Evaluation of the Tru-Align™ PID Using Optically Stimulated Luminescence Dosimetry

J. Seltzer*[1], D.C. Colosi [1], M.Bonvento [2], J. Biernacki [3], N. Roe[3], W. Zhang [4], K. Abramovitch [4], and A.D. Goren [1]

[1] Department of General Dentistry, School of Dental Medicine, SUNY Stony Brook, NY; [2] Department of Radiology, Stony Brook University Hospital, SUNY Stony Brook, Stony Brook, NY ; [3] Department of Radiological Health Services, Suffolk County, New York, [4] Section of Radiology, Department of Diagnostic Sciences, The University of Texas Health Science Center at Houston Dental Branch

Background: Rectangular collimation has been recommended by the ADA and the NCRP to be used whenever possible. Optically stimulated luminescence (OSL) has high levels of sensitivity and a wide range of dose measuring capabilities, down to 1 mrad. The optical readout method is fast and simple, and has become the method of choice for many areas of radiation dosimetry.

Objective: To compare phantom radiation exposure with the Tru-Align™ rectangular collimator to that with a conventional round collimator using InLight Dot Dosimeters. .

Methods: Dose measurements were conducted using exposure factors for a Schick digital sensor on a DXTRR phantom (Dentsply Rinn) and a cardboard cutout of both rectangular and round collimators. All normalization measurements were recorded using a calibrated Radcal MDH model 1015 dosimeter and InLight OSL Dot Dosimeters. The dosimeters measure radiation exposure with aluminum oxide detectors, and uses a light emitting diode array to stimulate the detectors; the amount of light released is directly proportional to the radiation dose. TLD measurements were also used for comparison.

Results: The Tru-Align™ instrument reduced the skin surface area dose by a factor of almost 5 when compared to round collimation. These measurements indicate a reduction of radiation exposure at the periphery of the circular collimation area from 70.8 mR (with round collimation) to 2.6 mR (with Tru-Align).
The Tru-Align instrument was easy to use. However, in certain instances, the perimeter of the rectangular collimator was not large enough to completely cover the sensor, resulting in unexposed areas at the sensor periphery (i.e., cone-cuts).

Our measurements indicate that OSL dosimeters have a 5 to 20% higher sensitivity when compared with TLD's.

Conclusions: The Tru-Align™ reduced radiation exposure at the points studied by a factor of almost 5, gave perfect alignment, and was easy to use; however, it did not allow complete coverage of the usable area of the sensor.

In our experience, the InLight dot dosimeters had a high level of sensitivity, a wide range of measuring capabilities in the low dose range, and a fast and relatively simple readout of samples.

Acknowledgement: IDI, Interactive Diagnostic Imaging,Inc. for use of the Tru-Align™.
Conflict of interest: None

Efficacy of Rectangular Collimators for Intraoral Radiography

Zhang W[1], Abramovitch K[1], Thames W[1], Leon I-L[1], Colosi DC[2], Goren AD[2],
[1] *Radiology Section, Department of Diagnostic Sciences, Univ. of Texas Dental Branch at Houston, Houston, TX.*, [2] *Department of General Dentistry, School of Dental Medicine, SUNY Stony Brook, NY;*

Background: Rectangular collimation for intraoral radiography significantly reduces patient exposure to ionizing radiation and is recommended by the ADA and the NCRP. Consequently, various types of rectangular collimation instruments are being devised but the efficiency and accuracy of these instruments have not been evaluated yet.

Objectives: This study is designed to compare the operating efficiency and technical accuracy of three different types of rectangular collimation:

Type I: "free-hand" alignment adjacent the Position Indicating Device (PID) of the X-ray unit (used at Dental Branch)

Type II: mechanical interlocking alignment to the position indicating ring of an XCP film-holding device

Type III: magnetic alignment to a position indicating ring attachment (Tru-Align)

Methods and Materials: A Rinn XCP unit was used with a Planmeca Intra rectangular collimator for the Type I "free-hand" alignment. For the Type II collimation, a Planmeca Intra rectangular collimator was modified to mechanically interlock and align to the position indicating ring of a Rinn XCP instrument. The Tru-Align instrument was used for the magnetic Type III collimation. Thirty-three sophomore dental and first year dental hygiene students were recruited to test the collimators. IRB approval was obtained for their participation. An 18 exposure Full Mouth Series (FMS) of radiographs was taken on DXTTR phantoms. Thus, nine views were taken per right or left side. Photostimulable phosphor (PSP) plates were used for image capture. Eighteen students exposed one side of the DXTTR with Type I "free-hand" collimation and the other side with Type II direct interlocking collimation. Fifteen students exposed one side with Type I collimation and the other side with Type III magnetic collimation. The time taken to expose each half of the FMS was measured. To determine the user friendliness of the collimation types, a question survey using a 5 point rating scale was completed by each student. Technique errors were measured by the number of views with placement errors, projection geometry errors and cone cuts, and by the total surface area of cone cuts per half FMS. These errors were evaluated by experienced radiologic technologists. The Student's t test or signed rank test was used to determine statistical difference between the different collimator types.

Results: Compared with Type I, Type II collimation significantly shortened the time required to finish a 9 exposure half FMS (31.03 min vs. 37.14 min, $p=0.007$) and it was judged much easier to use (score 4.07 on 5 point scale, $p<0.0001$). But Type II generated significantly more placement errors (3.76/9 vs. 2.94/9, $p=0.04$) and more cone cut errors (1.29/9 vs 0.47/9, $p=0.008$), although total cone cut area per half FMS and projection error were similar to type I ($p=0.42$, and 0.65, respectively). Meanwhile, compared with Type I, Type III was judged easier to use (score 4.27 on 5 point scale, $p<0.0001$). But Type III generated significantly more cone cuts (5.4/9 vs 1.2/9, $p=0.0002$) and a much larger total cone cut area (1088.83 mm^2 vs. 50.25 mm^2, $p<0.0001$). The time taken to complete the half FMS, and the placement and projection errors were comparable ($P=0.10$, 0.52, and 0.65, respectively).

Discussion: This study demonstrated that Types II and III collimations are more user-friendly. Type II collimation has shorter operating time compared to Type I. Type II and III collimation have increased cone cut error. The heavier weight of the Type II collimator is likely to cause the placement error, and the relatively small window of type III may contribute to the cone cut error. Further optimization of the design of these instruments is expected to improve their performance and utility.

Acknowledgements: The authors acknowledge the Interactive Diagnostic Imaging, Inc. (Marietta, GA) for providing the Tru-Align instrument.
Conflict of Interest: None