	William Gilmour, University of Dundee	O14
1424	*Improvements in R1 mapping at ultra-low field using denoised and motion corrected field-cycling MRI in brain*	Nicholas Senn, University of Aberdeen	O15
1436	*M1-PMd connectivity modula6on via fMRI-neurofeedback*	Marine Keime, University of Glasgow	O16

Session 5 – Ultrasound, Room D3 Chair: Prof Sandy Cochran, University of Glasgow, Assisted by Emily Cunningham			
1400	*A poly-vinyl Alcohol (PVA)-based phantom for prostate cancer detection using multiparametric ultrasound: a validation study.*	Adel Jawli, University of Dundee	O17
1412	*Imaging Modalities of a Thiel Heart*	Niall McCann, NHS Tayside	O18
1424	*Enhancing Transcranial Focused Ultrasound: Performance Analysis Based on Reconstructed CT-Derived Skull Acoustical Properties*	Han Li, University of Dundee	O19
1436	*MRgFUS volumetric dosimetry from 2D thermometry*	Isla Barnard, University of Dundee	O20

Poster Presentations – All Day

Poster Number	Title	Presenting Author
P01	*Random Forest Classifiers to predict psychotic symptoms in Alzheimer's disease*	Sara Scarfo
P02	*Neuroanatomical Associations with Autistic Characteristics in those with Acute Anorexia Nervosa (AAN) and Weight Restored (WR) Individuals*	Michelle Sader
P03	*The influence of dimmed lighting conditions on naturalistic obstacle negotiation in young and older adults: A proposed study using mobile EEG*	Danishta Kaul
P04	*Delineating In-Vivo T1-weighted Intensity Profiles within the Human Insula Cortex Using 7-Tesla MRI*	Connor Dalby
P05	*Avoiding biopsy for presumed fibroadenomas with benign ultrasound greyscale and shear-wave elastography features in women aged 25-39 years: Comparison between two ultrasound systems and review of follow-up data.*	Sarah Savaridas
P06	*Evaluation of Polyvinyl Chloride's acoustic and mechanical properties as a breast ultrasound phantom.*	Wadhhah Aldehani
P07	*Sonodynamic Therapy for glioblastoma*	Danial Kordbacheh
P08	*Simulating the effect of different water temperatures on skull*	Saeed Charbenny
P09	*Self-supervised cross-encoder for neurodegenerative disease Diagnosis*	Xiaochen Yang
P10	*A dynamic link between respiration and arousal*	Christian Keitel
P11	*Optimising sensory stimulation for the treatment of Alzheimer's disease*	Eva Clarkson
P12	*Quantitative T1 mapping with multi-contrast MP-RAGE at 7T*	Janhavi Ghosalkar
P13	*Uncovering Temporal Profiles in The Cortical Layers of M1 using High-resolution Line-Scanning fMRI at 7T*	Nils Nothnagel
P14	*Efficacy of a one day training day for reporting Contrast Enhanced Mammography*	Sarah Savaridas
P15	*Breast MRI in the absence of MRI-guided biopsy: A retrospective review with three years follow-up data*	Soheila Hajialiasgar
P16	*How does the implementation of an AI image interpretation tool and novel communication software impact time to treatment?*	Pamela Barr
P17	*Head and neck imaging with 7T MRI using a custom-built 8TxRx56Rx coil*	Belinda Ding
P18	*A Novel Foundation Model for Estimating Brain MRI Health*	Austin Dibble
P19	*Mechanisms of fatigue in multiple sclerosis: insights from single-echo quantitative susceptibility mapping*	Francesca Pentimalli
P20	*Towards endotyping neurodegeneration through the eye using multi-modal retinal imaging*	Miracle Ozzoude
P21	*Capture and Re-use of Ground Truth (to enhance cohort building)*	Suzie Law

P22	*High-Speed Preparation of DICOM Metadata for Research Purposes*	James Friel
P23	*Assessment of Coronary Artery Calcification in Patients with Bronchiectasis*	Khalid Hakami
P24	*Analysis of cardiac MRI scans to assess the effect of dapagliflozin on EAT*	Mohmmad Alghamdi
P25	*Software for Medical Imaging (SMI) - Processing Large-Scale DICOM Data in Safe Havens*	Ruairidh MacLeod
P26	*Radiomic Texture Analysis of Perirenal Fat: A Predictive Indicator of Tumour Grade and Stage in Renal Cell Carcinoma*	Abdulrahman Al Mopti
P27	*Text-based Medical Image Classification by Body Part*	Bianca Prodan
P28	*Evaluating the Superiority of Digital Breast Tomosynthesis Over Digital Mammography in Sensitivity and Specificity for Detecting Breast Cancer in Women Aged 18 and Above: A Meta-Analysis*	Ourania Varsou

Abstracts

Keynote Talks

Keynote 1

Implementation of a National Total Body PET platform in the UK: How will NPIP use Total Body PET in research?

Dr Ian Wilson

NPIP Engagement and Delivery Director

Abstract: The National PET Imaging Platform (NPIP) is a partnership between the Medicines Discovery Catapult, the Medical Research Council (MRC), and Innovate UK that was formed to provide UK researchers with access to total body PET infrastructure.

The infrastructure will include the installation of two total body scanners (located in Scotland and London) and access to PET research from various programmes and trials. As total body PET gathers pace in the UK, it is hoped that these will be the first of many scanners made available to researchers. The platform aims to connect research projects and create a community that can deliver progress across key research areas, driving progress and ultimately improving patient outcomes.

The Royal Free London Hospital currently hosts a total body scanner and is also a collaborative partner of the platform. Additional benefits of the platform include the capacity to build on the range of PET training programmes available in the UK, addressing the lack of access to trained PET professionals, which has been a historical barrier to use. The platform also increases the possibility of attracting international research projects of global importance to UK shores. Total body PET capabilities in the UK will also improve the clinical translation of associated technologies and novel radiotracers, further increasing the potential of future PET research.

Biography: Dr Ian Wilson is the former CEO of ImaginAb Inc and Edinburgh Molecular Imaging. 30+ years' experience in the development and commercialization of radiopharmaceutical therapy and imaging agents for CT, MR, hyperpolarized MR, PET, SPECT, ultrasound and optical imaging.

CEO, COO, and CTO at biotech and pharma companies, raising capital, developing 3-5 year strategies, and managing change and growth.

Working for GE HealthCare and Imanet PET centers; built R&D labs from the ground up, supporting radiochemistry, biology, and chemistry, and implemented appropriate quality systems. Established external networks to undertake radiopharmaceutical and imaging agent development and validation with external industrial and academic organizations. First-hand experience in clinical PET and MR studies, set up to measure drug efficacy, and occupancy for cancer, neurodegenerative disease, and cardiovascular disease, using a range of markers to measure transporters, receptors, inflammatory cells, and amyloid plaques.

Introducing the Centre for Adaptable MRI Technology

Title to be confirmed

Dr Najat Salameh and Dr Mathieu Sarracanie

University of Aberdeen

Abstract:

Biography:

Imaging Projects and Initiatives with Optos

Alan Anderson

Senior Director Research and Development, Optos

Abstract: Optos are a Scottish success story in Medical Imaging. In their 30-year journey - from a very personal beginning to the market leader in the field of Retinal imaging - Optos have heavily relied on making technical breakthroughs over these three decades, tapping into the talents of the local technical community. This presentation will review some of the highlights from over the years and take a forward looking view of what Optos' future collaborations and needs are for the coming decade.

Biography: Alan Anderson is the Senior Director of Research and Development at Optos. As an alumni of the University of Glasgow, with a background in Electronics Engineering, Alan's career has been instrumentation centric – beginning with Hewlett Packard within the Aerospace & Defence and Communications sectors, joining Optos a decade ago to develop Scanning Laser Ophthalmoscopes and Optical Coherence Tomography for the Medical Devices industry. He is now responsible for the Research and Academic Engagement at Optos.

ECR Rising Star

Mobile brain imaging in Parkinson's Disease

Dr Magda Mustile

Université Catholique de Louvain

Abstract: The recent development of mobile brain imaging techniques offers the unique opportunity to investigate brain processes of dynamic real-world behaviour. In particular, the mobile electroencephalogram (EEG) allows the examination of brain signals during whole-body movements, with fine-grained temporal resolution. This portable technique means we can now examine challenging movements in clinical populations such as Parkinson's disease. In this talk, I will present the results from two studies investigating neural correlates of real-world whole-body movements in Parkinson's disease patients using mobile EEG. In the first study, we recorded brain activity while participants walked uninterrupted compared to while they had to adjust their gait to step over expected obstacles or unexpected obstacles displayed on the floor. As the first brain imaging study to examine the neuro-cognitive correlates of such a dynamic scenario in Parkinson's disease, the brain signals revealed a pervasive deficit of motor-cognitive control, demonstrating that Parkinson's patients have difficulties in adapting movements both before and after avoiding obstacles on their path. The second study looked at movement aided through auditory cueing during sit-to-stand, a daily-living action that is particularly challenging for Parkinson's disease patients. For this we examined brain activity during self-initiated and externally cued sit-to-stand movements. The neural correlates indicate that cueing in Parkinson's induces greater activation of motor cortical areas supporting the maintenance of a more stable motor output, but involves the allocation of cognitive resources to update the motor plan. As such, it provides the first neural evidence for why and how cueing improves motor function in dynamic whole-body movement in Parkinson's disease.

Biography: Dr Magda Mustile is a post-doctoral researcher in Cognitive Neuroscience with a background in clinical neuropsychology. Her research focuses on the study of neural correlates underlying human cognition and behaviour in healthy and clinical populations, particularly in patients with Parkinson's disease. After graduation from a Master's in Cognitive Neuroscience at the Second University of Naples (Italy), she completed a second Master's Degree in Clinical Neuropsychology at the Lumsa University (Italy). Following this second Master's, she completed her Ph.D. in Cognitive Neuroscience at the University of Stirling (Scotland, UK). During her doctoral training, she employed the mobile EEG to investigate neural markers of cognitive functions during naturalistic behaviours, in both healthy participants and in patients with Parkinson's disease. After the PhD, she has worked as post-doctoral researcher at the Italian Institute of Technology (IIT, Italy) at the laboratory of 'Social Cognition in Human-Robot Interaction'. During this experience, she worked on hyper scanning technique to investigate neural synchrony between human-human partners and in robot-mediated interactions through teleoperation. Currently, she is a postdoctoral researcher at the Université Catholique de Louvain (Belgium), funded by the FSR incoming postdoctoral fund 2021. Her research project investigates the neural and behavioural correlates of cognitive and motor inhibition in healthy participants and Parkinson's disease patients.

Keynote 2

Advancing Brain-Computer Interfaces from bench to bedside for neurorehabilitation using TMS-Neurofeedback

Dr Kathy Ruddy

Queen's University Belfast

Abstract: Studies using Brain Computer Interfaces (BCIs) based upon non-invasive, scalp recorded electroencephalography (EEG) have consistently demonstrated utility, both as scientific tools for neuromodulation and for clinical neurorehabilitation purposes. They are particularly appealing in clinical contexts where physical movement is impaired, for instance following stroke. Using a BCI where on-screen avatars are driven by neural activation in motor regions encourages the patient to engage in imagined or attempted movements. By providing tangible visual feedback and rewarding desirable neural features, activity in motor pathways is maintained. This may promote use-dependant plasticity and rewiring for recovery of function. However, clinical adoption of the approach has been limited. This is due mainly to difficulties with implementation in non-research settings, as training to achieve neural control of the BCI requires lengthy sessions over multiple days or weeks (Simon et al., 2021). Neurofeedback of Motor Evoked Potential (MEP) amplitude in response to TMS (TMS-NF) gives direct, real-time muscle-specific feedback, even in situations where the user is unable to generate functional movements. In this talk I will present results demonstrating that priming participants with two days of TMS-NF results in shorter training times and more optimal use of the EEG BCI, making the approach more clinically useful. I will also show results from wireless, mobile EEG used to support longer term rehabilitation by promoting sustained practise of optimal motor imagery for movement rehabilitation.

Biography: Dr Kathy Ruddy is a neuroscientist with a specific focus on using brain stimulation and Brain-Computer Interface (BCI) to modify aspects of neurophysiological function.

She graduated with a first class honours degree in Psychology from Queen's University Belfast in 2010, followed by a PhD in Psychology with a focus on Motor Neuroscience in 2014 (also from Queen's). Following this she worked as a postdoctoral researcher at ETH Zürich in Switzerland for three years, in the Department for Health Science and Technology. In 2017 she began working as a postdoctoral research fellow at Trinity College Dublin, and in 2019 received an Emerging Investigator Award from the Health Research Board of Ireland to establish the Translational Brain Health Lab at Trinity College Institute of Neuroscience. In 2023 she joined the School of Psychology at Queen's University Belfast as a Senior Lecturer.

Kathy was named as Irish Researcher of the year by the Irish Research Council in 2021, and has won early career awards from the Psychological Society of Ireland (PSI) and Neuroscience Ireland in 2018 and 2019. In 2022 she won the Northern Ireland Firmus Energy award for 'Inspirational Woman of the Year' in Science, Technology, Engineering and Maths.

Parallel Sessions

Abstract number: O01

Radiomics and Artificial Intelligence in Predicting Heterogeneity and Tumour Grade in Clear Cell Renal Cell Carcinoma: Comparison with Percutaneous Biopsy

Abeer J. Alhussaini, J. Douglas Steele, Adel Jawli, **Ghulam Nabi**

University of Dundee

Background: Renal cancers are among the top ten causes of cancer-specific mortality of which the ccRCC subtype is responsible for most of the cases. Grading of ccRCC is important in determining the tumour aggressiveness and clinical management.

Objectives: To predict the WHO/ISUP grade of ccRCC pre-operatively and characterise the heterogeneity of tumour subregions using radiomics and ML models including comparison with pre-operative biopsy-determined grading in a subgroup. Methods: Data was obtained from multiple institutions across two countries from 391 patients with pathologically proven ccRCC. For analysis, the data were separated into 4 cohorts.

Cohorts 1 and 2 were data from the respective institutions from the two countries, cohort 3 was the combined data from both cohort 1 and 2 and cohort 4 data was a subset of cohort 1 where both biopsy and subsequent histology from resection (partial or total nephrectomy) was available. 3D image segmentation was done to derive a voxel of interest (VOI) mask. Radiomic features were then extracted from the contrast-enhanced images and the data normalised. Pearson correlation coefficient (rpb) and the XGBoost model were used to reduce the dimensionality of the features. Thereafter, 11 ML algorithms were implemented for the purpose of predicting the grade of ccRCC and characterising heterogeneity of subregions in the tumours; Results: For cohort 1, 50% tumour core and 25% tumour periphery exhibited the best performance with an average AUC of 77.91% and 78.64% respectively. 50% tumour core had the highest performance in cohort 2 and cohort 3 with an average AUC of 87.64% and 76.91% respectively. Cohort 4 with 25% periphery showed an AUC of 95% and 80% for grade prediction using internal and external validation respectively while biopsy histology had an AUC of 31% for the prediction with the final grade of resection histology as a reference standard.

Conclusion: Radiomic signatures combined with ML have the potential to predict the WHO/ISUP grade of ccRCC with superior performance compared to pre-operative biopsy. Moreover, tumour subregions contain useful information that should be analysed independently when determining tumour grade. It is therefore possible to distinguish the grade of ccRCC pre-operatively to improve patient care and management

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Abstract number: O02

Accurate and non-contact intraocular pressure assessment using corneal geometry and biomechanics with surface acoustic wave optical coherence elastography (SAW-OCE)

Yilong Zhang[1], Zhengshuyi Feng[1], Robert Scott[2], Ying Yang[3], Zhihong Huang[1]

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3. Keele University, School of Pharmacy and Bioengineering, Stoke-on-Trent, United Kingdom, ST4 7QB

Background, Motivation and Objective: Eyeball intraocular pressure (IOP) reflects the fluid dynamics within the eye, balancing the production and drainage of aqueous humor. Corneal biomechanical properties, notably elasticity, are essential in maintaining its shape and function. Measuring IOP and corneal elasticity is important in the screening of ocular diseases, such as glaucoma and keratoconus. Indentation tonometry is frequently used to assess IOP and biomechanics-related parameters, but requires physical contact or the application of a large air-puff force (~120 mN), potentially leading to cross-infection or discomfort. Moreover, the IOP measurements are often underestimated, and the relationship between the tonometer's estimates and actual biomechanical properties remains unclear. This study aims to develop a more accurate and non-contact assessment of IOP via corneal elasticity and geometry, employing a minimal force air-pulse SAW-OCE.

Methods: In this study, we introduce an inversion model based on Reissner's theory and Hooke's law, enabling the accurate assessment of IOP by integrating corneal elasticity (E) and geometric parameters. These parameters include the radius of applanation area (rp), central thickness (T), corneal radius (R) and apical displacements (δ). Our experimental procedure involved the examination of nine porcine eyeballs. The IOP in these eyes was adjusted to 20 mmHg, 30 mmHg, and 40 mmHg (N=3 per group) by an artificial IOP control system that comprises pressure gauge, infusion tube and pump. The corneal elasticity and geometry of the eyes were measured by the SAW-OCE system. SAW pulse with a maximal force of 4 mN was induced on the corneal surface by an air-pulse system. The air was delivered through a needle with a diameter of 0.4 mm. A customized phase-sensitive optical coherence tomography (PhS-OCT) system with a central wavelength of 1300 nm and a sampling frequency of 21 kHz was applied to capture the geometry and track the SAW propagation signals during air-pulse stimulation. The SAW speed was converted to elasticity using a surface wave equation. Figures (a) and (b) illustrate the structural and filtered elastic wave imaging on a porcine cornea set at an IOP of 40 mmHg. The IOP of these eyes was also measured with a commercially available Schiotz tonometer for comparison.

Results/Discussion: Our measurements of corneal elasticity were 123.5±35.0 kPa, 249.4±12.4 kPa, and 304.6±4.6 kPa across the three IOP levels. These measurements illustrated a direct correlation between increasing IOP and corneal stiffness. Importantly, our results showed that the IOP measurements obtained through the SAW-OCE system for three IOP levels were 21.8±3.6 mmHg, 33.4±3.5 mmHg, and 45.0±4.7 mmHg, respectively. These results aligned more closely with the artificial IOP levels compared to those measured by the Schiotz tonometer (8.5 mmHg, 20.6 mmHg, and 29.0 mmHg). This study demonstrates the capability of the SAW-OCE system in non-invasively assessing corneal elasticity and geometry, facilitated by our inversion model that

significantly enhances the accuracy of IOP measurements. Our findings have significant potential to provide critical information for detecting diseases and evaluating therapeutic outcomes.

