Accuracy of Dental Remote Monitoring Tooth Tracking Technology in Orthodontics

Homsi KD1 | Allareddy V1 | Kusnoto B1 | Atsawasuwan P1 | Viana G1 | Gajendrareddy P2 | Elnagar MH1

Introduction

DentalMonitoring™ is a remote monitoring platform designed to aid orthodontists with tracking patient care at a distance 1-6. The software facilitates asynchronous interpersonal interactions through a HIPPA compliant system 1-6. It is touted for its ability to track tooth movement, identify emergencies and encourage oral hygiene improvement 1-6. The software relies on the patients to record photos of their dentition on a weekly basis and upload them to the DentalMonitoring™ app on their smartphone 1-6. From there the DentalMonitoring™ software engages deep learning AI technology through their patented tooth tracking algorithm and communicates the treatment progression to the orthodontist and the patient 1-6. Although this technology has been evaluated by others, to date there has yet to be an in-vivo study utilizing fixed orthodontic treatment corroborating the ability of this technology to track tooth movement 1-6.

Hypothesis/Objective

Hypothesis: The DentalMonitoring™ algorithm can reconstruct accurate 3D models from DM™ remote scans by patients' smart phones and 3D track the tooth movement during in-vivo fixed orthodontic treatment.

Objective: The objective of this study is to compare the accuracy and reliability of stereolithography (STL) files generated from the DentalMonitoring™ application to STL files generated from the iTero® Element™ intraoral scanner during in-vivo fixed orthodontic treatment. The overall aim is to provide in-vivo evidence for the validity of the DentalMonitoring™ technology.

Method

Patients undergoing fixed orthodontic treatment with traditional brackets or bands at the UIC COD Department of Orthodontics were recruited to participate in this study. Of the 26 patients enrolled, 24 completed the study. The participants ranged from 14-55 years of age. Treatment was tracked across an average of 18 months. A chart for each patient subject was created within the DentalMonitoring™ account and linked to the patient's smartphone app. Both arches of each patient were scanned with an iTero® Element™ to produce an initial 3D model prior to tooth movement. The STL file of each arch was uploaded to the patient's DentalMonitoring™ chart and used as a baseline reference for the software's calculations. A DentalMonitoring™ scan and iTero® scan was taken at treatment initiation both with (T1) and without (T0) the fixed orthodontic appliances and at every future in-person adjustment appointment (T2-T10). Patients also continued the Dental Monitoring™ scans remotely from home once a week throughout the study period. The 3D STL file produced from the remotely reconstructed models from the DM™ scans and the 3D STL file from the iTero® Element™ reconstructed models were then superimposed using the 3D-compare analysis in Geomagic Control-X 2020 (3D Systems, Rock Hill, SC) 3D inspection and metrology software to calculate the global deviation between the two models based on the best fit alignment of the dentition. Descriptive analysis was used to determine the mean deviation at each time point for the maxillary and mandibular arches. Clinical significance was set to +/- 0.5mm based on the American Board of Orthodontics (ABO)–determined standards 7. (Refer to FIG 1)

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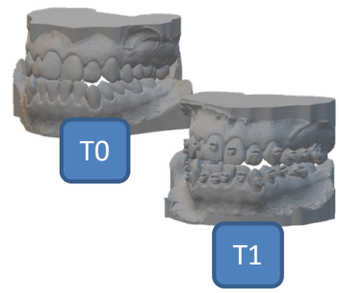
iTero®

