



Dr. Chung How Kau
2026 Biomedical Research Award
University of Alabama at Birmingham

1. Short Biography

Chung How is Professor and Chair at the Department of Orthodontics, University of Alabama at Birmingham. He also holds academic appointments as Senior Scientist at the Global Center for Craniofacial, Oral and Dental Disorders and UAB Microbiome Center. He is a Diplomate of the American Board of Orthodontics(US), Specialist Orthodontist on the Singapore Dental Council and the General Dental Council (United Kingdom). He holds full licenses to practice in Arizona, California, Minnesota, Missouri, Washington State and Vermont. In addition, he also has faculty licenses in Alabama and Texas. He serves as the Director of the Craniofacial Orthodontia Clinic in partnership with the Children's Rehabilitation Service and Medicaid of Alabama and is the craniofacial orthodontist on the Cleft Craniofacial Team at Children's Hospital of Alabama. He enjoys practicing clinical orthodontics has a special interest in craniofacial anomalies and dento-facial deformities. He is also a researcher with a keen interest in clinical translational research focusing on technology driven orthodontic applications, dent-facial deformities, juvenile idiopathic arthritis, accelerated tooth movement and 4D jaw tracking. At present, he is Principal Investigator on several NIH and Industry grants and has a research involvement more than US\$4+ million dollars. He actively contributes and publishes in the orthodontic literature and has over 450 peer-reviewed publications, conference papers, and lectures. He has over 175 invited presentations and lectures in over 50 countries. In 2011, he was awarded the King James IV Professor by the Royal College of Surgeons of Edinburgh where he also served as the International Advisor for the USA and examiner for the MFDS and MOrth examinations. He holds visiting Professorships at the University of Debrecen, Nanjing Medical University, University of Szeged and Xi'an Jiao Tong University. He has also been featured on CBS Nightly News, WBRC (Alabama) and ABC33 (Alabama) on various Orthodontic topics.

2. Description of Project

Title: Augmented intelligence 3D facial analysis and facial pattern detection of various populations

Background: Facial soft tissue morphological features are largely influenced by the jaw relationships and the occlusion of the teeth. As a result, these are important factors to consider when developing orthodontic treatment goals. At present, craniofacial treatment planning is based on a patient's 3D cephalometric measures (hard and soft tissue) which are compared with average norms obtained from racial sub-populations in which the patient does not often belong. However, facial morphological features are unique to different racial groups and there is a need to utilize information about these features indicative of a patient's ethnic background to create precise and suitable aesthetic evaluations and treatment strategies. Other methods of facial analysis like Principal Component Analysis have also been shown to have tremendous promise.

Objectives: Automated augmented intelligence systems have been used to understand Caucasian faces and some craniofacial anomalies. However, no studies have been conducted on non-Caucasian 3D datasets. As a result, the accuracy and reliability of 3D landmarking is relatively unknown. In this study, we aim to evaluate a novel augmented intelligence platform to better understand 3D facial landmarking for principal component analysis of 3 different populations. This is especially important as craniofacial anomalies tend to occur across many different racial populations. The objectives of this study are: 1) To determine the accuracy of 3D landmarking in a Caucasian dataset (Baseline), 2) To determine the accuracy of 3D landmarking in a non-Caucasian dataset and 3) To determine the PCA components of each of the 3D datasets.

Study Proposal and Experimental Design: We anticipate that 68,400 individual data variables will be obtained at the end of the study. The two populations of faces will be a Hungarian, Zimbabwe and Chinese dataset. The 3D faces will be obtained from the Hungarian 3D Faces repository of the Hungarian Orthodontic Society and the 3D Faces of the Chinese and Zimbabwe faces will be from the University of Alabama Birmingham 3D Faces Repository. The study will have 3 experimental aims. Aim #1: To determine the accuracy of 3D landmarking in a Caucasian dataset (Baseline). 50 Hungarian males and 50 Hungarian females will be used in this study. A total of 57 landmarks will be manually obtained on each 3D face using a proprietary software called 3dMD Vultus. Each landmark will

consist of x, y, z coordinates. Concurrently, each of the 100 faces will be imported to an augmented intelligence (AI) software - <https://3dmedx.nl> that automatically plotted the same 57 landmarks by AI. Aim #2: To determine the accuracy of 3D landmarking in a non-Caucasian dataset, 50 Chinese males and 50 Chinese females, 50 Zimbabwe Males and 50 Zimbabwe Females will be used in this study. A total of 57 landmarks will be manually obtained on each 3D face using a proprietary software called 3dMD Vultus. Each landmark will consist of x, y, z coordinates. Concurrently, each of the 100 faces will be imported to an augmented intelligence (AI) software - <https://3dmedx.nl> that automatically plotted the same 57 landmarks by AI.

Statistical analysis for Aims #1 and #2. The ANOVA descriptive statistical analysis will be used to determine the reliability of the linear distances and angle measurements arising from these 57 landmarks. Some of these measurements have been described in the pilot data presented in the analysis above. Aim #3: To determine the PCA components of each of the 3D datasets. Manually and AI landmarks obtained in Aim #1 and #2 will be imported into a dedicatedly written R software program to create the PCA analysis. Each PCA analysis will be unique to the manually obtained and AI generated datasets. Careful analysis will be conducted to determine the percentage that describes the variance of the facial landmarks. In short, this experimental aim should be able to determine if the manual and AI methods were comparable.

In determining the PCA of manual and AI methods, an inter-observer reliability statistical analysis will be used. Anticipated results from this study focuses on identifying facial soft tissue morphological features distinct to each population group considered, as well as identify if there are possible unique observable facials patterns and trends in the measured versus analyzed principal components by age, gender, and ethnicity.

Conclusion: This study will help determine and enhance the automatic 3D capabilities of facial recognition and simplify the diagnosis of craniofacial form, variation, disproportion, and deformity. It is anticipated that the result of this study will enhance understanding of the contribution of influencing factors like age, gender and ethnicity, and craniofacial anomalies to any observable distribution that may be identified. In addition, as the computing power of AI chips increases, there can be a faster and quicker identification of 3D facial variations. Future 3D faces maybe automatically landmarked and quantified for quick processing, diagnosis obtained, and clinical interventions prescribed.

3. This project adds an additional dimension to understanding methods of 3D facial diagnosis and treatment planning. It will be an interesting contribution to the future orthodontic resident education.
4. The AAO Foundation is important to your project as it provides the necessary resources to carry out the research. I am particularly honored to be named the Dr Fred and Dianne Garrett Biomedical Research Award recipient. Dr Garret has been a true supporter of the foundation and to giving back to our profession. I hope this piece of work will honor his legacy.
5. I am truly grateful that this grant will allow us to acquire the necessary data to compete for a future NIH grant.