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Abstract number: O03

Assessing sensitivity and count-rate performance in Geant4 simulation for total-body PET with different crystals and isotopes

Hanna Borecka-Bielska[1], Aparna Jayaraj[1], Franz Muheim[1], Matthew Needham[1], Adriana Tavares[2,3], Catriona Wimberley[1,2], Benjamin Wynne[1]

1. School of Physics and Astronomy, University of Edinburgh, Edinburgh
2. Edinburgh Imaging, University of Edinburgh, Edinburgh
3. BHF-University Centre for Cardiovascular Science, University of Edinburgh, Edinburgh

Commercially available PET/CT or PET/MRI scanners have a number of limitations due to a short axial field of view (aFOV) typically between 15–25 cm. Total-body PET scanners provide superior sensitivity by allowing to scan the entire human body at the same time without moving the bed position thanks to a long aFOV. The higher sensitivity allows for a shorter data acquisition time with a given dose of the radiopharmaceutical, or for a reduced dose where limiting patient exposure is necessary, e.g. paediatric medicine. We present a simulation of Siemens Biograph Vision Quadra and United Imaging uExplorer models of the total-body PET scanners, implemented using an open source platform for simulation of passage of particles through matter, Geant4. The simulation plays an important role in testing different scanner geometries and materials used, and serves as an input to image reconstruction, which can be compared to real Siemens scanner data available to us. The presentation will cover the effect of using different types of scintillation crystals such as the most popular LSO, LYSO, BGO and NaI, as well as less common and novel crystals like perovskites. Our simulation supports using a number of isotopes as radio-tracers, from F-18 to Rb-82. The presented results comprise the scanner sensitivity and relation between the noise equivalent count rate (NECR) and axial field of view, as well as NECR, true, scatter and random count rates versus activity concentration for different crystal-tracer-model configurations. Additionally, we present the first steps towards establishing a setup for testing perovskites for their use in PET.

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Abstract number: O04

Cerebrovascular reactivity repeatability and analysis method comparison for measurements using 3T BOLD MRI and fixed inhalation gas challenge

Edward Thomson[1], Emilie Sleight[2,3], Keelin Ridge[4,5], Joanna M Wardlaw[4,5], Michael J Thrippleton[4,5], Michael S Stringer[4,5]

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2. Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland
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4. Centre for Clinical Brain Sciences, University of Edinburgh, United Kingdom
5. UK Dementia Research Institute at the University of Edinburgh, United Kingdom

Introduction: Cerebrovascular Reactivity (CVR) assesses blood vessel dilation capability, typically measured using Blood Oxygen Level Dependant (BOLD) MRI with simultaneous End-tidal CO2 (EtCO2) recording[1]. For analysis, general linear models (GLM) adjusted for BOLD response onset against EtCO2 (CVR delay) are most used. Others convolve EtCO2 with a haemodynamic response function, e.g., exponential (τ-GLM)[2] or double-gamma (ΓΓ-GLM)[3] function, thereby varying time-to-peak (TTP) and/or dispersion. Fourier domain (FD-GLM) analysis avoids applying time-shifts, while adding a coherence weighting term (CW-GLM) can suppress noise.4 However, few systematic inter-processing method comparisons exist[1]. We assessed accuracy, precision and repeatability of CVR measurements in healthy volunteers using different processing methods.

Method: Simulations: Based on previous work (https://doi.org/10.7488/ds.3503),5 we determined normal-appearing white matter (NAWM) and subcortical grey matter (SGM) CVR magnitude and delay distributions from an openly accessible dataset (https://doi.org/10.7488/ds/3492, see below). We simulated voxelwise signals adding random Gaussian noise to match temporal contrast-to-noise ratio (tCNR). We varied signal tCNR, dispersion and TTP, calculating CVR magnitude and delay using standard GLM, τ-GLM, ΓΓ-GLM, FD-GLM and CW-GLM.

Repeatability: In each healthy volunteer (N=15, age:28.1±5.5 years, female:53%),5 we acquired two BOLD datasets (TR/TE=1550/30ms, TA=13.5min) during a block-type paradigm (2/3/2/3/2min alternating medical and 6% CO2-enriched air) while recording EtCO2, and a T1-weighted image (TR/TE=2500/4.37ms). We compared standard, τ- and ΓΓ-GLM methods.

Results: In simulations, ΓΓ-GLM most closely approximated simulated CVR magnitude and delay means, followed by the τ-GLM and FD methods (Figure 1). The standard GLM consistently underestimated CVR magnitude and delay.

In vivo, standard GLM gave the highest repeatability for CVR magnitude and delay, followed by ΓΓ- and τ-GLM (Figure 2).

Conclusion: Despite good repeatability, standard GLM consistently underestimated CVR magnitude and delay. While ΓΓ-GLM better accounted for non-linearities, and may be optimal for cross-sectional healthy volunteer studies, future comparisons should evaluate other HRFs and assess the impact of pathology.

Bibliography:

1. Sleight et al., Frontiers in Physiology, 2021, 10.3389/fphys.2021.643468
2. Poublanc et al., Journal of Cerebral Blood Flow & Metabolism, 2015, 10.1038/jcbfm.2015.114
3. Bhogal, NeuroImage, 2021, https://doi.org/10.1016/j.neuroimage.2021.118771
4. Xu et al., NeuroImage, 2023, https://doi.org/10.1016/j.neuroimage.2023.120448
5. Sleight et al., Frontiers in Physiology, 2023, 10.3389/fphys.2023.1070233

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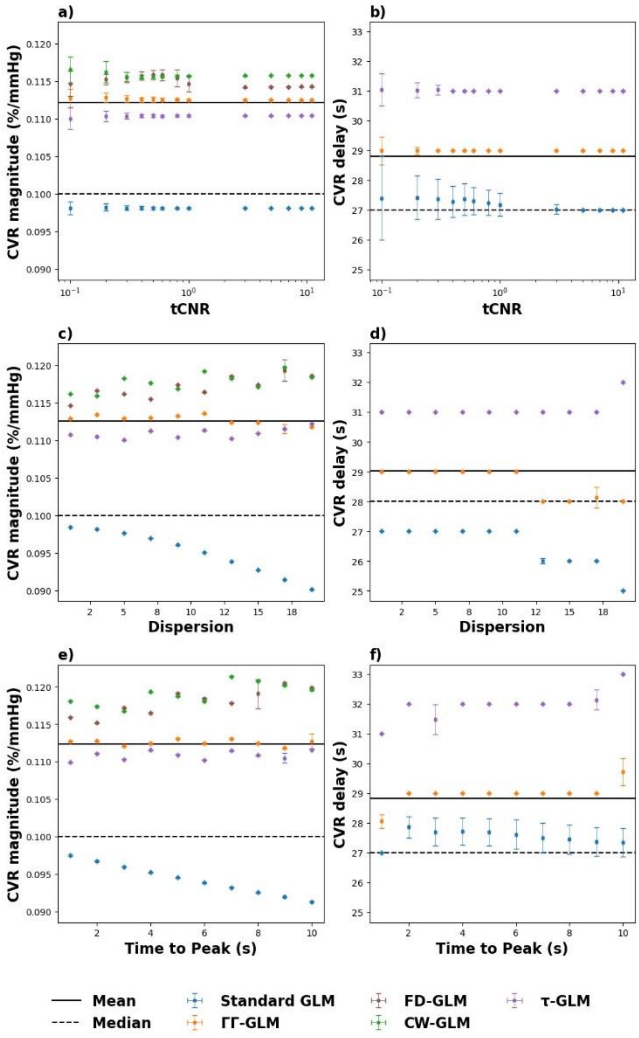

Figure 1: Simulated NAWM ROI processed with each of the 5 methods. CVR magnitude (left) and delays (right) results for varied tCNR (a,b; fixed TTP=0s, dispersion=0), dispersion (c,d; fixed tCNR=2, TTP=1s) and time to peak (e,f; fixed tCNR=2,dispersion=10) with the ground truth mean (solid) and median (dashed) displayed. Points and error bars indicate the mean ± the standard deviation of the estimates across 1000 simulations.

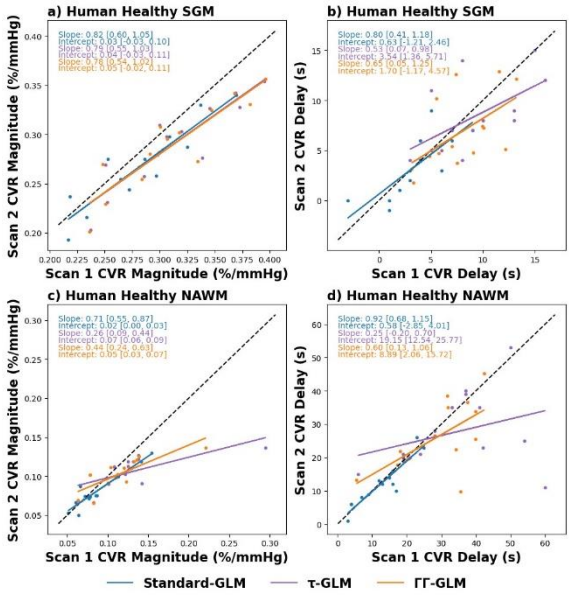

Figure 2: CVR magnitudes (a,c) and delays (b,d) of the human healthy NAWM (c,d) and SGM (a,b) ROIs comparing the 2 scans for the 3 methods. Linear regression lines (solid) show repeatability against unity (Black dashed).

Abstract number: O05

Exploring the impact of input function approaches on kinetic modelling for [18F]SynVesT-1 in mice

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Positron emission tomography (PET) quantifies radiotracer binding, facilitating longitudinal study of pathology in the brain and body. Mouse models of disease are used to study pathology and response to treatment. Generally, PET data for mice is characterised using semi-quantitative parameters such as the standardized uptake value, however it is possible to extract more robust and actionable physiological information. The gold standard for PET quantification is dynamic PET with arterial blood sampling (AIF), which is logistically difficult in the mouse, so ideally methods to extract this information directly from the image should be used. In this study, we have investigated 3 different image derived input function (IDIF) methods to find the optimal technique.

[18F]SynvesT-1 mouse PET scans (n=5) were undertaken. Regional brain time activity curves were extracted, and parameter estimation performed with two tissue compartmental modeling and population based metabolite correction. The following input functions were used: invasive AIF, two manually placed region of interests: left ventricle (LV) and vena cava (VC) and one data driven method: factor analysis (FA). The resulting parameters from the IDIFs were compared with the AIF parameters.

Blood curves were extracted using each method and factor analysis yielded curves most consistent with the AIF [Figure 1]. The estimated volume of distribution (VT) was significantly correlated for all three IDIFs with the AIF, with high R2 values of 0.845, 0.886 and 0.4565 for LV, VC and FA respectively. K1 (tracer transfer into tissue) was also significantly correlated for each method. R2 value of 0.524, 0.992 and 0.9878 and biases of 0.6335, 1.063 and 1.394 [ml/ccm] (based of linear fitting gradient) for each method respectively.

IDIFs are sufficient for extraction of the input function for all three methods investigated, however the estimated parameters from the VC were the most consistent with AIF parameters, albeit with a bias.

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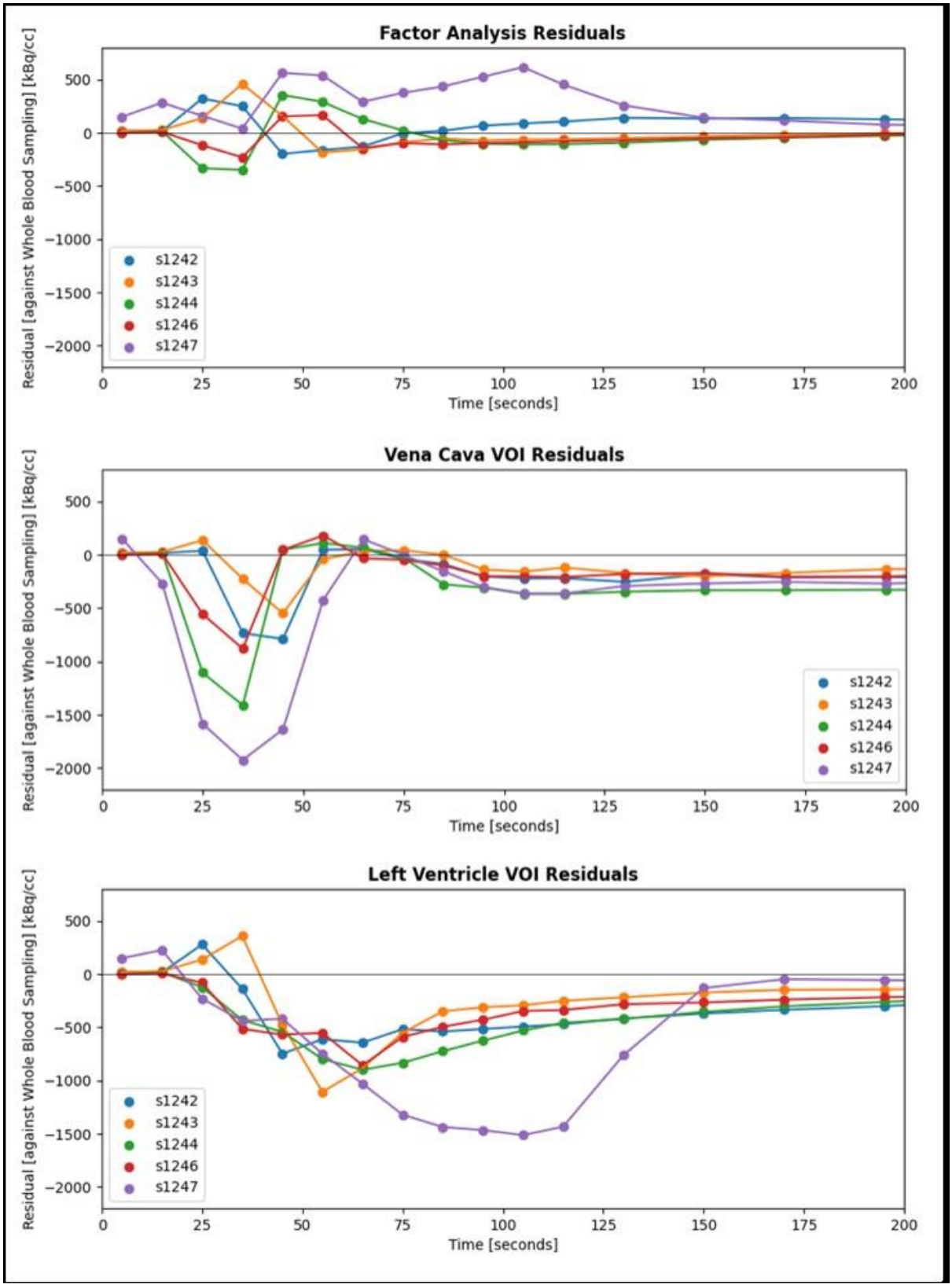
Factor Analysis Residuals
Residual [against Whole Blood Sampling] [kBq/cc]
Time [seconds]
s1242
s1243
s1244
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Vena Cava VOI Residuals
Residual [against Whole Blood Sampling] [kBq/cc]
Time [seconds]
s1242
s1243
s1244
s1246
s1247
Left Ventricle VOI Residuals
Residual [against Whole Blood Sampling] [kBq/cc]
Time [seconds]
s1242
s1243
s1244
s1246
s1247

Figure 1

Abstract number: O06

Peak-width skeletonised microstructural MRI changes and fatigue in relapsing-remitting multiple sclerosis

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Introduction: Relapsing-remitting multiple sclerosis (RRMS) is a chronic neuroinflammatory and neurodegenerative disease in which fatigue is a common disabling symptom. Mechanisms underlying fatigue remain unclear. Peak width of skeletonised (PS) diffusion provides a rapid, fully automated, quantitative MRI measure of microstructural heterogeneity in whole-brain white matter (WM). Longitudinal changes in PS diffusion metrics and their ability to predict fatigue in RRMS are previously unexplored. We assess PS diffusion changes in the initial five years post-diagnosis and their predictive associations with fatigue in RRMS.

Methods: Thirty-one participants (23 female; age 39±12y; DMT-naïve at baseline [Y0]), recently-diagnosed with RRMS, underwent 3T MRI and fatigue assessment (Fatigue Severity Scale [FSS]) at Y0 and 5-years (Y5). WM mean diffusivity (MD), fractional anisotropy (FA), axial diffusivity (AD) and radial diffusivity (RD) skeletons were generated from multi-shell diffusion MRI; the difference between 95th and 5th percentiles was calculated in each skeleton to determine PSMD, PSFA, PSAD and PSRD. WM lesions (WMLs) were segmented on FLAIR. Linear regression was used to assess PS[y5-y0] diffusion changes and determine associations of PS[y5] and PS[y5-y0] diffusion with FSS[y5] score, corrected for age[y0], sex, DMT, and WML[y0].

Results: FSS score (relative mean delta [Δ]18.4%; $t(30)=2.1$; $p<.05$), PSMD (Δ7.5%; $t(30)=3.4$; $p<.01$), PSFA (Δ1.1%; $t(30)= 3.3$; $p<.01$), PSAD (Δ3.0%; $t(30)=3.3$; $p<.01$) and PSRD (Δ2.8%; $t(30)=2.7$; $p<.05$) significantly increased over time. PSMD[y5-y0] ($t(25)=2.1$; $p<.05$) and PSAD[y5-y0] ($t(25)=2.5$; $p<.05$) were significantly associated with FSS[y5], but PSFA[y5-y0], PSRD[y5-y0] and PS-all[y5] were not ($p>.05$).

Discussion: Our results in this small cohort indicate that PS diffusion is sensitive to general WM microstructure (PSMD), tract directionality (PSFA), axonal (PSAD) and myelin (PSRD) injury in the initial five years post-RRMS diagnosis, suggesting potential for PS diffusion metrics as biomarkers of neurodegeneration. Furthermore, general microstructural WM and axonal injury was associated with fatigue, suggesting a role for neurodegeneration in MS-related fatigue.

Acknowledgments: With special thanks to all FutureMS participants who have made this study possible. FutureMS was hosted by Precision Medicine Scotland Innovation Centre and funded by the Scottish Funding Council and Biogen Idec Ltd Insurance. Additional funding came from the MS Society Edinburgh Centre for MS Research, Anne Rowling Regenerative Neurology Clinic, Chief Scientist Office, and Wellcome Trust.

