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AAO Foundation Final Report Form (a/o 2/9/2021)

Type of Award, e.g., Orthodontic Faculty Development Fellowship Award, Postdoctoral Fellowship Award, Biomedical Research Award, Center Award, Educational Innovation Award, Program Award, Research Aid Award

Name(s) of Principal Investigator(s) : Tarek ElShebiny

Institution: Case Western Reserve University

Title of Project: Comparing 3D tooth movement when implementing the same virtual setup on different software packages

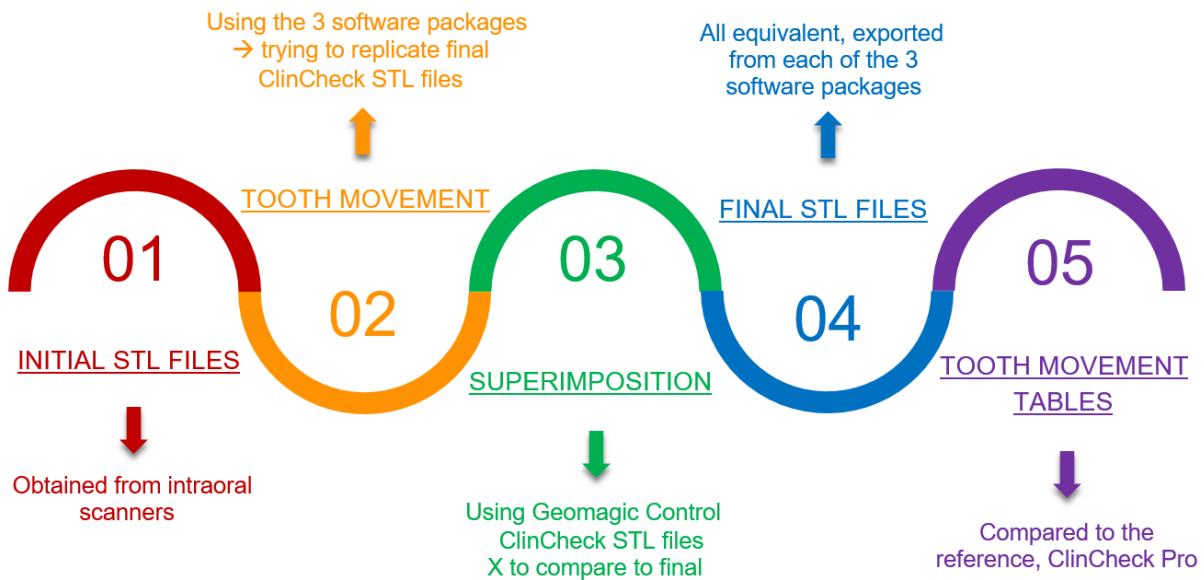
Period of AAOF Support: 07-01-2021 to 06-30-2022

Amount of Funding: \$20,000

Summary/Abstract

Abstract: Background/objectives: The purpose of this study was to compare the differences in tooth movements when implementing the same virtual setup on four different software packages: ClinCheck ® Pro, Ortho Analyzer ® , SureSmile ® and Ortho Insight 3D ® . **Materials/Methods:** Twenty-five adult patients treated with Invisalign ® at CWRU's department of orthodontics were retrospectively collected. Initial STL files were obtained and imported into three software packages. The teeth were moved in order to replicate the virtual setup from ClinCheck ® Pro. Final outcomes were exported from each software package. ClinCheck ® Pro STL files were used as the reference while STL files produced by the other software packages were used as targets. Best fit superimpositions were performed using Geomagic ® Control X. Based on the results, tooth position was adjusted in the three software packages until the virtual setups from

