Near Infrared Transillumination Efficacy for Interproximal Caries Detection in Children

Children's Hospital Colorado

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BACKGROUND AND PURPOSE

- Near Infrared transillumination (NIRT) is a non-radiographic method of caries detection using visible light.
- There is limited evidence on efficacy of NIRT in detecting interproximal carious lesions in primary or mixed dentition.
- The aim of this clinical trial was to determine the efficacy, efficiency, and acceptability of NIRT in diagnosing interproximal carious lesions in children as compared to bitewing radiographs (BW).

METHODS

- The study was approved by IRB at University of Colorado and registered at clinicaltrials.gov (#NCT05362461).
- Healthy, cooperative, high caries-risk children (5-9 years) at Children's Hospital Colorado, with contacting (non-restored) primary molars were screened and offered participation.
- Exclusion criteria included ASA III-IV and parents speaking any language other than English or Spanish.
- Fifty subjects were enrolled in the study and randomly assigned to one of two study arms: (Group 1) NIRT images prior to BW; (Group 2) BW prior to NIRT images.
- The NIRT images were taken at 780nm using Dexis CariVu^{TM} after air drying the tooth for 5 seconds. Standard BW were taken using 60kV, 7mA, and 0.125s settings.
- An independent, masked observer scored the behavior and documented time for capturing images.
- Patients and parents completed a short exit survey regarding their preference of either modality.
- Two calibrated evaluators scored BW and CariVu images for interproximal lesions at two timepoints. Both evaluators agreed on a final score which was used for analysis.
- Inter- and intra-rater reliability was determined, and data was analyzed using R statistical analysis software.
- Specificity and sensitivity was calculated for both imaging.

RESULTS

- The order in which BW and NIRT images were taken did not impact the study outcomes.
- Intra-rater reliability was 'substantial to almost perfect' for BW (wκR1=0.91, wκR2=0.80) and 'substantial' for NIRT (wκR1=0.64, κR2=0.73).
- Inter-rater reliability was 'substantial' for BW (wκ=0.75; 95%CI:0.65-0.84) and 'moderate' for NIRT (wκ=0.50; 95%CI:0.25-0.49).
- The agreement between NIRT and BW scores was 'none-to-slight' (wκ=0.26; 95%CI:0.14-0.37).
- The parents and patients preferred NIRT over BW images.
- The median time required for capturing BW images was longer (*P*<0.001) than that required for NIRT.
- Between the combined scores (BW vs. NIRT), the sensitivity and specificity for NIRT was 0.27 and 0.91, respectively.
- Between the images (BW vs. NIRT), the diagnostic efficacy was 'unsatisfactory' (AUC=0.59).

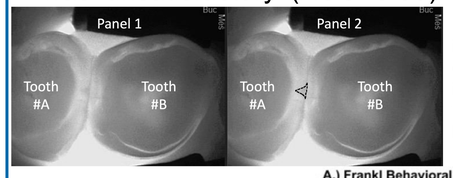

Figure 1: A sample NIRT image of interproximal area between tooth #s A-B (panel 1). Panel 2 demonstrates the same image with an interproximal enamel lesion on the mesial surface of tooth #A outlined with a black dotted line.

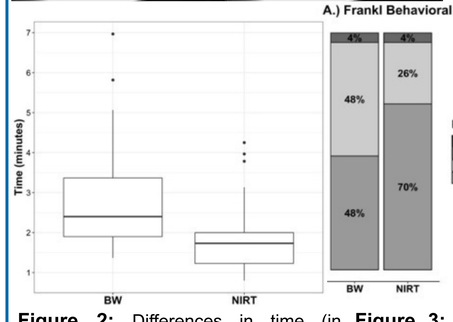

Figure 2: Differences in time (in minutes) for capturing bitewing radiographs (BW) and near infrared transillumination (NIRT) images.

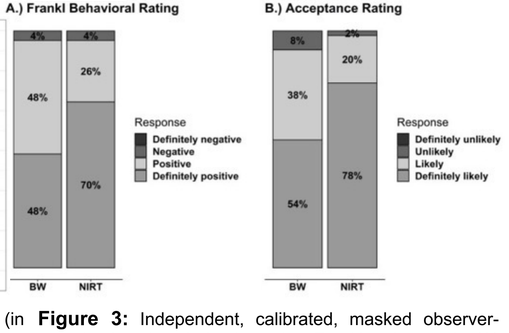

Figure 3: Independent, calibrated, masked observer-perceived patient behavior using Frankl rating scale (A) and acceptance (B) of bitewing radiographs (BW) and near infrared transillumination (NIRT) images.

RESULTS

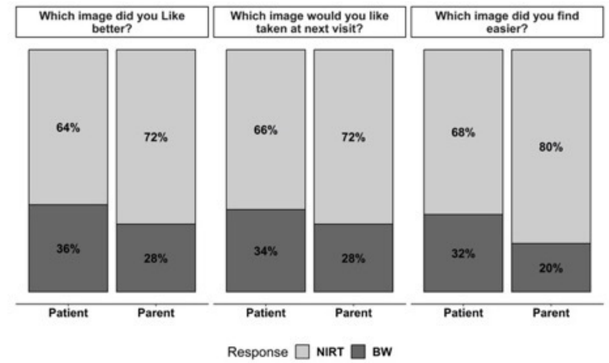

Figure 4: Patient- and parent-reported responses on survey evaluating the acceptance, ease, and preference for BW or NIRT imaging modality.

Discussion

- Patients and parents reported that capturing NIRT images was more comfortable and tolerable as compared to BW.
- Although capturing NIRT images was efficient and acceptable to patients and parents, NIRT images are limited in terms of diagnosing interproximal carious lesions in children.
- NIRT is a valuable tool for frequently tracking carious lesions in high caries-risk children with radiation concerns.
- The NIRT imaging modality has the potential to be harnessed for artificial intelligence and machine learning to create decision-making logical paths for detection software to help train students and dentists.
- Investigation is needed to study the efficacy of higher wavelength NIRT (830-1310nm) in detection.

ACKNOWLEDGEMENT

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REFERENCES

- Available upon request