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Abstract number: O07

Cerebrovascular Reactivity Delay in Small Vessel Disease: A Cross-Sectional Study

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Introduction: Small vessel disease (SVD) causes cerebral microvascular impairment and c.25% of strokes[1]. Patients with worse SVD have lower cerebrovascular reactivity (CVR) [2], brain vessel response to a vasoactive stimulus e.g., hypercapnic challenge during blood oxygen level dependent (BOLD)-MRI[3,4,5]. However, the role of CVR delay remains unclear. In this exploratory analysis, we investigated cross-sectional relationships between CVR delay and SVD features, cognition and clinical scores in patients with SVD.

Methods: We used data from Mild Stroke Study 3, in which patients up to 3-months post-mild ischaemic stroke[6] underwent structural MRI to assess SVD burden using STRIVE-1 criteria[7], CVR using hypercapnic gas-challenge during BOLD-MRI[2,4], cognitive (Montreal Cognitive Assessment [MoCA]; Trails A/B) and clinical (National Institutes of Health Stroke Scale [NIHSS]; modified Rankin scale [mRS]) evaluations.

We performed multivariable linear regression analyses between CVR delay (outcome) in subcortical grey matter (SGM), normal appearing white matter (NAWM) and WMH (white matter hyperintensities) and SVD feature/cognitive/clinical variable (independent), adjusting for age, sex, mean arterial pressure and key vascular risk factors. We log-transformed PVS, WMH and brain volumes normalised to region of interest or intracranial volume respectively to ensure normality of residuals.

Results: We report coefficients and 95% confidence intervals (Figures 1-2). We found longer NAWM delays in patients with lower brain volume, more microbleeds, higher trails B score and trails B/A ratio. In SGM, delay tended to be longer in patients with higher basal ganglia PVS volume and lower mRS. WMH delays were shorter in participants with higher superficial atrophy scores.

Conclusion: While most SVD variables were not associated with CVR delay we found some plausible associations e.g., longer NAWM delays with reduced executive function. Noise and susceptibility to systematic bias[8] may affect CVR delay calculation. More robust and accurate methods, optimised for patient datasets, may be needed to elucidate associations between delay, SVD markers.

References:

1. J.M. Wardlaw et al. Small vessel disease: mechanisms and clinical implications. Lancet Neurol. (2019) doi: 10.1016/S1474-4422(19)30079-1
2. M.J. Thrippleton et. Al. Cerebrovascular reactivity measurement in cerebral small vessel disease: Rationale and reproducibility of a protocol for MRI acquisition and image processing. Int. J. Stroke (2018) doi: 10.1177/1747493017730740.
3. E. Sleight et al. Cerebrovascular Reactivity Measurement Using Magnetic Resonance Imaging: A Systematic Review. Front. Physiol. (2021) doi: 10.3389/fphys.2021.643468.
4. E. Sleight et al. Cerebrovascular Reactivity in Patients With Small Vessel Disease: A Cross-Sectional Study. Stroke (2023) doi: 10.1161/STROKEAHA.123.042656.
5. G.W. Blair et al. Intracranial hemodynamic relationships in patients with cerebral small vessel disease. Neurology (2020) doi: 10.1212/WNL.0000000000009483.
6. U. Clancy et al. Rationale and design of a longitudinal study of cerebral small vessel diseases, clinical and imaging outcomes in patients presenting with mild ischaemic stroke: Mild Stroke Study 3. Eur. Stroke J. (2021) doi: 10.1177/2396987320929617
7. J.M. Wardlaw et al. Neuroimaging standards for research into small vessel disease and its contribution to ageing and neurodegeneration. Lancet Neurol. (2013) doi:10.1016/S1474-4422(13)70124-8
8. E. Sleight et al. Cerebrovascular reactivity measurements using 3T BOLD MRI and a fixed inhaled CO2 gas challenge: Repeatability and impact of processing strategy. Front. Physiol. (2023) doi: 10.3389/fphys.2023.1070233.

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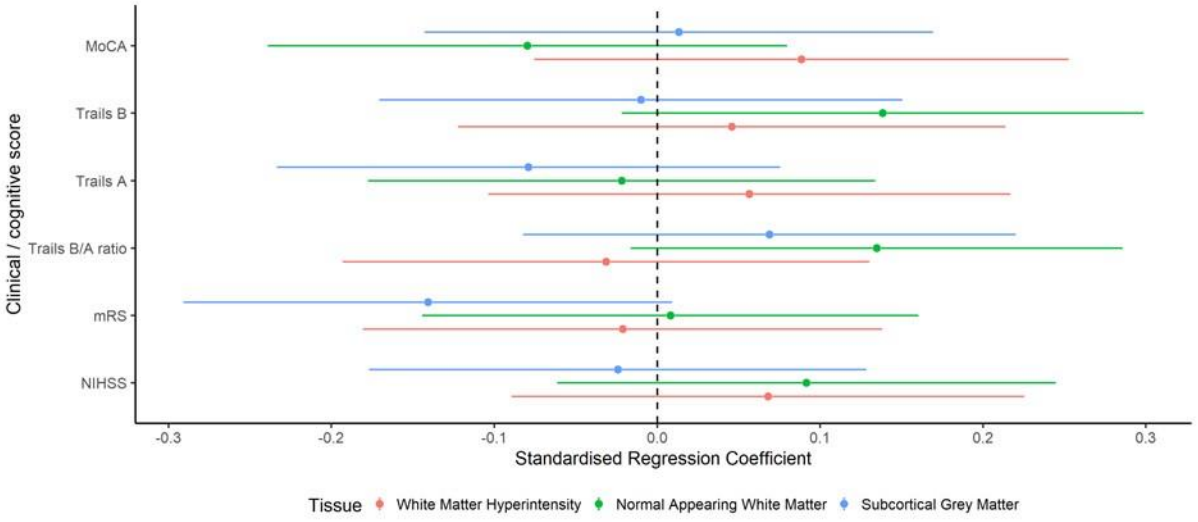

Figure 1: Standardised regression coefficients (dots) and 95% CIs (horizontal lines) obtained from analyses between cognitive and stroke severity scores and SGM, NAWM and WMH CVR delay. The vertical black dashed line represents a coefficient of zero (no association).

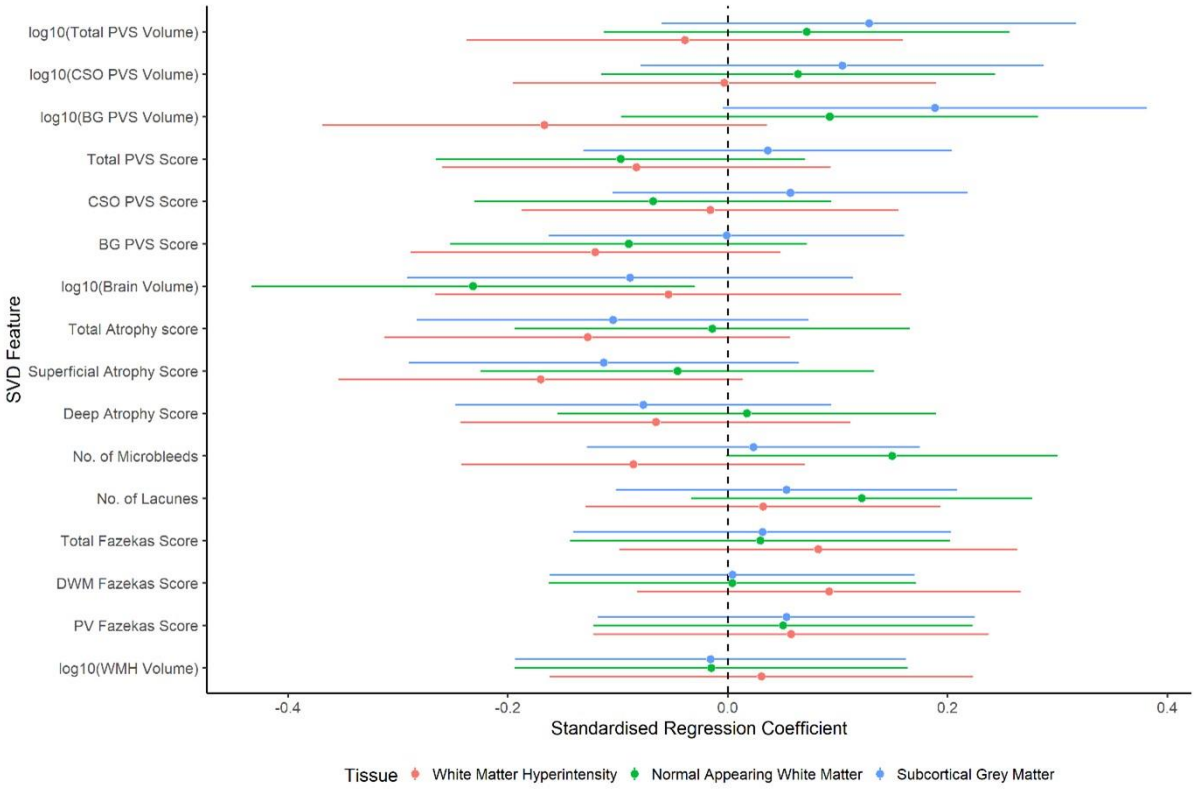

Figure 2: Standardised regression coefficients (dots) and 95% CIs (horizontal lines) obtained from analyses between imaging features and SGM, NAWM and WMH CVR delay. The vertical black dashed line represents a coefficient of zero (no association). Fazekas scores were assessed in deep white matter (DWM) and periventricular white matter (PV). PVS volumes and count were measured in the basal ganglia (BG) and centrum semiovale (CSO). PVS volumes were normalised to the ROI volume and WMH and brain volumes to the intracranial volume.

Abstract number: O08

Neural Correlates of Children with Avoidant Restrictive Food Intake Disorder (ARFID) Symptoms: Large-Scale Neuroanatomical Analysis of a Paediatric Population

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Background: Avoidant restrictive food intake disorder (ARFID) is a recently recognized feeding or eating disorder and is characterised by a lack of interest and motivation to eat. Despite burgeoning research, few studies to date have explored the underlying neurobiology of ARFID. Research examining the neural underpinnings of ARFID can greatly assist in understanding different mechanisms that play disorder-specific roles.

Methods: We studied a total of 1,977 10-year-old participants from the Generation R Study, a population-based Dutch cohort, to cross-sectionally examine neuroanatomical differences between those with versus without ARFID-like symptoms. Children were classified with versus without ARFID symptoms using the ARFID Index, a validated evaluative tool comprised of parent-reported and researcher-assessed measurements of picky eating, energy intake, diet quality, growth and psychosocial impact to characterise ARFID symptoms in the paediatric population. Global and regional values of surface area, cortical thickness, and volume from T1-weighted structural magnetic resonance imaging (MRI) scans in those with ARFID symptoms were compared with children not exhibiting symptoms.

Results: We identified 121 (6.1%) individuals with ARFID symptoms relative to 1,865 (93.9%) individuals without ARFID symptoms. Neuroanatomical findings identified significantly increased global (p=0.0486; d=0.13) and frontal (p=0.00743; d=0.21)/superior frontal (p=6.56E-04; d=0.28) cortical thickness, as well as increased medial orbitofrontal cortex (OFC) thickness (p=0.0352; d=0.17) among children with ARFID symptoms.

Conclusions: This study identified structural alterations in children with ARFID symptoms. Increased cortical thickness suggests differential development of cortical regions relative to those without symptoms occurring in regions pertinent to perception, executive function, and the development of goal-oriented behaviour.

Acknowledgements: We would like to express our thanks and sincere gratitude to the Northwood Charitable Trust for funding the PhD studentship and subsequent research for MS (Author 1). We would also like to thank the Generation R Study and team for collaborative work in this study. The Generation R Study is conducted by Erasmus MC, University Medical Center Rotterdam in close collaboration with the School of Law and Faculty of Social Sciences of the Erasmus University Rotterdam, the Municipal Health Service Rotterdam area, Rotterdam, the Rotterdam Homecare

Foundation, Rotterdam and the Stichting Trombosedienst & Artsenlaboratorium Rijnmond (STAR-MDC), Rotterdam. We gratefully acknowledge the contribution of children and parents, general practitioners, hospitals, midwives and pharmacies in Rotterdam.

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Abstract number: O09

"Is it not the collective that's most important?": Identifying perceptions, motivators, and barriers of older adult research participants in cognitive neuroscience

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Academic research participants in are often recruited using convenience sampling, residing around the testing site. Research samples can therefore become biased in terms of demographics (age, education, socio-economic status), and the interpretation of study results falsely generalised to the wider population. This mixed methods study aimed to identify effective routes to widening participation for older adults in cognitive neuroscience research across two focus groups of adults aged over 55 years old, and via an online questionnaire in 335 adults aged 18-88. The older adult focus groups emphasised the importance of 1) Having sufficient information about the aims, procedure, and safety of the study, 2) Distinguishing between medical and non-medical research, and 3) Contributing to the "collective good". This was echoed in the questionnaire, with older people reporting a strong desire to help other people, whereas young people reported financial incentives as a stronger facilitator for participation. The barriers for older people mainly centred around mobility issues, whereas young people reported having less available time, were less trusting of the researchers and were more concerned about discomfort and pain. Generally, older people expressed more positive attitudes towards taking part in imaging studies relative to the youngest groups, but some imaging methods (non-invasive brain stimulation and MRI) evoked more negative emotions than others (EEG and eye tracking). Context was also important, with academic research settings eliciting stronger feelings of excitement and interest compared to medical settings. These results are informative for researchers who wish to recruit participants across different age groups into studies involving a range of imaging modalities. This could help to improve the diversity of participants and widen participation to groups who have been traditionally under-represented in cognitive neuroimaging research.

Acknowledgements: Wellcome Trust & ScotPEN

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Abstract number: O10

Examining the impact of efference and afference on saccade-induced EEG Modulation

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Microsaccades have become a valuable tool in investigating EEG activity during tasks necessitating monitoring of eye fixation. Previous studies have suggested that fixational eye movements can modulate the spectral power in the EEG signal. However, the precise contribution of motor processing, sensory input, or their combination remains unclear. This uncertainty is particularly pertinent given the considerable spatial variability of visual stimuli across experiments, reflecting diverse sensory inputs. Our study seeks to determine whether the proximity of the fovea to high-contrast visual stimuli following a saccade and saccade magnitude influences EEG activity systematically.

Examining data from a neurofeedback experiment involving a Posner reaction time task and tACS stimulation, we focused on microsaccades during the 2.5-second cue period of the Posner task and the 120-second neurofeedback task. Microsaccades were classified into leftward and rightward directions and subsequently divided into 'close' and 'far' categories based on their proximity to lateralised visual stimuli, as well as 'large' and 'small' categories based on saccade amplitude. Employing a repeated measures cluster-based permutation test, we statistically evaluated the time-frequency response across saccade conditions for both directions.

The results revealed a main effect of saccade magnitude for leftward saccades during the Posner task, but a main effect of proximity to visual stimuli for saccades during the neurofeedback task. This suggests that both efference and afference play a role in saccade-related EEG modulation in a task-dependent fashion. The varying nature of each task's visual properties, particularly with higher contrast salient features, may induce modulations in the EEG signal to different degrees. These results also highlight the importance of considering eye movements when analysing and designing EEG studies, specifically those utilising signals associated with visual processing networks.

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Abstract number: O11

Around the Clock: Physiological Markers of Lapses in Attention During Sustained Task Performance

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Too often still, people lose their lives or livelihoods in tragic accidents that have their root causes in lapses of attention. With today's technology, the development of assistance systems which can detect attentional lapses and prevent such accidents should be viable. One way to achieve this is to use objective, physiological signals in which sudden changes may indicate an imminent lapse.

Our study aims at identifying physiological markers that are maximally diagnostic and reliable. We simultaneously record electroencephalographic (EEG) activity and changes in pupil size as we monitor performance in modified versions of two sustained attention paradigms: the Mackworth Clock Task and the Sustained Attention to Response Task. In both monotonous tasks, participants are required to stay focused for a long period of time and respond appropriately to infrequent target events.

Preliminary results thus far support our preregistered predictions: in the seconds preceding a miss (or misresponse) – when we assume that participants were not paying attention – we observe an increase in activity in the alpha frequency band (8-14Hz) in occipital electrodes, a marker previously associated with attentional focus, and a change in pupil diameter, a marker previously associated with neuromodulatory arousal. Furthermore, we observe time-on-task effects in both the EEG and behavioural data: a steady increase in alpha power and reaction time as participants generally become fatigued. Further analyses will target other measures such as the spectral slope of the EEG power spectrum that indexes excitability fluctuations and how different measures can be combined to increase reliability. Finally, comparing the data between the two tasks will provide insights into how much any given diagnostic marker generalises across situations with different response demands.

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Abstract number: O12

Temporal enhancement features on Contrasted Enhanced Mammography (CEM) accounting for background enhancement: Comparison with breast MRI

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Background: Contrast enhanced mammography (CEM) is a functional imaging technique with similar accuracy to MRI. Previous work suggests CEM quantitative temporal enhancement values using both freehand-ROIs and oval-ROIs follow a similar pattern to MRI time-intensity curves. We investigate whether subtracting background enhancement, a pre-enhancement image substitute, improves accuracy.

Methods: Enhancing mass-lesions on CEM with contemporaneous MRI studies were included. Two MLO views were acquired, 3 and 9-minutes post-contrast administration. Segmentation of background-ROIs and CEM lesions (oval and freehand-ROIs) were performed on both views by a radiologist blinded to MRI. Lesion enhancement was subtracted from background enhancement, the mean, 90th and 99th centile greyscale values (GSV) recorded, and temporal change calculated. Differences between CEM temporal enhancement according to MRI-curve type were calculated using a Mann Whitney U test.

Results: Of 55 lesions segmented, 19 produced type-1 curves and 35 type-3 curves. A solitary type-2 curve lesion was excluded. With respect to oval-ROIs, lesions with MRI type-1 curves demonstrated increasing CEM mean, 90th and 99th centile GSVs, lesions with type 3 curves demonstrated decreasing mean, CEM 90th and 99th centile GSVs with significant variation between MRI cohorts, $p<0.05$. However only mean and 90th centile GSVs demonstrated significant differences with the freehand-ROIs. Greatest variation was seen for oval-ROI 90th centile: temporal GSV 1.53 vs -8.90, $p=0.003$ and oval-ROI 99th centile: temporal GSV 0.68 vs 1.53, $p=0.005$, for type-1 and type-3 curves respectively.