Initial Records

iTero® Element™

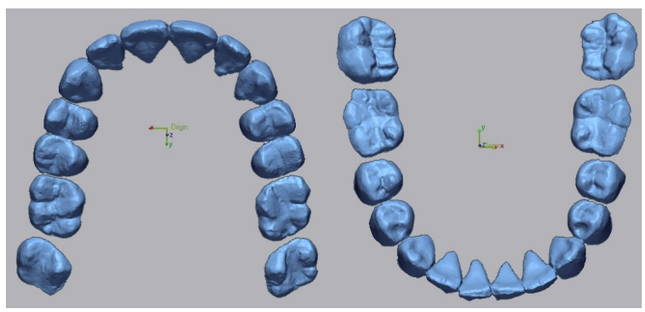
DentalMonitoring™

Initial Records



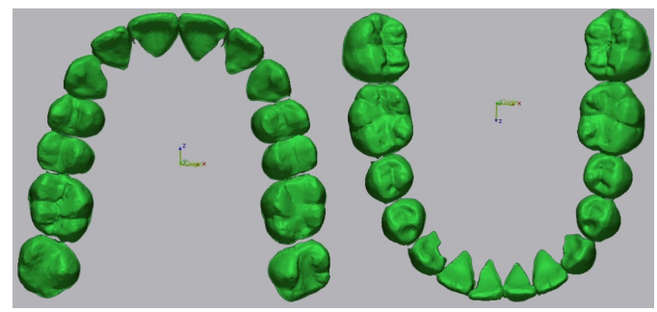
DentalMonitoring™

iTero®: Maxilla



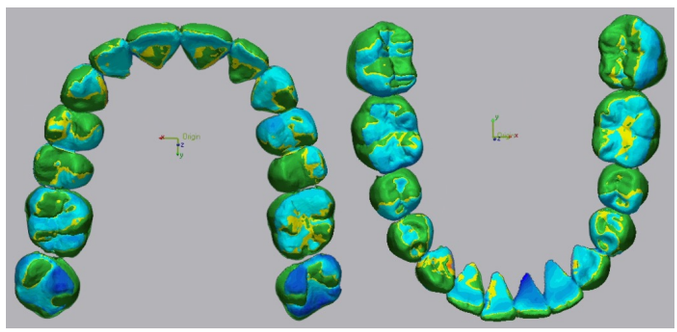
iTero®: Mandible

DM™: Maxilla



DM™: Mandible

SUPERIMPOSITION: Best Fit Alignment



3D COMPARE ANALYSIS

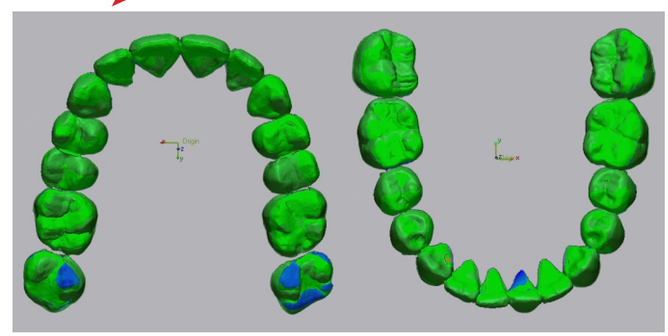


FIG 1: Study Design from Data Collection to Analysis

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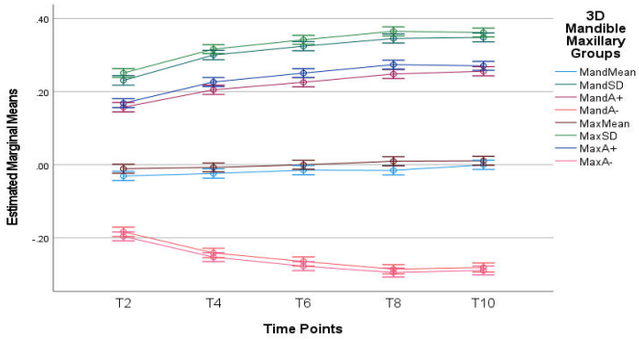
Results

FIG 2: Estimated Mean Differences between DM™ and iTero® models



No clinically significant differences were found. The marginal mean differences between the models at each time point for both the mandible and maxilla were found to be within the clinically acceptable range of +/- 0.5 mm (Table 1), as determined by the ABO standards 7. Global deviations between the DM remotely reconstructed models and the iTero constructed models increase with time and begin to plateau at T8 without reaching clinical significance (FIG 2).

TIME POINTS	Mean	Std. Deviation	(+) Average	(-) Average
T2 Maxilla	-0.0111	0.02594	0.1683	-0.1959
T2 Mandible	-0.0307	0.08731	0.1572	-0.1835
T4 Maxilla	-0.0073	0.03668	0.2263	-0.2527
T4 Mandible	-0.0241	0.03029	0.2050	-0.2413
T6 Maxilla	-0.0003	0.03863	0.2506	-0.2774
T6 Mandible	-0.0147	0.02558	0.2255	-0.2646
T8 Maxilla	0.0096	0.04096	0.2738	-0.2949
T8 Mandible	-0.0154	0.03268	0.2481	-0.2857
T10 Maxilla	0.0106	0.04197	0.2704	-0.2890
T10 Mandible	-0.0005	0.03006	0.2556	-0.2812

TABLE 1: Estimated Mean Differences between DM™ and iTero® models

Conclusion

The DentalMonitoring™ remote tooth tracking algorithm is capable of tracking tooth movement during fixed orthodontic treatment.

Acknowledgments

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