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**AAO Foundation Final Report Form
(a/o 1/3/2018)**

Type of Award: Research Aid Award

Name(s) of Principal Investigator: Tarek Elshebiny

Institution: Case Western Reserve University

Title of Project: **Comparison between Imaging Software Packages for Three Dimensional Measurements of The Upper Airway Volume and Accuracy of 3D Superimposition.**

Period of AAOF Support (e.g. 07-01-18 to 06-30-19):

Amount of Funding : \$5000

Summary/Abstract

Introduction: Several imaging software packages report ability to perform different procedures, but results are sometimes inconsistent, making it difficult for practitioners to communicate and compare values. The aim of this study was to compare 4 imaging software packages for measuring the upper airway volumes (UAV) and maximum constriction areas (MCA) and to compare 3D voxel based superimposition between Dolphin 3D and OnDemand3D for growing and non-growing patients.

Methods: For the airway measurements twenty eight cone-beam computed tomography (CBCT) scans were randomly selected, UAV and MCA were calculated by two experienced operators, separately. Dolphin3D, InVivo Dental, OnDemand3D, and ITK-SNAP software programs were used to measure the UAV and the MCA. The measurements were repeated after 2 weeks, and interclass and intraclass correlation coefficients were used for the reliability tests. A repeated measurements analysis of variance (ANOVA) test and post-hoc tests were used to compare software programs. For the 3D voxel based superimposition comparison, the sample consisted of 15 growing patients and 15 non-growing patients, each with two previously taken CBCT at least 2 years apart. The mean age at initial scan (T1) for the growing sample was 11.8 ± 0.5 , with the second scan (T2) at 14.2 ± 0.8 years. In the non-growing group, T1 had an average age of 24.7 ± 1.6 years and T2, 28.2 ± 0.8 years. Voxel based superimposition was performed on the anterior cranial base, using the same anatomical limits, for all the scans using both

software programs. T2 registrations from both software programs were compared with each other using the absolute closest point color map. **Results:** For the airway measurements, the reliability was high for all programs. The average measures for the two investigators showed high consistency (0.984 for the UAV and 0.960 for the MCA). ANOVA test did not show any statistical significance between the software programs in measuring the UAV and the MCA. Also Post Hoc Group Comparisons did not show significant difference between the software programs. For the 3D voxel based superimposition comparison, the quantification of the superimposition difference by color mapped surface distances showed that the absolute mean difference was less than 0.5mm in both growing and non-growing patients. **Conclusions:** The upper airway volume and maximum constriction area measurements using 4 different software packages showed no significant difference for all values, and high intra and inter-operator reliability. Also, both Dolphin3D and OnDemand3D are reliable and deliver the same voxel-based cranial base superimposition results, regardless if the patient is growing or not. This is an important step in software agreement, which allow for better inter-office communication, and for research consistency.

Response to the following questions:

1. Were the original, specific aims of the proposal realized?
The aims of the proposal have been answered through two separate manuscripts.
2. Were the results published?
 - a. If so, cite reference/s for publication/s including titles, dates, author or co-authors, journal, issue and page numbers

First manuscript has been accepted for a publication in the Journal of clinical Orthodontics. (JCO)

Elshebiny T, Elbarnashawy S, Bennisir E, Nadim M , Palomo JM. **Comparison of** voxel based 3D superimposition between two software programs. Accepted for a publication in JCO

Second manuscript is under review in the American Journal of Orthodontics(AJODO)

- b. Was AAOF support acknowledged?
Yes
3. Have the results of this proposal been presented?
 - a. If so, list titles, author or co-authors of these presentation/s, year and locations
American Association of Orthodontics Annual Meeting 2018
 - b. Was AAOF support acknowledged? Yes
3. To what extent have you used, or how do you intend to use, AAOF funding to further your career?

I plan to apply this year to continue more projects in my areas of interest which is 3D technology and printing.