Discussion: Significant differences in CEM temporal GSV are demonstrated between MRI curve types. Accuracy is not improved by subtracting background enhancement.

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Abstract number: O14

Enhancing Medical Imaging and Surgical Precision with Machine Learning: A Case Study on MRgFUS Thalamotomy

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The application of machine learning (ML) in healthcare is setting new standards for medical diagnostics and treatment strategies. This study illustrates the impact of ML through a case study on Magnetic Resonance-guided Focused Ultrasound (MRgFUS) thalamotomy for essential tremor, highlighting two primary benefits: anatomical bias reduction and treatment tailoring.

Utilizing convolutional neural networks (CNNs), our approach improves surgical targeting by analysing post-operative MRI scans from a dataset of 129 scans across 30 patients. This method demonstrates the removal of anatomical bias, allowing for more precise and effective interventions. Additionally, our preliminary models suggest the potential to simulate future treatment outcomes. This predictive capability offers a unique opportunity to 'test' and refine treatment plans for individual patients, potentially enhancing therapeutic success rates.

These findings not only advance the specific field of MRgFUS thalamotomy but also underscore the versatile benefits of ML in healthcare. By enabling more accurate and personalized treatment strategies, ML technologies promise to significantly improve patient care across various medical disciplines.

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Abstract number: O15

Improvements in R1 mapping at ultra-low field using denoised and motion corrected field-cycling MRI in brain

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Field-cycling imaging (FCI) is an emerging whole-body MRI technology. FCI makes it possible to acquire images across multiple ultra-low magnetic field strengths below 0.2 T and interrogate ultra-low field endogenous R1 (1/T1) contrast in-vivo. The objective of this work was to examine whether translated motion correction and denoising approaches improve the sensitivity and accuracy of R1 mapping performed in brain and small vessel disease (SVD).

Thirteen participants were recruited with moderate or severe SVD. Each participant underwent 3T MRI (Philips 3T dStream) and FCI scans at the same visit. For each single slice FCI scan, 20 images were acquired across evolution fields of 0.2, 2, 20, and 200 mT. R1 maps were generated using a multifield fitting approach for data with and without motion correction (SPM12) and denoising approaches applied (BM3D or MATLAB dnCNN: denoising convolution neural network).

Tissue label maps of white matter (WM), grey matter (GM) and white matter hyperintensity (WMH) associated with SVD, were generated from 3T MRI images and co-registered to images obtained from FCI. Sensitivity was quantified as effect size, a measure of degree of separation between R1 histogram distributions extracted from regions of WM and WMH. Improvements to sensitivity and goodness of fit were examined.

Application of motion correction and denoising improved goodness of fit (Fig.1A). The effect size between WM and WMH SVD regions was improved with addition of denoising approaches (Fig.1B). Greatest improvement in effect size (percentage difference of 62.5, 43.6 - 78.2 %) was observed with motion correction and dnCNN applied. A significant difference ($P < 0.001$) was observed between R1 values obtained from WM and WMH SVD at each field (Fig. 2).

Use of motion correction and denoising approaches improves the sensitivity and fitting accuracy of R1 mapping performed at ultra-low magnetic field strengths using field-cycling MRI.

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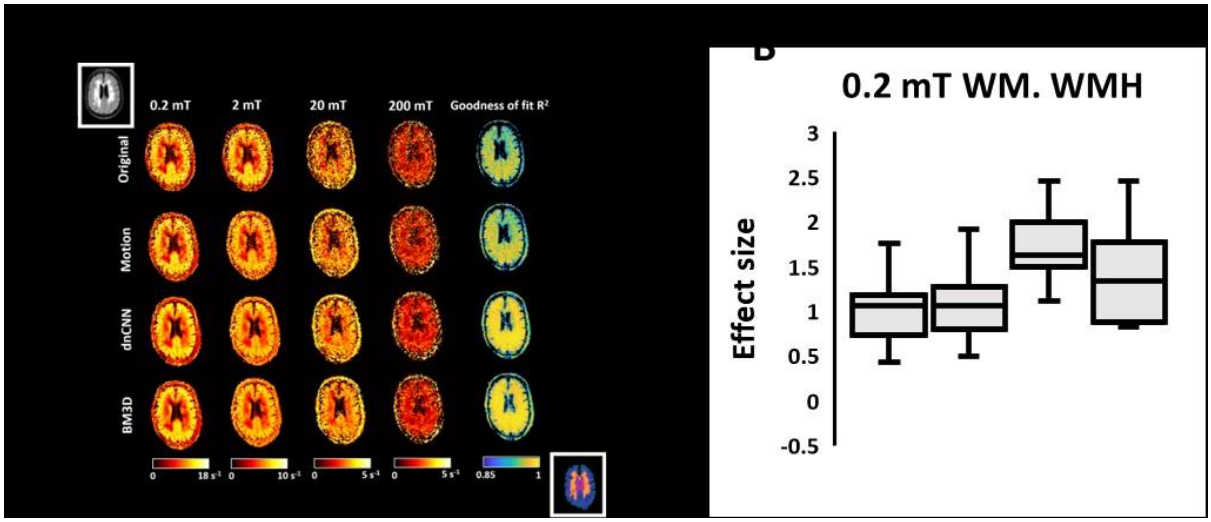

Figure 1: R1 mapping improvement. A) Rows 1-4 corresponds to four preprocessing methods. Motion correction was applied before each denoising approach. Columns 1-4 contain R1 maps generated at each magnetic field strength. The 3T MRI FLAIR image and tissue label map are shown. SVD WMH is orange on the tissue label. B) Box whisker plot for cohort effect size.

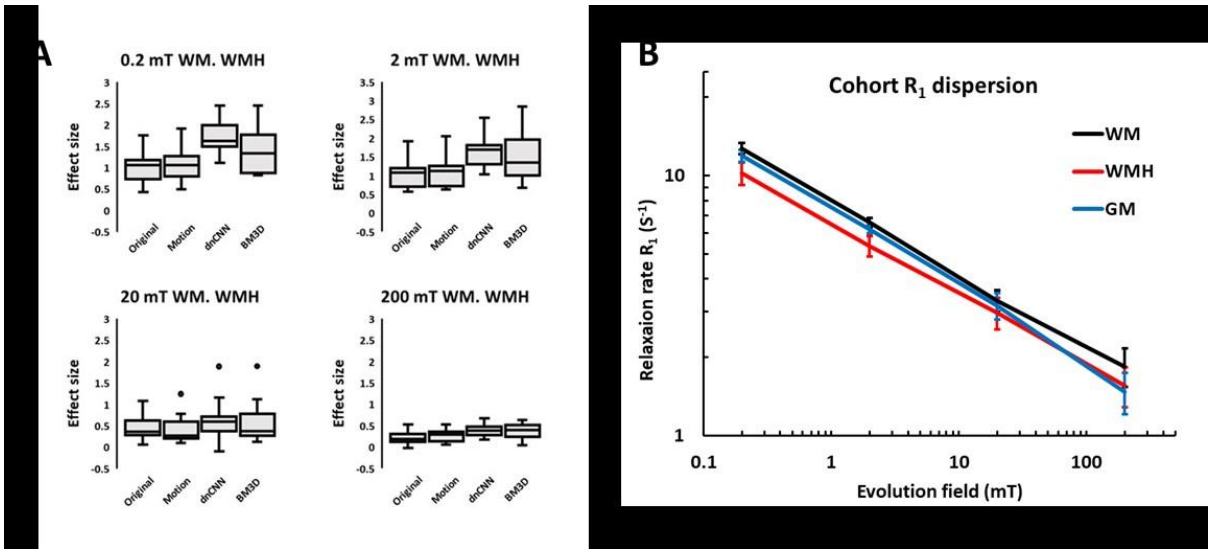

Figure 2: Differences in R1 between tissue types. A) Box whisker plot for average R1 value extracted from WM and WMH regions (motion correction and DnCNN applied). A significant difference ($P < 0.001$) was obtained for each comparison. B) Dispersion of R1 values with magnetic field strength for each tissue region (cohort mean ± SD).

Abstract number: O16

M1-PMd connectivity modula6on via fMRI-neurofeedback

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Neurofeedback (NF) used at rest could serve as a mean to explore the connection between resting state connectivity, task-related connectivity, and task performance. Evidence shows greater M1-PMd connectivity is associated with superior performance in action selection (AS). However, the causal relationship has not been thoroughly examined. Therefore, this study aimed to determine if M1-PMd connectivity could be modulated through covert fMRI-NF during rest, subsequently affecting cognitive-motor connectivity and behaviour. 20 adults took part in this counterbalanced within-subject double-blind study. Participants were trained covertly on 3T fMRI-NF in two separate conditions, one month apart: increase and decrease M1-PMd connectivity. The NF training consisted of three runs in each condition, and participants were given a monetary reward at the end of each run depending on their performance. No main effect of condition, NF run, nor order was found. Only an interaction between order and run was found to be significant ($F(2,34) = 3.80$, $p=0.03$), implying that participants starting with the increase condition, overall decreased their connectivity more than those starting with the decrease condition (Fig. B). No significant changes were induced on neither AS-related connectivity nor AS performance. A positive correlation between reward sensitivity and NF performance in the decrease condition was found. We conclude that due to potential ceiling effects, more training might have been necessary to make to desired link between rest connectivity, task connectivity and task performance. This study, however, brings key insight into NF success variability.

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Abstract number: O17

A poly-vinyl Alcohol (PVA)-based phantom for prostate cancer detection using multiparametric ultrasound: a validation study

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Background: Multiparametric ultrasound (mpUS) is an advanced medical imaging procedure utilizing multiple ultrasound images to improve diagnostic assessment. It is commonly used in assessing prostate cancer (PCa). Tissue-mimicking materials (TMM) phantoms have traditionally been preferred over animal or cadaver models for medical imaging instrumentation training, validation, and quality assurance. This is due to ethical concerns and human and animal body structure variations. The aim is to assess the physical properties of PVA with different molecular weights (Mw) and create a mpUS phantom.

Methods: Create four samples with 10%(w/v) PVA with high and low Mw. Two of the four contain 10%(w/v) Glycerol, and all samples contain 1%(w/v) Silicon carbide (SIC) and 0.5%(w/v) Aluminium oxide (Al2O3) with a 0.3-micron particular size. creating a mpUS phantom consisting of prostate mimic tissue with two inclusions (isoechoic and hypoechoic) and vessels mimic tissue. Supersonic ultrasound, strain elastography ultrasound, and Doppler ultrasound were used to scan the phantom. Patients' data on prostate cancer using radical prostatectomy and shear-wave elastography was used to validate the findings.

Result: the acoustic properties of the PVA depend on the enhancer material, such as glycerol and Al2O3. The range of speed of sound and attenuation coefficient of the low Mw PVA sample with and without glycerol is 1547.50±2,1553.70±2.2, m/s, and 0.63±0.05, 0.61±0.062 dB/cm at 5 MHz, respectively. While the range of speed of sound and attenuation coefficient of the high Mw PVA sample with and without glycerol 1555±2.82 and 1566±4.5 m/s and 0.71±0.02, and 0.73±0.046 dB/cm at 5MHz, respectively. The range of the young's modulus for the samples is from 11 ± 2 to 82.3 ± 0.5, from 1 to 10 Freeze-Thaw cycle (FTC). The Young's modulus obtained by shear wave elastography Us of isoechoic inclusion, prostate mimic tissue, and surrounding tissue was 91.6 ± 5.5, 47.65 ± 3.67, and 20.75 ± 3.6, respectively. in the flow phantom, the average velocity measurement was 94.6 ±9, 25.5 ± 3, and 23.5 ± 4.12 for the peak systolic velocity and end-diastolic velocity mean velocity, respectively.

Conclusion: PVA mixed with glycerol, SIC, and Al2O3 provides a phantom with optimal properties identical to those of normal and abnormal prostate tissue, blood vessel tissue, and soft tissue. This creates a multiparametric ultrasound phantom.

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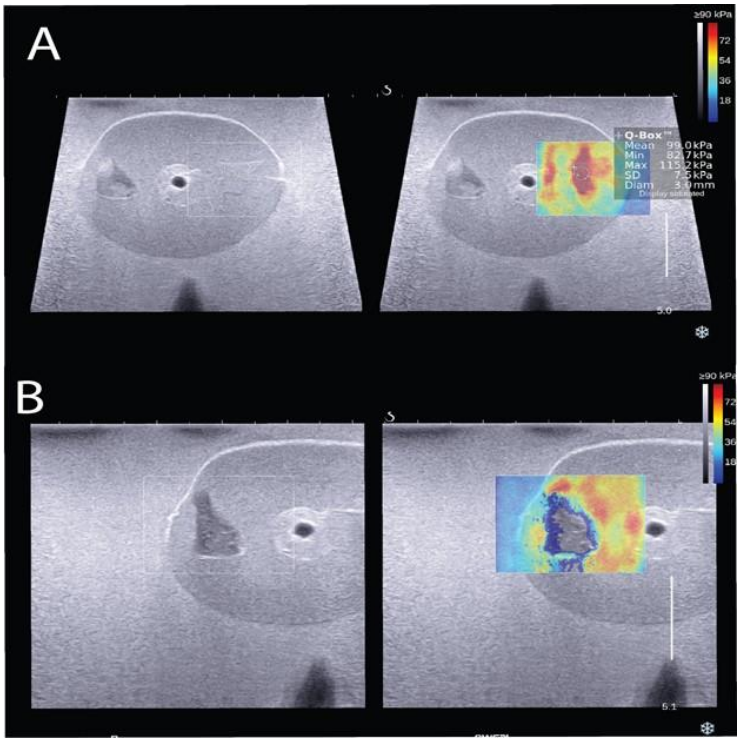

Figure 1: Young's modulus estimation of the inclusions: isoechoic inclusion (A) hypoechoic (B) in mpUS phantom using ShearWave elastography ultrasound.

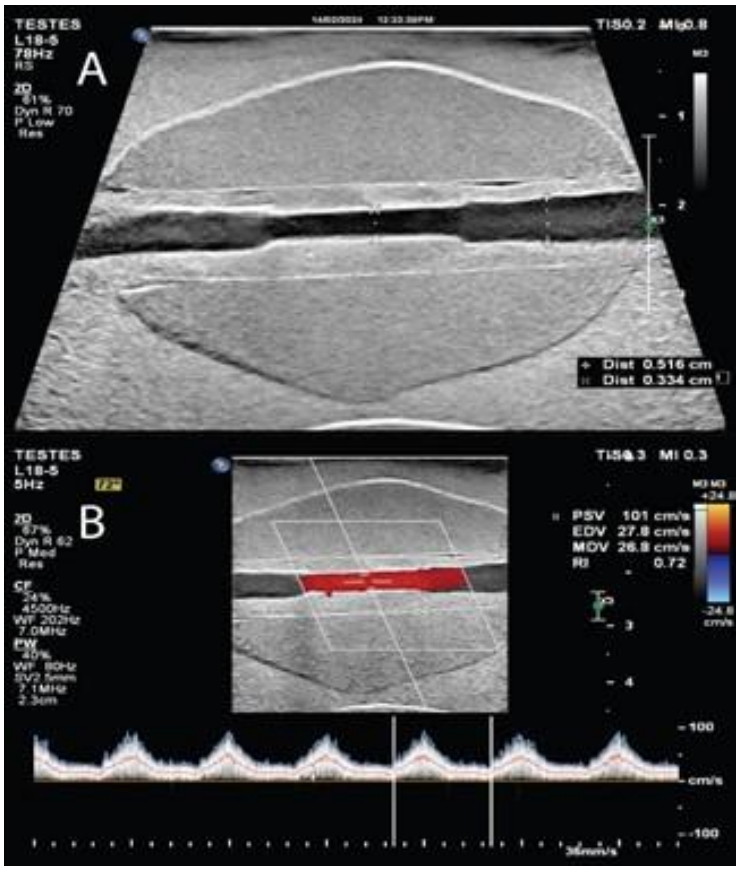

Figure 2: Doppler US image of the mpUS phantom used as flow phantom with steady flow rate. (A) measured of the inner diameter for the blood vessels tissue. (B) measurement of the peak systolic velocity and median velocity.

Abstract number: O18

Imaging Modalities of a Thiel Heart

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Introduction: In the University of Dundee's Thiel embalmed cadavers, we can achieve extracorporeal perfusion of both the arterial and venous circuits facilitating a patent vascular system. This makes it possible to perform multimodality imaging and a wide range of surgical interventions, while providing a training model that can follow current clinical pathways where pre-interventional imaging is required. We aimed to explore the imaging modalities that are possible on a Thiel embalmed cadaveric heart.

Methods: Various imaging modalities were explored including cardiopulmonary endoscopy, fluoroscopy, conventional computed tomography (CT), Micro-CT (Figure 1.), intravascular ultrasound (IVUS) and photon-counting CT (PCD CT). Conventional CT was used to assess the vasculature of the cadaver to assess suitability of its use for cardiac training and research. The left and right coronary arteries were cannulated and imaged by injecting iodine contrast into each to assess patency. PCD CT was used to image the heart post dissection with images being taken at different energy levels 40keV-140keV (Figure 2.).

Results: The perfused Thiel embalmed cadaver enabled multiple imaging modalities to be successfully performed on a cadaveric heart. The conventional CT imaging allowed for this cadaver to be selected for further research due to the extensive coronary artery calcification and right coronary artery stent visualisation. PCD CT was used to assess coronary calcification using different energy levels more accurately from a single CT acquisition thus minimising radiation dose.

Discussion: The University of Dundee's Thiel embalmed cadaver allowed multimodality imaging and provides a clinically relevant training model. This allows clinicians and researchers to perform interventions and imaging on anatomy that is as close to a living cardiovascular system as possible. The wide range of imaging modalities used in this study has demonstrated the ability to simulate clinical interventions that have the potential to improve diagnosis and treatment of patients.

Acknowledgements: All cadaveric research is conducted in compliance with relevant anatomical legislation, with donors having given their consent in accordance with the Anatomy Act (1984) and the Human Tissue (Scotland) Act (2006).

