



Asynchronous Teledentistry: Assessing Efficacy With Three Intraoral Image Capture Devices

Harrison Karp, DDS, Julia Kim, DDS, Courtney Chinn, DDS, MPH

New York University, College of Dentistry, New York, NY, USA

Department of Pediatric Dentistry, New York University, College of Dentistry, New York, NY, USA

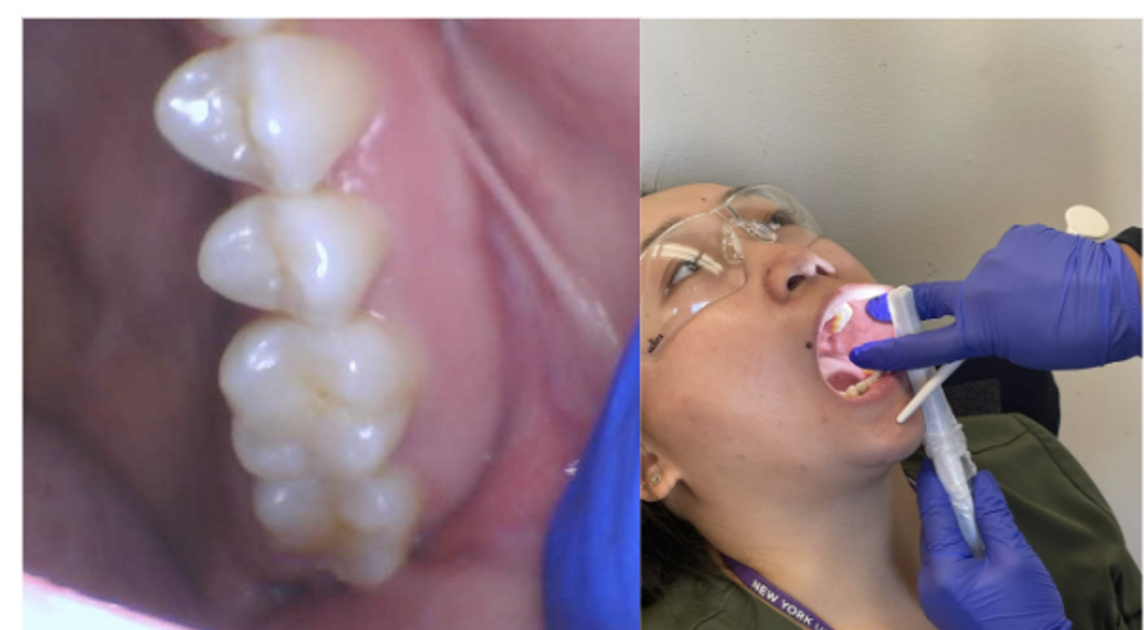
Introduction

Within asynchronous teledentistry, there are few best practices for image capture, including determining the required number of images or the quality of camera. The purpose of this study was to compare the efficacy of a standardized set of intraoral images using three different devices: a low-cost intraoral camera (MouthWatch), a smartphone (Iphone 8), and a high definition intraoral camera (MouthWatch Plus+), for use in a community-based setting.

Materials and Methods

Intraoral image sets of five adult volunteers were captured by two calibrated 3rd-year dental students. Calibration of image capturers consisted of three 2-hour sessions, during which they captured 2 practice image sets on each device. Image capturers followed a guide that included directions for each image, oral structures to be visualized, and the recommended position of the patient and the image capturer. An additional team member was present solely to record the total time and total number of images required to complete each image set. Image sets were organized independently by Image capturers. Two calibrated dentists independently reviewed completed image sets.

Figure 1: Example instructions from the NYU Pediatric Dentistry Image Capture Guide for Community-Based Teledentistry



9. Maxillary Left Quadrant:
Occlusal Buccal Directions:
Have pt swallow then open.
Take image from first premolar
to most posterior tooth capturing
the occlusal and buccal aspect-
use single retractor if needed.
Required structures to be
visualized: Occlusal and buccal
surfaces of #12-16 and
associated gingiva, buccal and
vestibular mucosa

Figure 2: Example of completed 15-image set



Results

Table 1: Dental reviewer acceptability and total time and number of images required