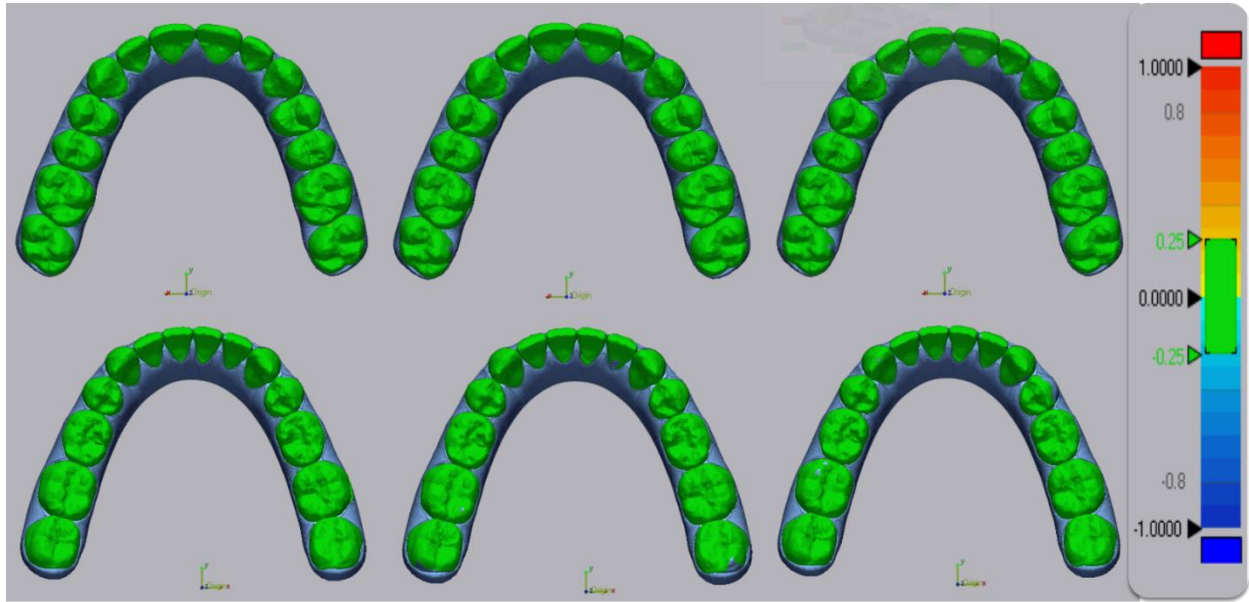
ClinCheck® Pro were replicated. Once confirmed, the tables containing the tooth movements were compared. The number of aligners and number of attachments automatically generated from each of the software packages were also evaluated. Results: Extrusion/intrusion ($p \leq 0.0001$) and translation buccal/lingual ($p \leq 0.0004$) were significantly different among the software packages. ClinCheck® Pro and SureSmile® ($p \leq 0.000$), SureSmile® and Ortho Insight 3D® ($p \leq 0.014$), SureSmile® and Ortho Analyzer® ($p \leq 0.009$), and Ortho Insight 3D® and Ortho Analyzer® ($p \leq 0.000$) generated a significantly different number of maxillary aligners. The results varied slightly for mandibular aligners with only ClinCheck® Pro and Ortho Insight 3D® ($p \leq 0.000$), SureSmile® and Ortho Insight 3D® ($p \leq 0.000$), and Ortho Insight 3D® and Ortho Analyzer® ($p \leq 0.000$) exhibiting a significant difference. ClinCheck® Pro and SureSmile® ($p \leq 0.000$) differed significantly in the number of attachments produced. Conclusions: There are statistically significant differences in extrusion/intrusion, translation buccal/lingual, number of aligners and number of attachments when implementing the same virtual setup on different software packages. Clinicians may need to consider this when utilizing software programs for digital diagnosis and treatment planning.