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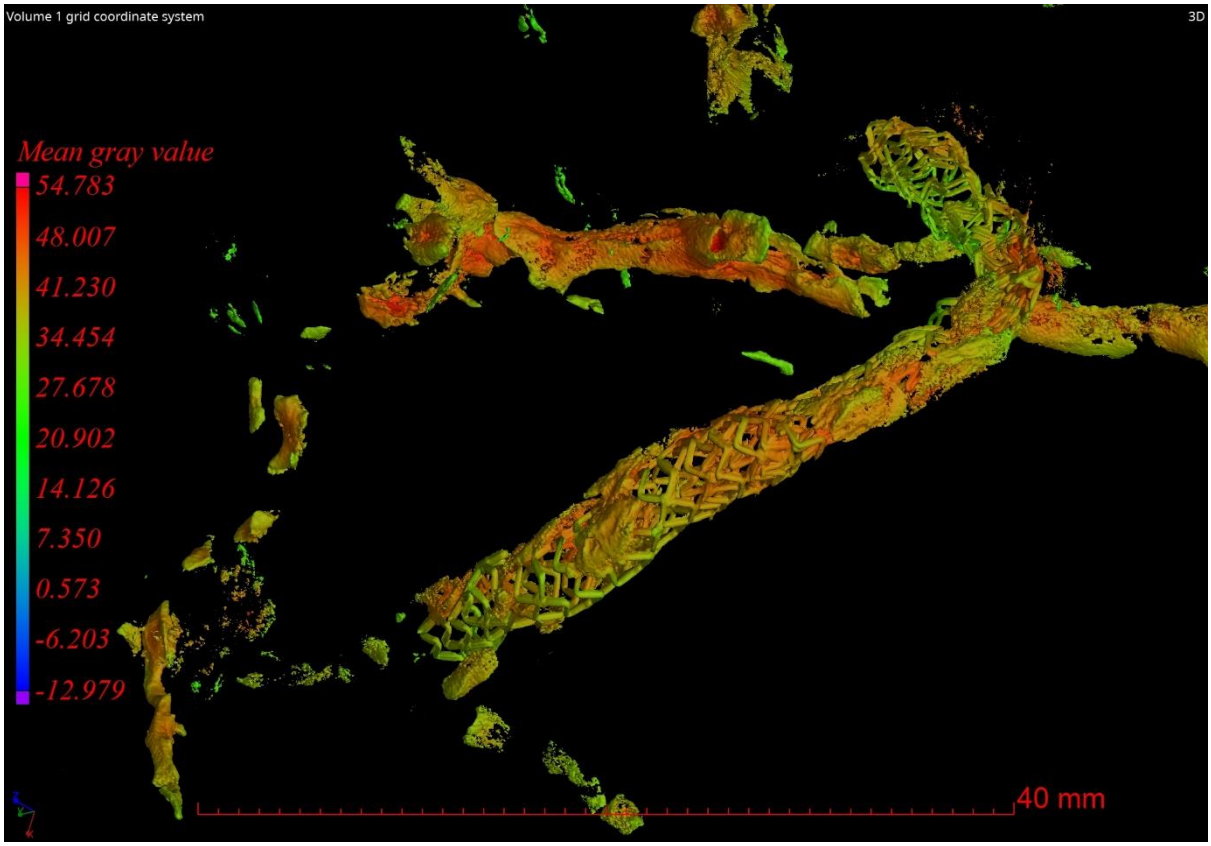

Figure 1

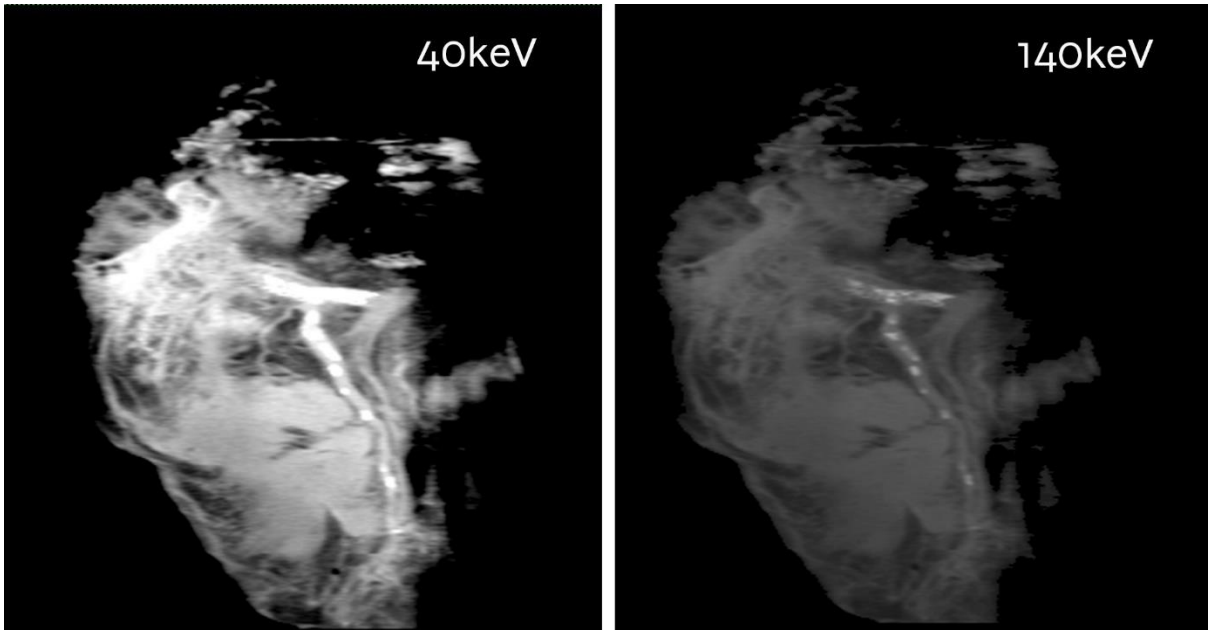

Figure 2

Abstract number: O19

Enhancing Transcranial Focused Ultrasound: Performance Analysis Based on Reconstructed CT-Derived Skull Acoustical Properties

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Background: Focused ultrasound (FUS) is increasingly recognized for its potential in neuromodulation by targeting specific brain areas with acoustic energy. However, the complex anatomy of the skull introduces significant uncertainties in transmission efficiency and targeting accuracy. This study introduces a comprehensive framework using computed tomography (CT) imaging to analyse and reconstruct skull acoustical properties, thereby evaluating the impact on acoustic transmission and enhancing the precision of FUS applications.

Methods: CT data from 20 skulls were analysed using a proprietary segmentation method developed in-house to reconstruct parameters such as skull thickness, radiodensity ratio, and mass density. Acoustic speeds were measured at 84 distinct locations, facilitating a correlation between skull bulk density and the speed of sound. These acoustical properties informed a mathematical model emulating continuous wave propagation through three distinct skull layers. And a k-Wave simulations model to calculate the transmission efficiency. Both results were empirically validated through 3D acoustic field mapping experiments.

Results: The reconstructed images of skull acoustical properties highlighted variations in porosity and vascular structures within the trabecular bone, critical for understanding ultrasound transmission. The transmission efficiencies calculated and simulated showed strong concordance with experimental measurements, confirming the model's reliability across frequencies ranging from 100kHz to 1000kHz. Notably, fluctuations in transmission efficiency were attributed to wave interactions influenced by variations in skull thickness and transducer-skull spacing. Our analysis framework effectively identifies optimal FUS transmission locations and appropriate thresholds for transmitted acoustic energy, providing invaluable insights for in vivo neuromodulation research.

By leveraging detailed CT-based reconstructions of skull acoustical properties, this study significantly advances the precision of transcranial focused ultrasound for therapeutic neuromodulation, offering a robust methodological framework for future clinical research and application.

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Abstract number: O20

MRgFUS volumetric dosimetry from 2D thermometry

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Magnetic resonance-guided Focused Ultrasound (MRgFUS) for essential tremor (ET) relies upon accurate interoperative monitoring of the temperature rise induced by ultrasound at the intended neurosurgical target. The goal of MRgFUS for ET is to deliver enough acoustic energy to the target to induce a permanent brain lesion at the target (which has the effect of reducing tremor with minimal side effects).

MRgFUS is minimally invasive. Ultrasound is delivered via a hemispherical array transducer to a target in the deep brain while the patient is in an MR scanner. During the operation, the neurosurgeon uses thermometry derived from MR phase maps to indicate the position of the ultrasonic focus in the brain, and as an indicator of dose delivered.

Each procedure consists of about 7-10 sonications. Early sonications are used to locate the target and assess ET response to thermal neuromodulation- energy is delivered and brain tissue at the target heated, but not by enough to induce a lesion. After target engagement is confirmed, the final sonications deliver enough energy to lesion the target.

Actual thermal doses delivered can be calculated post operatively from intraprocedural 2D temperature maps, which are derived from phase maps recovered from a single imaging plane.

By applying previously described methodologies, a pipeline is presented to expand intraoperative thermometry to 3D dosimetry maps, enabling prediction of spatial and temporal reach of thermal neuromodulation and resultant lesion volume

Acknowledgements: Sadaquate Khan (NHS Lothian), Jennifer MacFarlane (NHS Tayside), Graeme Mackenzie (NHS Tayside)

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Posters

Poster number: P01

Random Forest Classifiers to predict psychotic symptoms in Alzheimer's disease

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Psychotic symptoms (delusions and/or hallucinations) are among the most common and impactful neuropsychiatric symptoms that occur within Alzheimer's disease (AD). Using Random Forest analyses, aim of this study is to provide clarity on the value of neuroanatomical, neuropsychological, and neuropsychiatric features when predicting the presence of psychotic symptoms in AD.

Data used in preparation for this study was obtained from the ADNI database (adni.loni.usc.edu). Based on the scores of the Neuropsychiatric Inventory, participants were selected with the criterion of presenting with psychotic symptoms. Controls were matched, who did not present with any psychotic symptom, and did not differ from the psychosis group for disease stage, age, gender, education, genetic profile, and overall cognitive and neuropsychiatric status. The predictors were derived from: Neuropsychiatric Inventory's scores for the other neuropsychiatric symptoms; Alzheimer's Disease Assessment Scale-Cognitive Subscale, to select different cognitive functions; brain metrics derived from the FreeSurfer software (available via ADNI), as measures of cortical and subcortical volumes, cortical thickness, and surface area.

The Random Forest Classifiers were employed to generate feature importance ranking. While further analyses are currently underway, preliminary results suggest that it is possible to understand how the different variables interact to predict the presence of psychotic symptoms, and which of those variables hold greater importance. Among neuropsychiatric symptoms, apathy has emerged; short-term and long-term memory and orientation resulted as best predictors among the cognitive functions. Lastly, the anterior and posterior cingulate cortex and insula (bilaterally), and right frontal areas were identified as the most important brain areas. Overall, the brain region metrics appear to have better discriminatory ability compared to neuropsychological and neuropsychiatric data.

The results indicate that the machine learning technique Random Forest Classifier can be used to advance our understanding of the complex interaction of different predictors in the manifestation of psychotic symptoms in AD.

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Poster number: P02

Neuroanatomical Associations with Autistic Characteristics in those with Acute Anorexia Nervosa (AAN) and Weight Restored (WR) Individuals

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A growing body of research is dedicated towards understanding the increased rates of co-occurrence as well as the social, emotional and cognitive similarities reported between those with anorexia nervosa (AN) and Autistic individuals. Neuroanatomical studies have identified regions of interest associated with both states of AN and autistic characteristics, but restoration of BMI/weight has been shown to play a role in the presentation of autistic characteristics in those with AN. The varying roles played by weight restoration have impacted the manner with which Autistic individuals with AN are identified and treated for their eating disorder (ED). This study aims to examine neuroanatomical correlates associated with autistic characteristics in those with acute anorexia nervosa (AAN) and those weight restored (WR). 183 individuals (nHC=67; nAAN=68; nWR=48) were included to establish group-wise differences, with autistic characteristics examined in those with both AAN and in WR individuals (n=116). To examine the potential impact of weight/BMI differences, tests were repeated in the Lowest 20% (n=23) and Highest 20% (n=23) BMI percentiles within this group. Those with AAN demonstrated significant socio-emotional differences and increased levels of depression, anxiety, and obsessive-compulsive disorder (OCD), as well as increased presentation of autistic characteristics, which did not differ across AAN or WR groups. Group-wise differences were identified within volume/surface area of the middle frontal gyrus (MFG) and orbitofrontal cortex (OFC), but differences were also unrelated to BMI. Autistic characteristics were inversely associated with volume of the MFG, as well as the anterior cingulate cortex (ACC). No associations were found in the Lowest/Highest 20% BMI percentiles, and thus no significant differences in correlations were identified. Findings suggest that the presence of autistic characteristics in those with AAN are identified within the MFG, and are unrelated to changes in, or restoration of weight/BMI.

Acknowledgements: We would like to thank Professor Kate Tchanturia and Professor Steve Williams for their use of the King's College London BEACON dataset (MR/S020381/1; BiomaRkers for AnorexIa Nervosa and autism spectrum Disorders – longitudinal study and MR/R004595/1; The Triple A study [Adolescents with Anorexia and Autism]: A search for biomarkers), as well as to Daniel Halls for his knowledge, guidance and familiarity with the BEACON data.

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Abstract number: P03

The influence of dimmed lighting conditions on naturalistic obstacle negotiation in young and older adults: A proposed study using mobile EEG

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Falls due to slipping and tripping in older adults are a major public health concern, since over one third of adults aged over 65 experience falls annually. These incidents can lead to severe consequences for older adults such as lower quality of life, hospitalization and increased risk of death. The risk of falls escalates with age-related decline in the visual, vestibular, and somatosensory systems. Moreover, changes in natural gait patterns and risk of falls are influenced by the amount of ambient light within the immediate environment.

Adaptive gait mechanisms vary with age. While young individuals can effectively modify their gait when visual information is limited (such as when lighting is dimmed or low), older adults are less able. This interaction between the visual and locomotor systems is especially evident during obstacle negotiation, reflecting an adaptation in movement strategies based on visual cues.

This proposed study will investigate how different light conditions influence walking patterns and obstacle negotiation in young and older adults. Participants will walk along a track, on which obstacles will be projected, either prior to starting (predictable obstacles) or after they have started walking (unpredictable obstacles). Mobile EEG data will be collected during naturalistic walking to identify neural correlates of successful and unsuccessful obstacle negotiations. We predict that older adults will have reduced speed, shorter stride length, increased stride time and more obstacle negotiation errors relative to young adults, particularly in dimmed and dark lighting. Additionally, negotiating unpredicted obstacles in lower lighting conditions will involve greater proactive cognitive control (as indexed by frontal theta oscillations) relative to predictable obstacles, and obstacles presented in full ambient lighting. This will allow us to better understand how the visual environment places increased cognitive demands on older adults during real-world behaviours, and to design environments more effectively to minimise these demands.

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Abstract number: P04

Delineating In-Vivo T1-weighted Intensity Profiles within the Human Insula Cortex Using 7-Tesla MRI

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The integral role of the insula cortex in sensory and cognitive function has been well documented in humans, and fine anatomical details characterising the insula have been extensively investigated ex-vivo in both human and non-human primates. However, in-vivo studies of insula anatomy in humans (in general), and within-insula parcellation (in particular) have been relatively limited.

The current study leverages 7-Tesla magnetic resonance imaging to delineate T1-weighted intensity profiles within the human cortex, serving as an indirect proxy of myelination. Our analysis revealed two separate clusters of relatively high and low signal intensity across the insula cortex located in three distinct cortical locations within the posterior, anterior, and middle insula. The posterior and anterior cortical locations are characterised by elevated T1-weighted signal intensities, contrasting with lower intensity observed in the middle insular cortical location.

Importantly, the detection of the high T1-weighted anterior cluster is determined by the choice of brain atlas employed to define the insular ROI. Our results are robust at both individual and group levels across two separate cohorts acquired in two separate sites (n1 = 21, Glasgow, UK; n2 = 100, Amsterdam, NL).

These results reflect new insights into the insula anatomical structure, in-vivo, while highlighting the use of 7-Tesla in neuroimaging. Specifically, the current study also paves the way to study within-insula parcellation as a feasible path for high field imaging at 7T and above, with further implications for individualised medicine approaches and their potential clinical implications.

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Abstract number: P05

Avoiding biopsy for presumed fibroadenomas with benign ultrasound greyscale and shear-wave elastography features in women aged 25-39 years: Comparison between two ultrasound systems and review of follow-up data.

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Background: Based on previous research using an Aixplorer ultrasound system, biopsy is not required presumed fibroadenomas with benign greyscale ultrasound and shear-wave elastography (SWE) findings for women aged 25-39 years. This service evaluation compares findings between the Aixplorer and Samsung ultrasound systems, and reviews follow-up data.

Methods: Patients aged 25-39 years who attended breast clinic between 03/06/21 – 12/07/23, with presumed fibroadenoma with benign ultrasound and SWE features were included. Age and average SWE value (across four images) were recorded, grey-scale images were reviewed for benignity. The independent T-test was used to compare patient age and average lesion SWE value between those scanned on the Aixplorer system vs the Samsung system. Databases were reviewed for patients with at least six months follow-up.

Results: 111 patients were included (Aixplorer cohort: 30 patients, Samsung cohort: 81 patients). Average age was 32.0 years, no significant difference between cohorts ($p=0.4$). Average SWE values were significantly higher in the Samsung cohort compared to Aixplorer cohort; 33.19kPA vs 23.27kPA respectively, $p<0.01$. 36 patients had six months – 2 years follow-up with no subsequent malignant diagnosis, two further lesions with benign greyscale and SWE features were biopsied and proven to be fibroadenomas.

Conclusion: No cancers were detected on follow-up. Average SWE values were significantly higher in the Samsung cohort. This supports that the existing guidance can be safely applied to the new system; however, it suggests that a higher cut-off value may be appropriate to limit unnecessary benign biopsies. Further validation work on the new system is recommended.

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Abstract number: P06

Evaluation of Polyvinyl Chloride's acoustic and mechanical properties as a breast ultrasound phantom.

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A tissue mimicking phantom has become an essential part of quality assurance and control for radiation imaging modalities as well as for the development of new methods. Tissue mimicking phantoms provide a controlled environment in which to test the performance of imaging modalities and to develop new methods. They can also be used to simulate different tissue types, allowing for more accurate testing. This study aims to evaluate polyvinyl chloride (PVC) tissue mimicking material for breast phantoms in ultrasound B-mode and shearwave elastography. Breast tissue equivalence was evaluated based on speed of sound, attenuation ,acoustic impedance and Young's modulus. A total of six samples of PVC material were fabricated, each of which contains a different concentration of PVC and an additive. A breast phantom was constructed from TMP material and analysed using ultrasound to assess its image quality. The results showed that samples 1 (PVC 5%, DOP 95%), 2 (PVC 8%, DOP 92%), 3 (PVC 10%, DOP 90%), 4 (PVC 8%, DOP 90%, graphite 2%) ,5 (PVC 8%, DOP 90%, SiC 2%) , and 6 (PVC 8%, DOP 90%, AlO3 2%) were the closest equivalents to mimic various breast tissues from both fatty and fibroglandular.