Image	% Acceptability HK	% Acceptability JK	Image	% Acceptability HK	% Acceptability JK
Frontal Smiling (n=60)	40	40	Mandibular Left Posterior Occlusal Lingual (n=60)	48.33	48.33
Maxillary Anterior Buccal (n=60)	43.33	41.67	Mandibular Left Posterior Occlusal Buccal (n=60)	53.33	53.33
Mandibular Anterior Buccal (n=60)	66.67	68.33	Right Side Molar Occlusion (n=60)	28.33	28.33
Maxillary Anterior Incisal-Palatal (n=60)	53.33	65	Left Side Molar Occlusion (n=60)	65	66.67
Mandibular Anterior Incisal-Lingual (n=60)	38.33	41.67			
Maxillary Right Posterior Occlusal Palatal (n=60)	38.33	41.67	MW (n=300)	44.33	45.67
Maxillary Right Posterior Occlusal Buccal (n=60)	38.33	40	Iphone (n=300)	52.33	53
Mandibular Right Posterior Occlusal Lingual (n=60)	61.67	58.33	MW HD (n=300)	48.44	51
Mandibular Right Posterior Occlusal Buccal (n=60)	43.33	40			N
Maxillary Left Posterior Occlusal Palatal (n=60)	58.33	56.67	Overall Average Time (sec)	174.35 (SD: 66.42)	60
Maxillary Left Posterior Occlusal Buccal (n=60)	50	58.33	Overall Average # Images	16.37 (SD: 1.65)	60

Figure 3: Side by side image comparison (L to R) Iphone 8, Mouthwatch, and Mouthwatch HD



Table 2: Dental reviewer agreement by location and device type (* p>0.05)

Location	% Acceptability HK	% Acceptability JK	% Agreement HK-JK	Location	% Acceptability HK	% Acceptability JK	% Agreement HK-JK
Mandibular Anterior (n=120)	52.5	55	97.5	Anterior (n=300)	48.33	51.33	95
Other (n=780)	47.82	49.1	96.15	Posterior (n=600)	48.5	49.17	97
Maxillary Anterior (n=120)	48.46	53.33	90*	Maxillary (n=360)	46.94	50.56	93.1*
Other (n=780)	48.33	49.36	97.31*	Mandibular (n=360)	51.94	51.67	98.1*
Maxillary Posterior (n=240)	46.25	49.17	94.58	Buccal/Facial (n=540)	47.59	48.52	96.85
Other (n=660)	49.24	50.15	96.97	Lingual/Palatal (n=360)	49.72	51.94	95.56
Mandibular Posterior (n=240)	51.67	50	98.33*	Right Side (n=300)	42*	41.67*	96.33
Other (n=660)	47.27	49.85	95.61*	Left Side (n=300)	55*	56.67*	97.67

Results (cont.)

Table 3: Mean number of images and time to complete by device type (* p>0.05)

Device Type	Mean number of images taken to complete set	Mean Time (sec) to complete set
MW	15.5	159.07
Iphone	18.05	193.27
Mean Difference	-2.550*	-34.2
MW HD	15.55	170.73
Iphone	18.05	193.27
Mean Difference	-2.500*	22.54
MW	15.5	159.07
MW HD	15.55	170.73
Mean Difference	-0.05	-11.66

A total of 60 image sets that included 900 images were captured and reviewed. The average time to complete a 15-image set was 174.35 seconds and required taking 16.37 images. Dental reviewers HK and JK found that 48.44% (436/900) and 49.89% (449/900) of images were of acceptable quality and able to visualize all necessary structures respectively. The two evaluators agreed on the acceptability of 96.33% of images (867/900). On average, image capturers using the MouthWatch camera and MouthWatch Plus+ camera took 2.55 and 2.50 fewer images per image set than when using the iphone, respectively (p<.001).

No significant difference in image acceptability was found by device type or by tooth surfaces or location. Images taken on patient's left side had significantly higher acceptability than images taken on the right. Significantly higher agreement between reviewers was found for mandibular teeth compared to maxillary teeth. No significant differences in the average total time to complete image capture were found by device type.

Discussion

No significant differences in reviewer acceptability were found by device type and training may be a key determinant for successful image capture. Image capturers were aware of being timed and having a total image count, which may have contributed to potential bias to rush and/or choose not to take extra imaging. Strict acceptability criteria may also have contributed to the study's outcomes, with each image being evaluated individually and not considered acceptable even if a missing structure could be visualized on a different image within the set. Teledentistry also involves assessing screening forms, health histories, x-rays, as well as imaging, which have been found to be equivalent to in-person exams. Future studies should include exploring the optimal number of images and level of training required for remote diagnosis of specific oral diseases and establishing recommendations and preferred practices for asynchronous teledentistry.

Acknowledgements

The authors would like to thank Rochelle Bubis, Sonia Sondhi, Madusha Perera, Hannah Kim, Helen Chen, Seeun Mo, Rami Habib, and Liz Best for their involvement in this project.