Year: 2023 **Type of Awards: Elite**

Name of Principal Investigator: Padhraig Fleming
Affiliated Institution: Dublin Dental University Hospital, Trinity College Dublin

About of the PI:

Padhraig is Chair of Orthodontics at Trinity College Dublin and was formerly Professor, Consultant and Postgraduate Training Lead in Orthodontics at the Institute of Dentistry, Queen Mary University of London. He was awarded MSc. with Distinction in 2007, the Membership in Orthodontics and British Orthodontic Society Medal for clinical excellence in 2008 and a PhD in 2013. He is an Associate Editor of the American Journal of Orthodontics and Dentofacial Orthopedics, British Dental Journal, Journal of Dentistry and Progress in Orthodontics and is on the editorial board of numerous other journals.

Padhraig has published over 190 peer-reviewed papers and received numerous research awards including the Turpin Award from the American Academy of Orthodontists (AAO) in 2021, the Helen E. Dewel Award from the AAO on three occasions and the Chapman Prize from the British Orthodontic Society. Padhraig has co-authored four successful orthodontic textbooks: 'Clinical Cases in Orthodontics', 'Functional Appliances: Theory and Practice', 'Fixed Orthodontic Appliances: A practical guide' and in 2023 'Graber's 'Orthodontics: Current Principles and Techniques.

Dr. Padhraig's research interests have included the evaluation of the comparative effectiveness of various approaches to retention and functional appliance therapy in addition to fixed appliance mechanics. He has recently undertaken a course in AI in Healthcare and is increasingly focussed on its application within orthodontic diagnosis and management.

Brief Summary of the Project:

Formal estimation of orthodontic space requirements is a recognized approach underpinning evidence-based treatment planning. Adequate space is necessary in order to position the dentition best in terms of periodontal health, aesthetics and prospective stability with excessive arch lengthening risking instability, periodontal sequelae and unesthetic outcomes. Formal space planning approaches has been developed accounting for pivotal factors including crowding, antero-posterior change, the effects of arch levelling, inclination and transverse change. This approach is currently applied manually and is therefore both time-consuming and susceptible to error with gross inter- and intra-examiner inconsistency being reported.

The advent of machine and deep learning has raised the possibility of increased efficiency

and indeed improved accuracy in relation to the interpretation of clinical images. Moreover, the use of deep learning has become imbedded within orthodontics with attempts to utilise this approach in informing treatment planning.

We aim to develop a machine learning tool to inform the assessment of orthodontic space requirements and to apply this to facilitate an automated approach to treatment planning. Our objectives include the use of image processing to evaluate pre- and post-treatment orthodontic models to develop an algorithm to assess space conditions, and to predict the nature of alignment and associated arch dimensional changes. This information will then be applied to develop a trained model capable to orthodontic treatment planning.

This tool will streamline the evaluation of orthodontic space conditions by accounting for a range of key occlusal parameters. It is anticipated that robust, efficient and pragmatic algorithms will be developed helping to inform automated, rapid and reliable diagnosis and treatment planning