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Abstract number: P07

Sonodynamic Therapy for glioblastoma

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Sonodynamic therapy (SDT) represents a promising approach in cancer treatment, utilizing ultrasound in conjunction with sonosensitizers to eradicate tumor cells. Through the activation of sonosensitizers by low-intensity ultrasound, SDT triggers the generation of reactive oxygen species (ROS) within the tumor microenvironment, instigating oxidative stress and consequent apoptosis in cancer cells. Notably, SDT offers advantages such as reduced invasiveness, precise tumor targeting, and minimal systemic side effects compared to conventional therapies. Its capacity to selectively eliminate cancerous tissues while preserving healthy cells highlights its potential as a groundbreaking therapeutic strategy in oncology, paving the way for more effective and tolerable cancer treatments.

The current investigation has developed and validated an automated in vitro system tailored specifically for sonodynamic therapy (SDT), revolutionizing the precision of treatment application. This sophisticated system allows for meticulous adjustment and mapping of focused ultrasound fields across diverse exposure conditions and setup configurations. By finely tuning parameters including ultrasound frequency, intensity, plate base material, thermal effects, and the integration of live cells, this study ensures optimized experimental conditions for SDT. Notably, when coupled with a sonosensitizer, the focused ultrasound triggers apoptotic cell death in primary patient-derived glioma cells while concurrently amplifying intracellular levels of reactive oxygen species (ROS). Furthermore, the remarkable reduction in 3D growth observed in primary glioma stem neurospheres post-SDT exposure underscores the profound potential of this approach in combating cancer stem cells, thereby advancing our understanding and application of SDT in cancer therapy.

In my PhD project, I aim to design a new setup that enhances ultrasound field mapping accuracy and enables experiments with mice. This new approach to testing Sonodynamic Therapy (SDT) in lab-based disease models could facilitate comparison with existing treatments. Understanding the physical properties affecting precise determination and application of focused ultrasound (FUS) dose to cells is vital for in vitro SDT experiments. Many current systems prioritize investigating specific properties like standing waves over cell testing. Further research is necessary to refine setups and tumour models for swift parameter optimization. This understanding could guide the development of optimal FUS parameters for clinical SDT applications.

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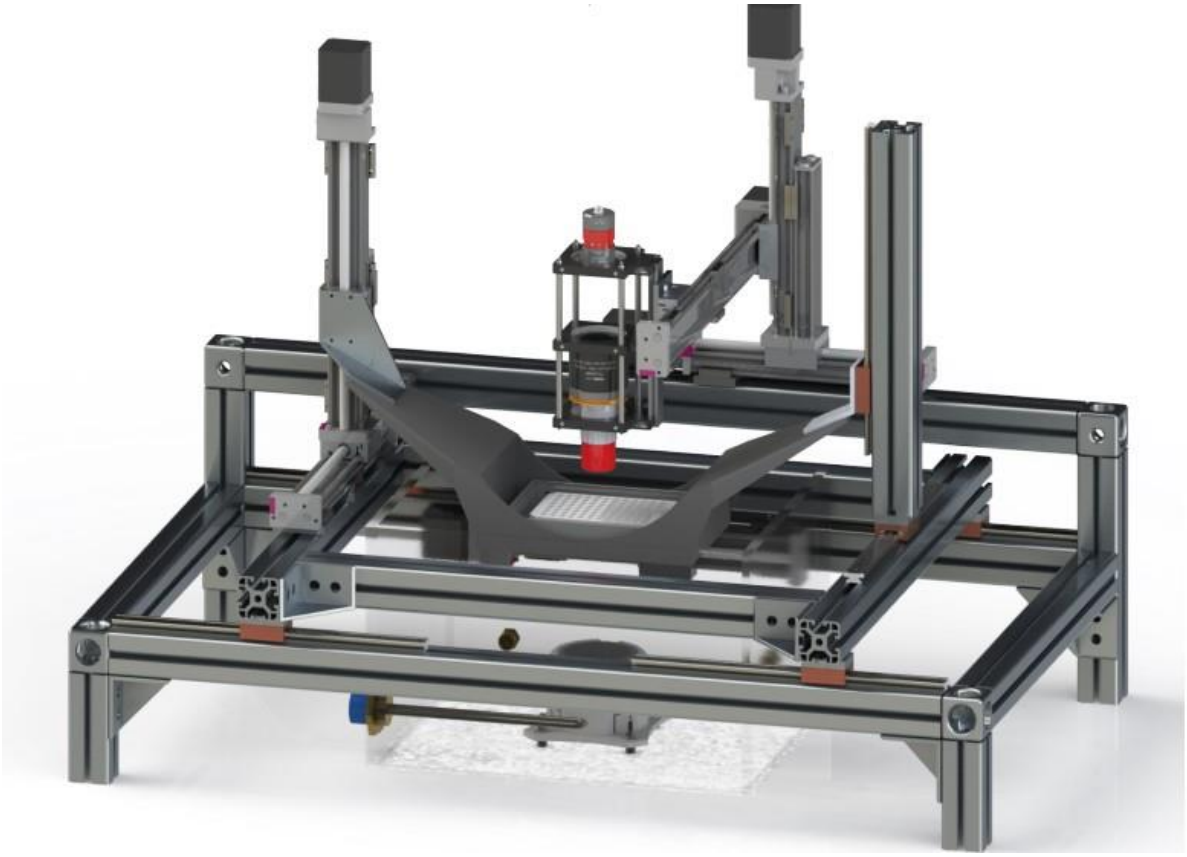

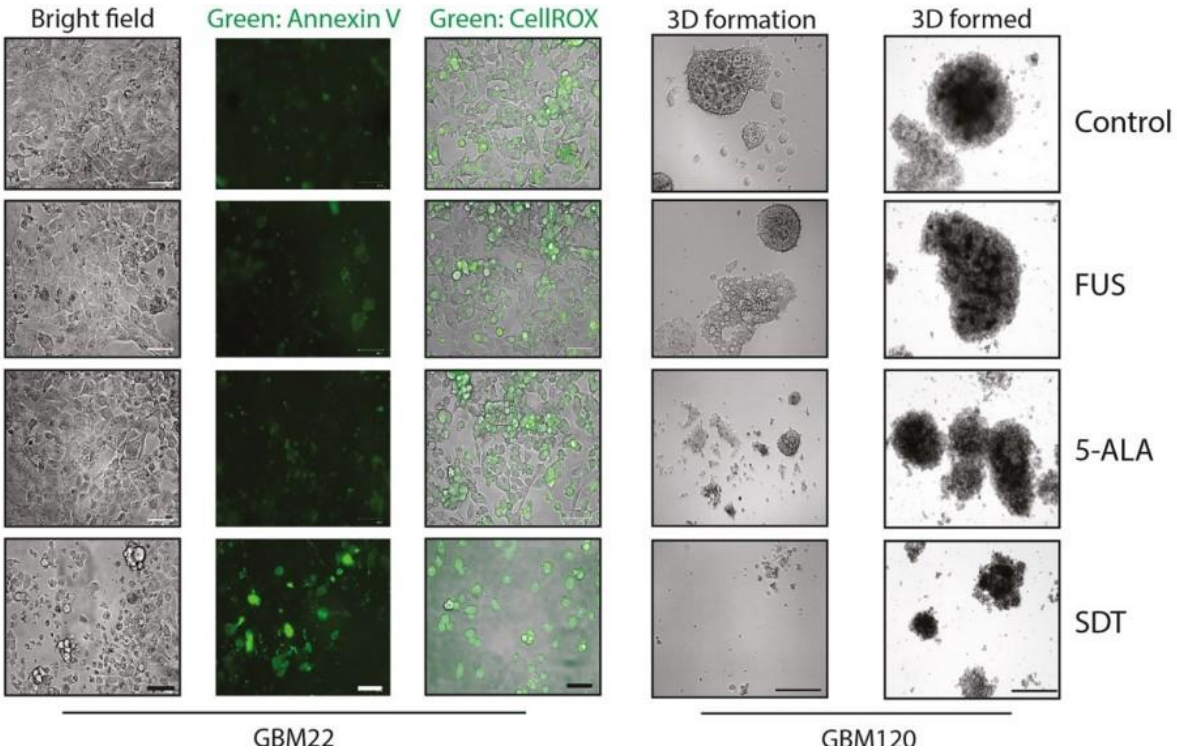
Bright field
Green: Annexin V
Green: CellROX
3D formation
3D formed
Control
FUS
5-ALA
SDT
GBM22
GBM120

Abstract number: P08

Simulating the Effect of different Water Temperatures on Skull

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Therapeutic Focused Ultrasound US has received extensive research for its accuracy, safety, and non-invasive approach. Multiple theories try to connect the mechanical aspect of ultrasound to the neuron state change from rest to active. The current treatment approach involves using water as a protective medium between the ultrasound transducer and patients. Ultrasound can induce thermal increase in the skull and brain. Therefore, to counter the effect of thermal change in the skull, water temperatures are controlled and changed to keep patients safe. An investigation was conducted using simulation of different water temperatures at different intensities to record the ability of the different water temperatures to reduce the rise in skull temperature.

The 3D head was exposed to a continuous ultrasound transducer which has a radius of 71.5 mm. As the current treatment option, it was mounted on the upper front-right side of the head. The transducer was at low intensity for 30 seconds at two different water temperatures: 25°C and 37°C.

We noticed a sudden decline in the outer skull temperature beyond the body's average operating temperature when water was at 25°C, which also lowered the temperature of the outer and inner skulls. Furthermore, water at 25°C prevented the skull from increasing temperature after the first few seconds, while water at 37°C did not keep the skull at normal temperature. Rather, it increased skull temperature as time progressed.

The simulation highlights the importance of water temperature as a patient safety mechanism. It also shows that if the intensity level of the therapeutic is low, it is better to accommodate water temperature to prevent the skull from experiencing a sudden drop in temperature.

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Abstract number: P09

Self-Supervised Cross-Encoder for Neurodegenerative Disease Diagnosis

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Deep learning has been extensively applied to the diagnosis of Alzheimer's disease (AD) based on MRI data. However, these methods often require a substantial amount of labeled images, and the resulting feature representations are hard to interpret. To simultaneously address these two issues, we propose a self-supervised cross-encoder framework, which leverages the temporal information among longitudinal MRI scans as the supervision and yields disentangled representations comprising two components. The first component, subject to an additional constraint enforced through contrastive learning, captures static brain information, and the second component, governed by input-gradient regularization, captures the dynamic information and can be readily fine-tuned for downstream classification tasks. The proposed method demonstrates superior performance in both classification accuracy and interpretability when diagnosing AD, while also exhibiting good generalization when transferring the learned representations to the diagnosis of Parkinson's disease.

Acknowledgements: Data for this project was funded by the Alzheimer's Disease Neuroimaging Initiative (ADNI) (National Institutes of Health Grant U01 AG024904). PPMI used in this project was funded by the Michael J. Fox Foundation for Parkinson's Research (MJFF).

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Abstract number: P10

A dynamic link between respiration and arousal

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Viewing brain function through the lens of other physiological processes has critically added to our understanding of human cognition. Further advances though may need a closer look at the interactions between these physiological processes themselves. Here we characterise the interplay of the highly periodic, and metabolically vital respiratory process and fluctuations in arousal neuromodulation, a process classically seen as non-periodic. In data of three experiments (N = 56 / 27 / 25) we tested for covariations in tidal volume (respiration) and pupil size (arousal). After substantiating a robust coupling in the largest dataset, we further show that coupling strength decreases during task performance compared with rest, and that it mirrors a decreased respiratory rate when participants take deeper breaths. Taken together, these findings suggest a stronger link between respiratory and arousal processes than previously thought. Moreover, these links imply a stronger coupling during periods of rest, and the effect of respiratory rate on the coupling suggests a driving role. As a consequence, studying the role of neuromodulatory arousal on cortical function may also need to consider respiratory influences.

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Abstract number: P11

Optimising sensory stimulation for the treatment of Alzheimer's disease

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Alzheimer's disease (AD) is the most prevalent form of dementia and while there are pharmaceutical treatments for it, these can be invasive and have significant side effects. Gamma Entrainment Using Sensory Stimuli (GENUS) offers an alternative potential treatment for AD, by exposing patients to sound and light sensory stimuli that flicker at a frequency of 40Hz. Naturalistic soundscapes (such as immersive forest sounds) have also been shown to be beneficial to those with AD (e.g., within care home settings), however there are no studies on whether GENUS can be successfully paired with soundscape auditory stimuli.

The aims of this study are to investigate the effect of volume level of the 40Hz stimuli on the production of gamma oscillations, testing whether the gamma oscillations will occur when the 40Hz stimuli are paired with a soundscape, and testing whether the desirable attributes of the soundscape are affected by the 40Hz flicker.

The recruitment target is 30 healthy young adult participants, aged 17-30 years old. Electroencephalography will be used to study participant's brain waves while they listen to the different auditory stimuli. There will be 6 conditions, which include resting baseline, 40Hz auditory stimulation at two volume levels (high, low), a soundscape, and the soundscape paired with each 40Hz auditory stimulation volume (high, low). Results and data interpretation will be presented at the conference.

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Abstract number: P12

Quantitative T1 mapping with multi-contrast MP-RAGE at 7T

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Introduction: Magnetization-prepared two rapid acquisition gradient echo (MP2RAGE) is an established method for high contrast T1-weighted (T1-w) imaging at 7T(1). There is a growing interest in quantitative T1w imaging for investigating cerebral myelin and iron concentrations(2) and identifying multiple sclerosis(3) and epilepsy(4). Expanding the contrasts utilized in MP2RAGE beyond two images with different inversion times (TI) could enhance T1 estimation accuracy by encompassing a broader range of relaxation times along the curve(5). Kecskemeti et al(6) introduced MPnRAGE based on this principle using radial k-space sampling T1-mapping of the brain at 3T. This study aims to use a similar method with inversion times using cartesian k-space sampling at 7T.

Methods: Longitudinal magnetization is prepared using a 180° RF pulse followed by a gradient echo(GRE) image acquisition for five image contrasts with different inversion times. Subsequently, there is a two-second delay before the next 180° RF pulse for spin relaxation. Healthy volunteers were scanned using this sequence using a 7T MAGNETOM Terra MRI scanner (Siemens Healthcare, Germany) and a custom-built head coil(7). Images for healthy volunteer and phantom scans were acquired at 1.1mm3 isotropic resolution and TIs ranging from 300ms-2300ms. T1 fitting was a voxel-wise analysis using the Look-Locker model with Deichmann-Hasse correction(5).

Results/Discussion: Figure 1 illustrates the diverse T1-weighted contrasts (nulled white matter, grey matter, and cerebrospinal fluid) achievable from a singular acquisition employing five TI values. In this preliminary analysis, the estimation of T1 values (Figure 2) was conducted via a three-parameter fitting approach, incorporating the Deichmann-Hasse correction. However, this model underestimates T1 values due to incomplete relaxation of longitudinal magnetization before subsequent inversions. Future studies will refine the model by optimizing fitting procedures to include a specified delay time. With these modifications, the proposed sequence will provide whole-brain T1 values as potential biomarkers in neuroscience applications.

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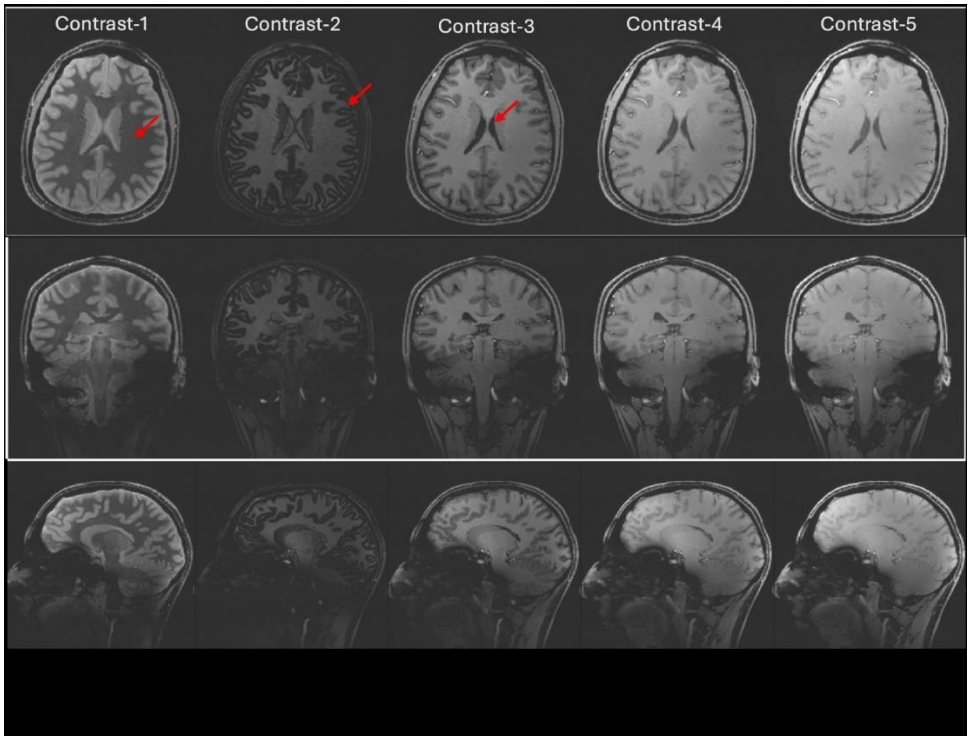

Figure 1: In-vivo images exhibiting different T1w contrasts that are achieved using a TR = 7.75ms, TE = 3ms, 5 TIs (300ms-2300ms) and a total acquisition time of 13.7mins. Contrast-1 with the lowest TI shows nulled white matter, contrast-2 has nulled grey matter and contrast-3 has nulled CSF shown by the red arrows.