Ortho Analyzer

SureSmile

Ortho Insight 3D



Ortho Analyzer

SureSmile

Ortho Insight 3D

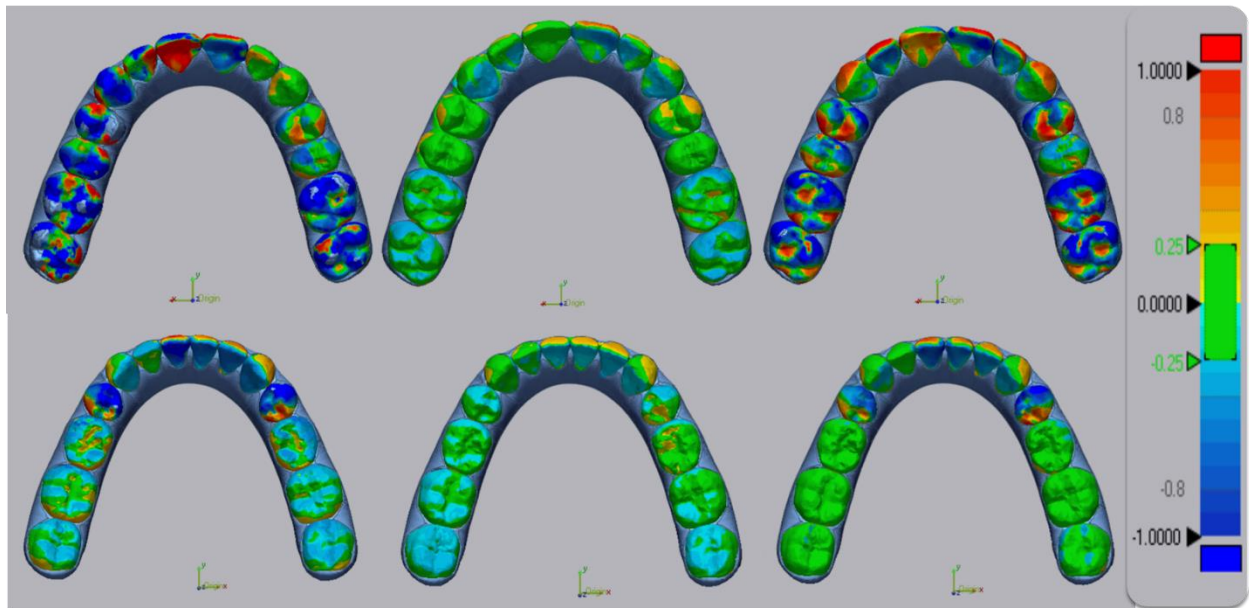


Table I: Kruskal-Wallis One-Way Analysis of Variance for All Tooth Movements

Tooth Movement Variables	ClinCheck® Pro (n=682) Mean ± SD	Ortho Analyzer® (n=682) Mean ± SD	SureSmile® (n=682) Mean ± SD	Ortho Insight 3D® (n=682) Mean ± SD	p-value
Extrusion/Intrusion (mm)	0.063 ± 0.025	0.329 ± 0.025	0.092 ± 0.025	0.136 ± 0.025	0.0001*
Translation Buccal/Lingual (mm)	0.248 ± 0.036	0.077 ± 0.036	0.234 ± 0.036	0.133 ± 0.036	0.0004*
Translation Mesial/Distal (mm)	0.016 ± 0.026	-0.027 ± 0.026	0.023 ± 0.026	0.023 ± 0.026	0.4630
Rotation Mesial/Distal (°)	-0.788 ± 0.350	-0.741 ± 0.350	-0.836 ± 0.350	-0.865 ± 0.350	0.9945
Angulation Mesial/Distal (°)	-0.149 ± 0.156	0.054 ± 0.156	-0.208 ± 0.156	-0.090 ± 0.156	0.6871
Inclination Buccal/Lingual (°)	0.740 ± 0.202	0.831 ± 0.202	0.686 ± 0.202	0.715 ± 0.202	0.9580

Table II: Pairwise Comparison for Extrusion/Intrusion.

Sample Comparison	Mean (mm)	Standard Deviation (mm)	p-value
ClinCheck® Pro – SureSmile®	0.063 – 0.092	± 0.621 – ± 0.652	0.226
ClinCheck® Pro – Ortho Insight 3D®	0.063 – 0.136	± 0.621 – ± 0.637	0.026*
ClinCheck® Pro – Ortho Analyzer®	0.063 – 0.330	± 0.621 – ± 0.656	0.000*
SureSmile® – Ortho Insight 3D®	0.092 – 0.136	± 0.652 – ± 0.637	0.311
SureSmile® – Ortho Analyzer®	0.092 – 0.330	± 0.652 – ± 0.656	0.000*
Ortho Insight 3D® – Ortho Analyzer®	0.136 – 0.330	± 0.637 – ± 0.656	0.000*

Table III: Pairwise Comparison for Translation Buccal/Lingual.

Sample Comparison	Mean (mm)	Standard Deviation (mm)	p-value
ClinCheck® Pro – SureSmile®	0.248 – 0.234	± 0.864 – ± 0.832	0.814
ClinCheck® Pro – Ortho Insight 3D®	0.248 – 0.133	± 0.864 – ± 0.915	0.004*
ClinCheck® Pro – Ortho Analyzer®	0.248 – 0.077	± 0.864 – ± 1.095	0.001*
SureSmile® – Ortho Insight 3D®	0.234 – 0.133	± 0.832 – ± 0.915	0.009*
SureSmile® – Ortho Analyzer®	0.234 – 0.077	± 0.832 – ± 1.095	0.002*
Ortho Insight 3D® – Ortho Analyzer®	0.133 – 0.077	± 0.915 – ± 1.095	0.601

Respond to the following questions:

1. Were the original, specific aims of the proposal realized?

- Development plan:

- a. Introduction to clinical research class at Case western Medical School was successfully completed with a grade “A”
- b. Currently enrolled in “Effective writing for Health Care” Harvard Medical School

- Teaching plan:

Established a new course “Digital Workflow” to teach residents the most recent advances in technology using tools for 3D Printing, in-house aligners, printing brackets and using software programs.

- Research Plan:

Proposed research plan is completed and now in the process of review before final publication.

2. Were the results published?

- a. The final manuscript is under review in a peer review journal for publication.
- b. AAOF was acknowledged

3. Have the results of this proposal been presented?

- a. Elshebiny T, Dhingra A, Stefanovic N, Palomo JM Comparing 3D tooth movement when implementing the same virtual setup on different software packages. AAO annual meeting. Miami, Florida. 2022.
- b. Elshebiny T, Dhingra A, Stefanovic N, Palomo JM Comparing 3D tooth movement when implementing the same virtual setup on different software packages. Angle east society meeting. Saint Petersburg, Florida. 2022.
- c. AAOF was acknowledged

4. To what extent have you used, or how do you intend to use, AAOF funding to further your career?

This AAOF funding has been critical to my early career development through supporting an important part of my research activity and providing me with opportunities to expand my knowledge in the area of computer science and technology. I plan to continue to build my research program in topics of 3D printing, Imaging , artificial intelligence and machine learning in orthodontics.