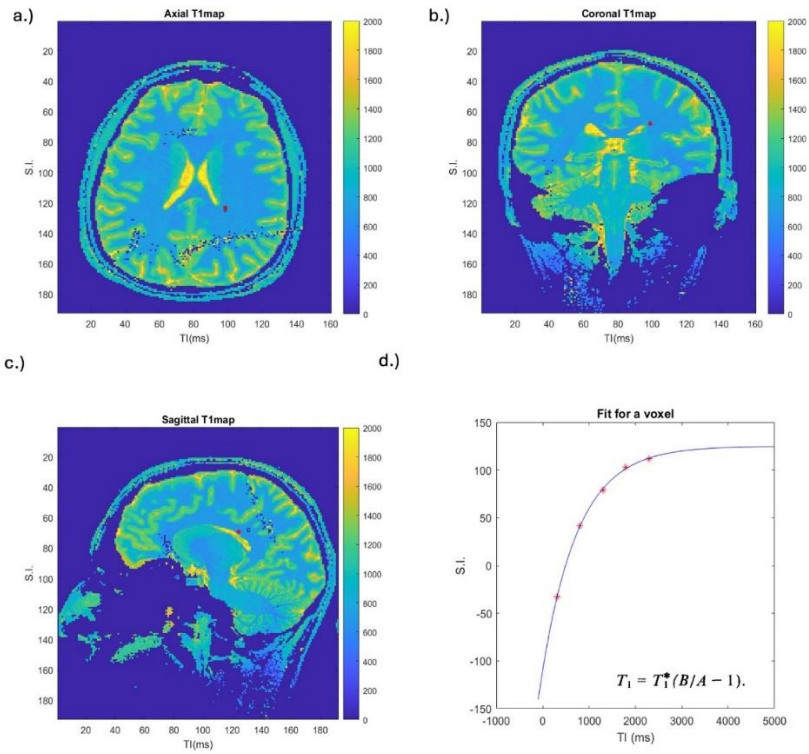

Figure 2: 3D T1 maps (a-c) and the fit(d) for one voxel highlighted in red. The correction equation(d) was used, A = 125, B = 233.5, T1 = 782.27ms, to calculate a T1 = 678.6ms.*

Abstract number: P13

Uncovering Temporal Profiles in The Cortical Layers of M1 using High-resolution Line-Scanning fMRI at 7T

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Modern 7T fMRI imaging has limitations, such as low sampling rates and spatial resolution. This has made it difficult to capture mesoscopic neuronal processes in the brain. We propose a new line-scanning fMRI method as a solution to these limitations. Our approach collapses the entire MRI image acquisition into a single readout radially through the grey matter band within a region of interest. This allows for fast retrieval of fMRI signals across cortical depth, aiming to maintain high temporal specificity of these mesoscopic processes in the BOLD response. We demonstrate the adaptation of line-scanning fMRI to SAR-limited human imaging by showing the differentiated BOLD response across the cortical depth of the primary motor cortex (M1), evoked by a simple finger-tapping task. Our findings demonstrate the potential applications of complementary techniques for capturing mesoscopic neuronal processes with fMRI in clinical and experimental imaging research. This has potentially significant implications for developments in clinical and experimental imaging.

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Abstract number: P14

Efficacy of a one day training day for reporting Contrast Enhanced Mammography

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Background: Rapid uptake of contrast enhanced mammography (CEM) in the UK is driving the need to train mammography readers in this technique. We assessed the efficacy of a one-day training course through comparison of delegates responses with that of an experienced reader.

Methods: Following a series of tutorials, participants were given a series of anonymous CEM studies with relevant clinical details. All CEM studies were acquired as part of a prospective study and had at least three years follow-up. All were initially reported by an experienced reader. Participants were asked to grade images and any lesions to suspicion level. Analysis was performed at lesion level, a true positive was defined as a cancer graded 3-5 on CEM, a false positive a benign lesion or normal breast on 3-year follow-up graded 3-5 on CEM.

Results: 16 patients with 18 lesions (16 malignant, 2 benign) were included. Data from seven delegate readers was analysed. All delegates reported >3000 mammograms per annum in routine clinical practice. Diagnostic accuracy for the delegate readers was, sensitivity: 76.5-88.2%, specificity 72.2-94.4% and accuracy 80.0-91.4%. The experienced reader had a sensitivity of 93.8%, specificity of 90.0% and accuracy of 91.7%. The results for all readers are consistent with the published literature. There was no significant difference between any of the delegate readers and the experienced reader, $p > 0.05$.

Conclusion: Training CEM readers is essential as CEM is adopted into clinical practice. Our results are promising, suggesting competence may be achieved with an intensive one-day training course.

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Abstract number: P15

Breast MRI in the absence of MRI-guided biopsy: A retrospective review with three years follow-up data

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Background: Utilisation of breast MRI is ever-increasing against a backdrop of workforce shortages. MRI has high sensitivity, but lower specificity may result in unnecessary recalls and benign biopsies. This is further hampered by extremely limited access to MRI-guided biopsy.

Methods: Clinical reporting systems were used to identify all breast MRIs performed between 01/01/2019 - 31/12/2019. Indication for MRI and MRI lesion features were recorded, recall rates and biopsy rates were calculated. Pathology was reviewed. Cases were followed-up for a minimum of three years.

Results: 283 MRIs (216 women) were included. Indications were; high-risk screening(40), neoadjuvant chemotherapy monitoring(65), locoregional staging(89) and other(22). Twenty-seven MRIs (9.5%) were recalled. Twenty-six biopsies were performed, biopsy results were B1-2 (4), B3 (4), B5 (19). One B3 case was upgraded to ILC at surgery. Cancer detection rate in the screening group was 7.5% (3 of 40). Over 3 years of follow-up, no cancers were identified within the recalled cases with normal/benign second-look imaging and/or biopsy. Four patients developed new cancers, one in a high-risk screener, one in a patient with presumed previously occult cancer on all imaging with proven nodal disease and contralateral breast cancer was detected in two patients.

Discussion: When MRI is conducted in a carefully selected population, recall rate and benign biopsy rate is relatively low. Follow-up data is reassuring, with no evidence that the lack of access to MRI-guided biopsy is resulting in missed cancers.

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Abstract number: P16

How does the implementation of an AI image interpretation tool and novel communication software impact time to treatment?

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Purpose: Every minute of an acute ischemic stroke (AIS) almost 2 million brain cells die. Quick and accurate interpretation of computed tomography (CT) images and the coordination of a multi-specialty team is therefore essential. Brainomix Ltd. (Oxford,UK) is an artificial intelligence (AI) software that automatically detects infarct volume and Alberta Stroke Programme Early CT Score (ASPECTS) from plain CT scans. Pulsara (Montana, USA) is a digital healthcare communication tool that enables all pathway team members to collaboratively communicate in a single, secure patient channel. We report the very 1st integration of both AI tools and evaluated the impact of the implementation on door to CT times in thrombolysis patients.

Method: Differences between door to CT and door to needle were recorded in thrombolysis patients with AIS during regular service hours (weekdays 9am-5pm) between January 2018 and September 2023. The following two time periods were compared: Conventional stroke pathway (no AI support, 1st January 2018 to 1st January 2020), and after integration of Brainomix into Pulsara (14th February 2023 to 19th September 2023). The U-Mann Witney test was used to compare times using Statistica®13.1 software.

Results: We analysed door to CT times in a sub-cohort of thrombolysis patients. After the implementation of integrated AI support, there was a significant improvement in door to CT times ($p<0.05$). There was a trend towards better outcome at 3 months. Clinicians provided positive feedback "This software makes the treatment we provide more precise and patient-centred", "The software presents an essential safety tool for patient care"

Conclusion: The new digitally streamlined pathway triggered by the implementation of Brainomix and Pulsara significantly improved patient diagnostic and treatment times. With AI tools for automated scoring of acute ischemic stroke scans now established in clinical practice, their integration into a dedicated communication tool may further reduce time to treatment.

Acknowledgements: We would like to thank the University of Dundee Thrombotic Diseases Endowment Fund for their contributions to the Pulsara project.

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Abstract number: P17

Head and neck imaging with 7T MRI using a custom-built 8TxRx56Rx coil

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7T MRI offers superior resolution and signal-to-noise ratio (SNR) compared to lower field strengths[1]. However, these benefits are generally restricted to brain-only imaging due to the lack of coils for other anatomical regions. To address this, a dedicated head coil has been developed with extended coverage to include soft tissues and blood vessels in the neck and the upper region of the cervical spine[2v].

The coil has an 8-channel transceiver (TxRx) array, configured in two rows with six loops in the upper row and two in the upper neck's posterior portion (Figure 1A). There is also a 56-channel receiver (Rx) array with a split-top design that has 16 channels in the anterior and 40 channels in the posterior sections (Figure 1B).

Imaging was performed on a 7T MAGNETOM Terra (Siemens Healthcare, Germany) in three healthy subjects. One subject was also scanned with an 8Tx64Rx head-only coil (MRCoilTech UK). Sequences include B1+-mapping using actual flip-angle imaging[3], SNR mapping using 2D GRE[4], T1 weighted imaging using MP2RAGE and FLASH, T2-weighted imaging using turbo spin echo (TSE), and phase-contrast magnetic resonance angiography (PC-MRA)[5].

The coil provided higher B1+ and SNR in the neck region compared to an 8Tx64Rx head-only coil (Figure 1C). The larger transceiver loops also enhance SNR centrally. Figure 2A demonstrates good visualisation of blood vessels in the neck, including common carotid arteries. Figure 2B shows anatomical images at various levels of the cervical spine. Figure 2C illustrates the comparison with an 8Tx64Rx head-only coil in the same volunteer. The extended coverage of the head-and-neck coil makes cervical spine and cord imaging with multiple sequences possible.

Overall, this coil's extended coverage offers promising neck, cervical spine, and cord imaging without compromising brain imaging quality. This opens the door for new clinical research with 7T MRI focussing on the head and neck.

References:

1. Kraff O, Quick HH. 7T: Physics, safety, and potential clinical applications. J Magn Reson Imaging. 2017;46(6):1573-1589. doi:10.1002/jmri.25723
2. Baskaran D, McElhinney P, Williams S, Allwood-Spiers S, Porter D, Gunamony S. Eight-channel Transceiver Array for Combined Head and Neck Imaging at 7 Tesla. In: Toronto, Canada; 2023. https://eprints.gla.ac.uk/301651/. Accessed April 18, 2024.
3. Yarnykh VL. Actual flip-angle imaging in the pulsed steady state: A method for rapid three-dimensional mapping of the transmitted radiofrequency field. Magn Reson Med. 2007;57(1):192-200. doi:10.1002/mrm.21120

4. Kellman P, McVeigh ER. Image reconstruction in SNR units: A general method for SNR measurement†. Magnetic Resonance in Med. 2005;54(6):1439-1447. doi:10.1002/mrm.20713
5. Vilela P. Phase Contrast Magnetic Resonance Angiography (PC MRA) and Flow Analysis: Clinical Applications. In: Vascular Imaging of the Central Nervous System. John Wiley & Sons, Ltd; 2014:161-175. doi:10.1002/9781118434550.ch10

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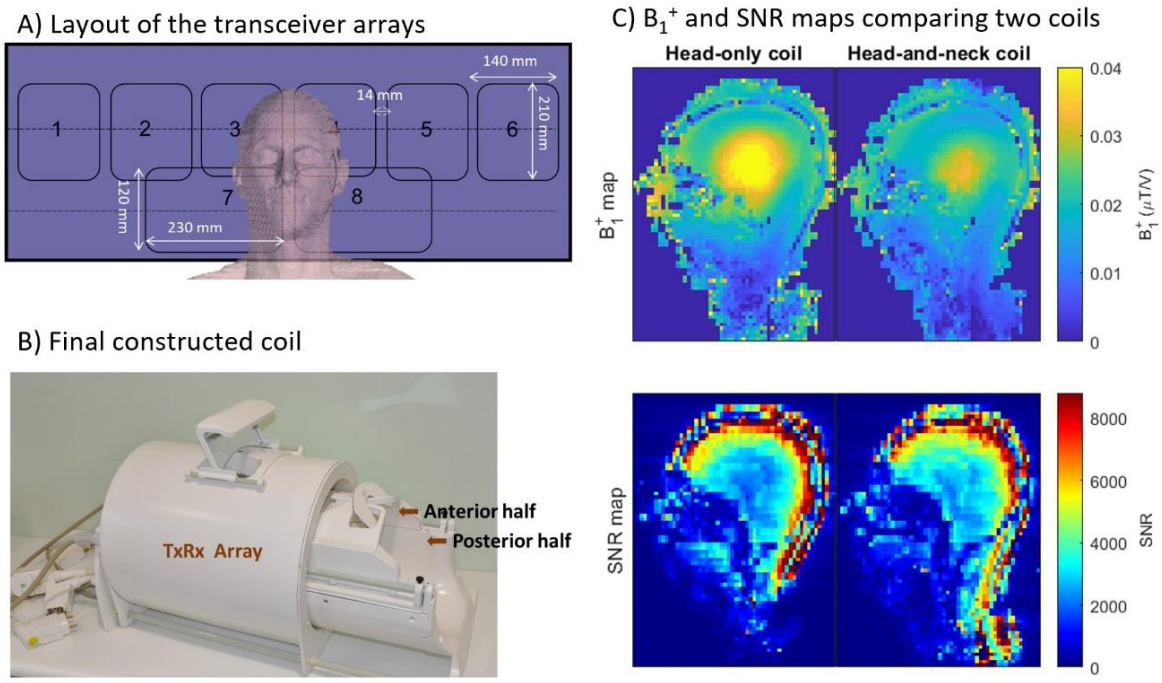

Figure 1: A) Layout of the transceiver arrays showing 6 elements around the head and 2 elements covering the posterior area of the neck. B) Final constructed coil with an outer transceiver array and a split-top receiver helmet. C) Comparison of transmit B_1^+ maps (top) and SNR maps (bottom) between the head-and-neck coil (right) and a head-only coil (left) in a healthy volunteer.

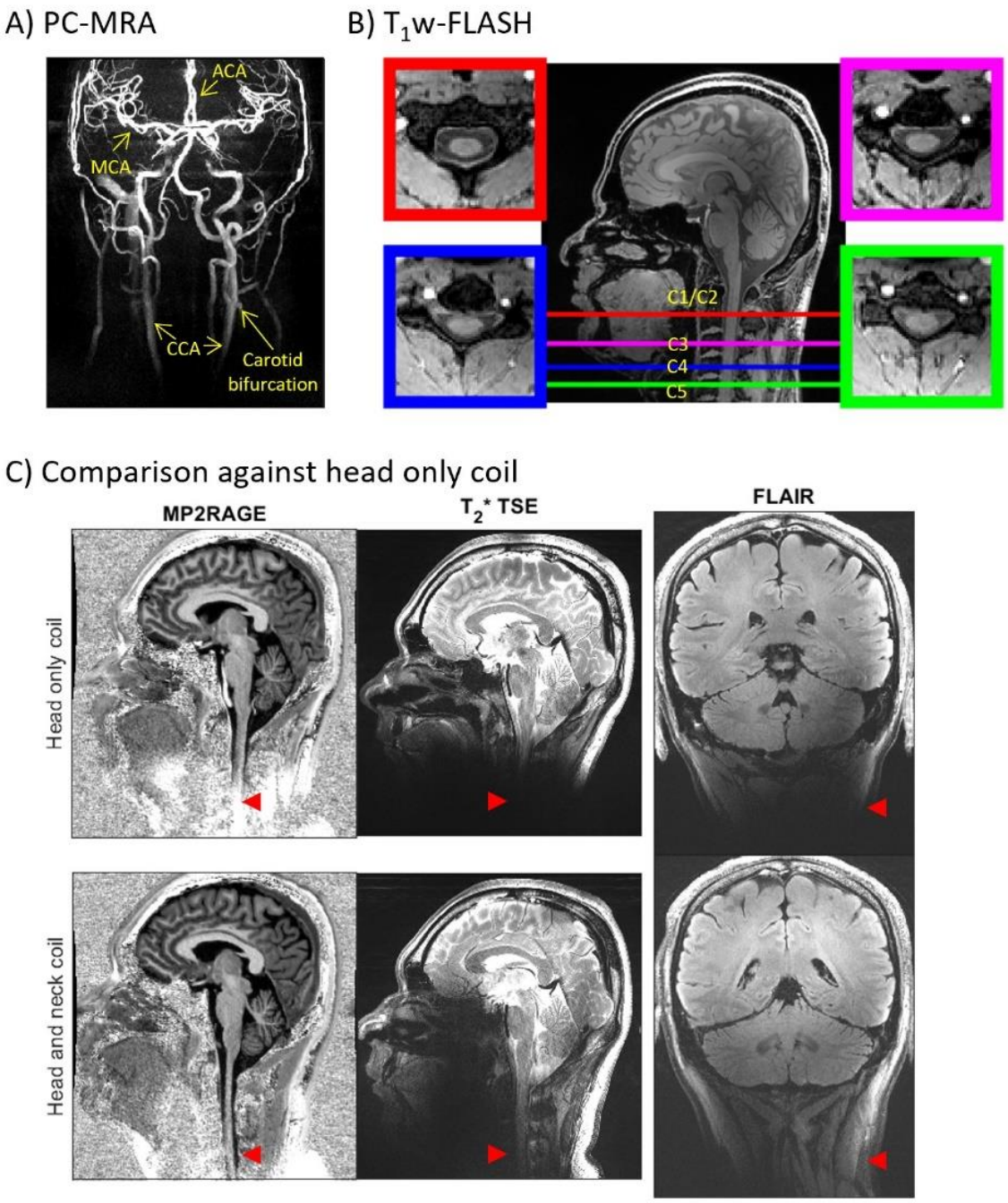

Figure 2: A) Phase-contrast MR angiogram showing the major vessels in the brain and neck of a healthy volunteer using the novel head-and-neck coil. B) Anatomical images at various levels of the cervical spine of a healthy volunteer using the novel head-and-neck coil. C) Comparison of the head-and-neck coil (bottom) against a head-only coil (top). Red arrows show areas of improved signals with this new coil.

Abstract number: P18

A Novel Foundation Model for Estimating Brain MRI Health

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Introduction: Despite the rapid advancement of deep learning in its application to neuroscience tasks, there are still no models that generate a rapid, overall assessment of brain health. This project aims to build and deliver the first foundation model for neuroscience which will provide an accurate and comprehensive method to assess an individual's brain health. As a biomarker and proxy measure of healthy ageing, we are utilizing the brain age gap (the difference between the chronological and predicted brain age).

Methods: To overcome a lack of clinical data, we take advantage of a large, synthetic MRI dataset (100,000 volumes) created by generative AI. The fine-tuned model is then deployed on several novel tasks—it can act as a brain health estimator to test life-behaviour factors, map patient trajectories over time, identify changes in the brain's anatomical structures as well as their links to cognitive changes. As a test of its adaptability, we are applying the model to the UK Biobank (~56,000 MRI volumes). As well as offering the first foundation model designed for brain health estimation, this model will also be the first to use synthetic neuroimaging data and to be fine-tuned on the UK Biobank.

Results/Discussion: With an achieved mean absolute error (MAE) of 3.2 years on the synthetic dataset, our current model demonstrates state-of-the-art predictive accuracy in estimating brain age. Initial findings indicate significant increases in brain age gaps between the healthy population and patients with dementia symptoms, head injury, Parkinson's disease and multiple sclerosis. In addition, we see an increased brain age gap in those who are currently smoking versus non-smoking controls, demonstrating lifestyle effects on brain health.

We present a promising new model, capable of picking up differences between different brain dysfunctions, with a future aim of mapping brain health in individual patients.

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Abstract number: P19

Mechanisms of fatigue in multiple sclerosis: insights from single-echo quantitative susceptibility mapping

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Introduction: Relapsing remitting multiple sclerosis (RRMS) is a chronic neuroinflammatory disease; fatigue is a common debilitating symptom, yet poorly understood. Magnetic resonance imaging (MRI)-derived quantitative susceptibility mapping (QSM) detects CNS iron accumulation, thought to reflect 'smouldering' microglia-associated inflammation associated with disability. QSM studies mostly use multi-echo acquisition, however, QSM can also be derived from a single-echo susceptibility sequence, which is easier to implement clinically. This study aims to establish the viability of deriving single-echo QSM maps and explore associations between fatigue and iron load in normal-appearing white matter (NAWM) and white matter lesions (WMLs) in RRMS.

Methods: Recently diagnosed, treatment-naïve RRMS individuals were recruited to FutureMS, a longitudinal multi-centre cohort study. Susceptibility-weighted imaging (SWI) data from a cross-sectional, single-centre sample were available at 5-year follow-up. Participants underwent SWI, T1w, T2w, and 2D-FLAIR on a 3T Siemens Prisma MR system. SWI-derived QSM maps were generated with the SEPIA toolbox and QSM values were extracted for NAWM and WMLs. Fatigue was assessed using the Fatigue Severity Scale (FSS;fatigued/non-fatigued, >/≤ 36), and depression was evaluated with the Patient Health Questionnaire-9. Binomial logistic regression assessed associations between QSM and dichotomized FSS scores, adjusting for age, sex, and depression.

Results: Data from N=60 participants were used (fatigued=31, non-fatigued=29). Satisfactory quality 3D single-echo QSM maps were generated. No significant associations between NAWM ($p = 0.596$) or WML ($p = 0.499$) magnetic susceptibility and fatigue status were found.

Discussion: Single-echo QSM offers potential for clinically translatable iron quantification. Our preliminary results suggest microglial-associated inflammation reflected in NAWM and WML iron deposition does not drive fatigue in RRMS. Further studies with larger samples are needed to validate QSM measures. Additionally, assessing iron deposition around the margins of lesions and in cortical/subcortical grey matter where microglial accumulation is known to occur, could enhance our understanding of fatigue mechanisms.

Acknowledgements: With special thanks to all FutureMS participants who have made this study possible. FutureMS was hosted by Precision Medicine Scotland Innovation Centre and funded by the Scottish Funding Council and Biogen Idec Ltd Insurance. Additional funding came from the MS Society Edinburgh Centre for MS Research, Anne Rowling Regenerative Neurology Clinic, Chief Scientist Office, Wellcome Trust, US National Institutes of Health, National Multiple Sclerosis Society, US Department of Defense, and Erwin Rautenberg Foundation.

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Abstract number: P20

Towards endotyping neurodegeneration through the eye using multi-modal retinal imaging.

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Neurodegenerative diseases pose a significant global health challenge, affecting millions worldwide by progressively impairing nerve cells in the brain and peripheral nervous system. Despite lacking cures, early detection offers the prospect of timely intervention, potentially slowing disease progression and alleviating symptoms to improve patients' quality of life. Clinicians typically rely on complex biomarker data from invasive tests like MRI and PET scans, alongside cerebrospinal fluid analysis, to monitor disease progression. However, there's a critical need for less invasive, quicker, and more cost-effective diagnostic tools that are better tolerated by patients and offer higher accuracy. Identifying biomarkers capable of predicting disease progression and serving as trial endpoints for new therapeutics is paramount. The retina, like the brain in cellular and vascular composition and inflammatory response to injuries, offers a promising avenue for exploring neurodegeneration and vascular dysfunction due to its accessibility and micron-level imaging capabilities. Previous research has linked retinal atrophy in MS and dementia. Expanding our investigations to include Parkinson's disease and Amyotrophic lateral sclerosis aims to pinpoint specific and sensitive retinal biomarkers capable of distinguishing between individuals with the aforementioned diseases and healthy controls.

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Abstract number: P21

Capture and Re-use of Ground Truth (to enhance cohort building)

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Research projects often go to considerable time and expense to gather 'ground truth' from subject matter experts. This project aims to provide a simple mechanism to support bringing this data asset back into a central location where it can be linked to existing data for use in future research projects.

The Researcher Generated Outputs (RGO) application is a simple, configurable tool designed to capture Ground Truth results generated by researchers. Starting with an initial structured interview with the researcher, the cohort building team can define what ground truth items should be captured and how to link them back to existing data. From this, the cohort building team can use RGO to construct a template for the researcher to populate and return.

These templates are .CSV or .XLS documents, for which the researchers can define the column headings. They can then either populate a pre-generated template created by RGO, or generate their own file as long as it matches the agreed criteria.

Returned RGO ground truth templates are fed back into the RGO system, where they can be exposed to the team's cohort building toolset. This additional data is fully attributable back to the original researcher and any DOI or publications therein.

These ground truths aim to improve the quality of data available for future research while expanding the visibility of the research community through the strong attribution of previous work.

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Abstract number: P22

High-Speed Preparation of DICOM Metadata for Research Purposes

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With the rise in machine-learning based medical research activities increasing year-on-year, the demand for large-scale DICOM datasets has never been higher. Due to the complex and flexible structure of the DICOM standard, anonymisation of DICOM metadata is a cumbersome task. The Research Data Management Platform (RDMP) is a free & open-source software application centred around the extraction and anonymisation of data from primary care systems, such as PACS, into reproducible, auditable, and pseudonymous cohorts for research purposes.

Originally designed for tabular data, RDMP has been extended to support the extraction and anonymisation of DICOM tags for research purposes. Built upon the principles of Extract, Transform & Load (ETL), RDMP provides the ability to construct pipelines for the extraction of data from clinical systems into a central data warehouse. From this central data warehouse, users can explore potential cohorts and extract anonymised data subsets into their research environment. These cohorts and extracted data subsets are repeatable, versionable and reusable through RDMPs modular ETL pipeline system.

The DICOM processing extension for RDMP supports the routing of specified DICOM tags from source images into a tabular format within the central data warehouse. This facilitates cohort exploration and creation using any combination of tags from within the DICOM standard alongside traditional cohort building techniques.

RDMP has been used to facilitate hundreds of research projects within the safe-haven network across several data modalities since 2013. RDMP's DICOM processing functionality has been proven to be able to process thousands of DICOMs a minute, reducing the turnaround time for DICOM based research data subsets by several order of magnitudes.

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Abstract number: P23

Assessment of Coronary Artery Calcification in Patients with Bronchiectasis

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Background: Cardiovascular disease (CVD) is an important co-existing condition with bronchiectasis. Coronary artery calcification (CAC) can be identified on routine chest computed tomography (CT) performed without ECG gating. The presence of CAC can serve as a predictor of prospective coronary events.

Aims: To investigate whether the assessment of CAC is related to bronchiectasis disease severity.

Methods: A retrospective evaluation of 165 (82 male 83 female) CT scans for patients with bronchiectasis from the BRIDGE study. The analysis was conducted to determine the presence of CAC using a semi-quantitative Weston method. Consequently, the correlation between bronchiectasis severity index and CAC was assessed.

Results: The analysis revealed a strong linear relationship between CAC and Bronchiectasis Severity Index (BSI) scores, with the latter being a significant predictor of CAC scores. Multiple linear regression indicated that BSI predicts CAC, and that BSI can explain 69.4% of the variance in CAC, while one-way ANOVA confirmed significant differences in BSI scores across CAC categories.

Conclusions: These results highlight the importance of the CAC score in clinical assessment and decision-making, suggesting the need for further research to explore the complexities and potential non-linear interactions affecting BSI scoring and CV outcomes in patients with bronchiectasis.

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Abstract number: P24

Analysis of cardiac MRI scans to assess the effect of dapagliflozin on EAT

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Introduction: Epicardial adipose tissue (EAT) accumulation is a significant risk factor for heart failure. The relationship between EAT thickness and their impact on patients who have diabetes and heart failure remains unclear. Dapagliflozin, a key heart failure treatment, blocks the kidney's SGLT2 protein, reducing glucose reabsorption and lowering blood sugar. Beyond controlling blood sugar, dapagliflozin causes diuresis and reduces cardiovascular deaths and heart failure hospitalisations. Our aim was to analyse cardiac MRI scans to assess dapagliflozin's effect on EAT thickness, exploring its potential role in heart failure management.

Methods: In a secondary analysis of the REFORM clinical trial, 56 individuals with type 2 diabetes and heart failure were randomised to receive either dapagliflozin or a placebo. The evaluation involved cardiac magnetic resonance (CMR) scans at baseline and at 12 months post-treatment. Epicardial fat was measured utilizing 4-chamber cine images to quantify adipose tissue between the myocardium and the visceral layer of the pericardium. This assessment was carried out using the single end-diastolic image, with measurements conducted by evaluators blinded to the randomisation status of participants.

Results: 47 participants completed the study. The placebo group, including 23 participants, exhibited a minimal average epicardial fat change of 0.09 cm^2 (baseline: 11.54 cm^2, 12 months: 11.52 cm^2). The dapagliflozin group, comprising 24 participants, showed a significant reduction, with a mean change of 1.21 cm^2 (baseline: 11.74 cm^2, 12 months: 10.63 cm^2, $p<0.007$ compared to placebo).

Conclusion: Dapagliflozin significantly reduced epicardial adipose tissue compared to placebo in patients with type 2 diabetes and heart failure. The reduction in EAT may play a role in the beneficial effects of dapagliflozin in heart failure patients.

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Abstract number: P25

Software for Medical Imaging (SMI) - Processing Large-Scale DICOM Data in Safe Havens

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The SMI software ecosystem has been developed over the past 6 years to turn a petabyte-scale dataset of raw DICOM images into a rich, “research-ready”, data resource. Through the PICTURES programme, it has been successfully deployed in the Scottish National Safe Haven and the HIC Trusted Research Environment in Dundee. We now support several active research studies across both environments.

We have a commitment to provide open-source software, and our work is freely available on GitHub at https://github.com/SMI. These repos include our scalable pipeline for data ingest and de-identification, a tool for scanning text and images for identifiable data, processing of free-text radiology reports using NLP, and libraries to support management of DICOM objects. Our Ansible collection allows the automated deployment of the software, supporting standardised installations for developers and production environments.

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Abstract number: P26

Radiomic Texture Analysis of Perirenal Fat: A Predictive Indicator of Tumour Grade and Stage in Renal Cell Carcinoma

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Radiomic analysis is emerging as a pivotal tool in the non-invasive assessment of tumour characteristics, particularly in renal cell carcinoma (RCC). This study investigates the predictive capacity of perirenal fat (PRF) texture analysis in discerning the grade and stage of RCC, using clear cell RCC (ccRCC) as a model. The study amalgamated a retrospective cohort from a single institution with cases from the KITS and KIRK datasets, resulting in a total of 474 analyzable cases after rigorous inclusion and exclusion based on CT imaging quality and histological confirmation of ccRCC. Sample size calculations ensured sufficient power to detect significant differences in 'low' versus 'high' tumour classifications, informed by radiological stage and histological grade.

Radiomic features were extracted from the perirenal fat surrounding both the tumour and normal kidney tissue using a standardized imaging protocol and advanced machine learning algorithms for feature selection and model validation. Our analysis revealed that the texture of PRF could be a reliable indicator of tumour aggression and stage, potentially due to the interaction between the tumour microenvironment and the adipose tissue. The study employed various machine learning classifiers, with Logistic Regression and Random Forest demonstrating the highest predictive accuracy for tumour grade and stage, respectively.

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Abstract number: P27

Text-based Medical Image Classification by Body Part

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A major difficulty of working with big medical data is the classification of images by procedure, condition, treatment, and body part. Accurate image classification would enable researchers to specify criteria for the efficient extraction of relevant medical images for study and analysis.

Most solutions look at pixel data for classification due to its high reliability in comparison with attached metadata. In comparison, a text-based solution would be faster, more scalable, and more computationally efficient. To decide whether there is value in metadata classification, a radiologist examined a collection of common DICOM tags and measured their reliability for body part classification by comparing them with their respective pixel data.

They found the most reliable tag for body part descriptions was “StudyDescription”. We cleaned the "StudyDescription" text, extracting a list of unique values, to make the data more manageable. Analysing these unique studies, we created a dictionary defining medical terms with one or more common body part labels such as “head”, “neck”, “chest”, “abdomen”, “pelvis”, “upper limb”, “lower limb”, “spine”, and “whole body”.

Our current dictionary contains 223 terms. Applying this to 38,742 unique studies across 11 modalities, resulted in a labelling coverage of 92.98%. Manual verification of the labelling across the studies resulted in a 91.74% accuracy. Mislabelling issues such as false positives, harsh abbreviations, incorrect spellings, double meanings, negations, and body part ranges, were identified in 3.79% of the unique studies.

This short study highlights the potential advantages of using metadata for classification when a reliable set of tags is available. Further study of combinations of tags and validation against pixel data will help determine whether this solution can be used reliably and expanded to include other classification types. This study does not aim to replace pixel data classification; pixel and metadata solutions can validate and complement each other.

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Abstract number: O19

Evaluating the Superiority of Digital Breast Tomosynthesis Over Digital Mammography in Sensitivity and Specificity for Detecting Breast Cancer in Women Aged 18 and Above: A Meta-Analysis

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Introduction: In 2020, over 2.3 million women were diagnosed with breast cancer with 685,000 dying due to the disease. To reduce mortality rates, many countries have implemented screening programmes for early detection of breast cancer. Digital mammography (DM) is the standard imaging procedure used in the screening and diagnosis of breast cancer; however, it has limitations such as tissue superimposition, which has the potential to mask smaller tumours in dense breast tissue. Digital breast tomosynthesis (DBT) was developed to eliminate this superimposition effect, allowing better tumour detection. The aim of this meta-analysis was to evaluate if DBT has superior sensitivity and specificity for detecting breast cancer than DM in women aged 18 and above.

Methods: 19 studies were retrieved from three bibliographic databases spanning the period from March 2020, aligning with the last published review, through October 2023. The Wilcoxon rank-sum test was used to compare the mean sensitivity and specificity of DM and DBT.

Results: DBT had higher mean sensitivity (87.45± 8.24% vs. 74.66± 14.39%) and specificity (91.39±7.80% vs. 85.29±13.59%) than DM (Fig. 1). There was a statistically significant difference in DBT vs. DM sensitivity (p=0.0025), but not specificity (p=0.12).

Discussion: DBT is characterised by better sensitivity which may be due to a potential reduction of the superimposition effect. There were sample size differences, in the retrieved studies, which may have accounted for some of the result heterogeneity. More research is required in comparing DM vs. DBT alongside newer image analysis techniques, including AI algorithms, to evaluate what is the best approach in terms of identifying smaller tumours in dense breast tissue.

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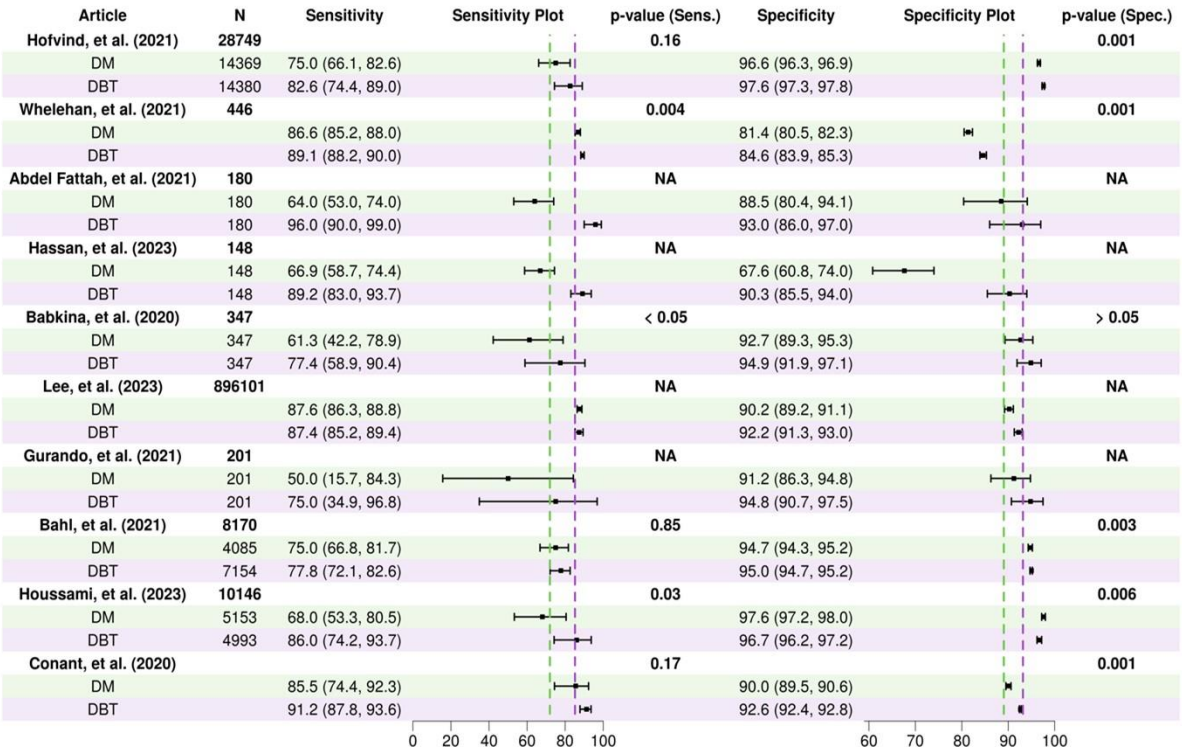

Figure 1: Sensitivity and specificity forest plot for DM and DBT (n=11 studies with 95% CI sensitivity and specificity reported)