



# *Accuracy and Reliability of Shade Detection from an Intraoral Scanner*

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# Disclaimer

2

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# Outline



- Background
- Objective
- Materials and Methods

# Background



- Shade matching...
  - has been used since the start of tooth-colored restorations
  - has traditionally been done by the human eye
    - ✦ Error-prone due to human error and external/internal factors



# Background

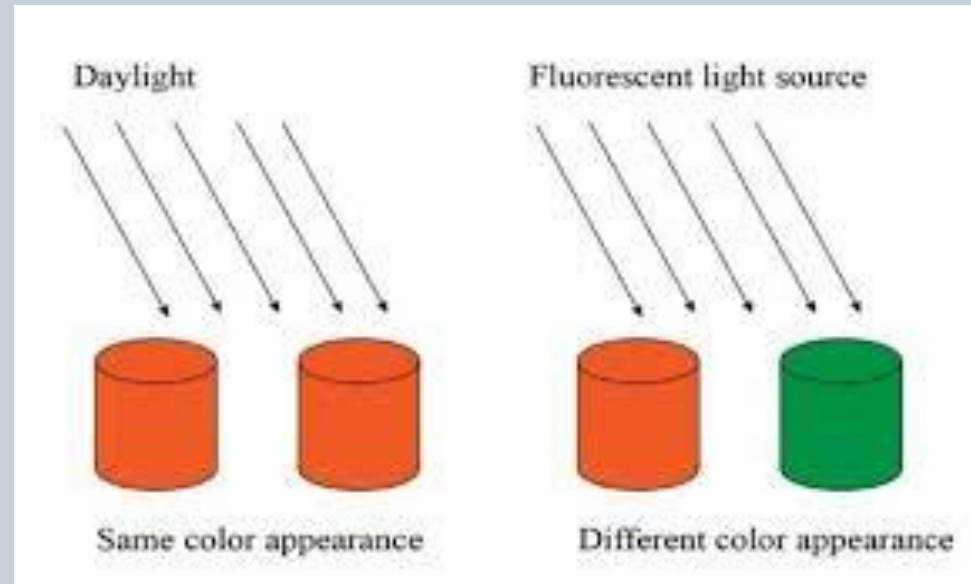
## Factors affecting shade perception

### ○ External factors:

- ✦ Type of light
- ✦ Quantity of light
- ✦ Surrounding environment
- ✦ Color adaptation
- ✦ Metamerism →

### ○ Internal factors:

- ✦ Surface texture
- ✦ Translucency



# Background



- Shade matching with machines
  - Multiple studies showed intraoral color-measuring devices having high accuracy and consistency
  - A literature review covering 249 articles concluded that digital methods showed higher accuracy and reliability compared to visual methods and that spectrophotometers provided the highest overall accuracy and reliability among the different shade selection instruments (Farhad et al 2021)
  - One study showed the spectrophotometer accuracy was 83.3% while human accuracy was 26.6% (Paul et al 2002)

# Background

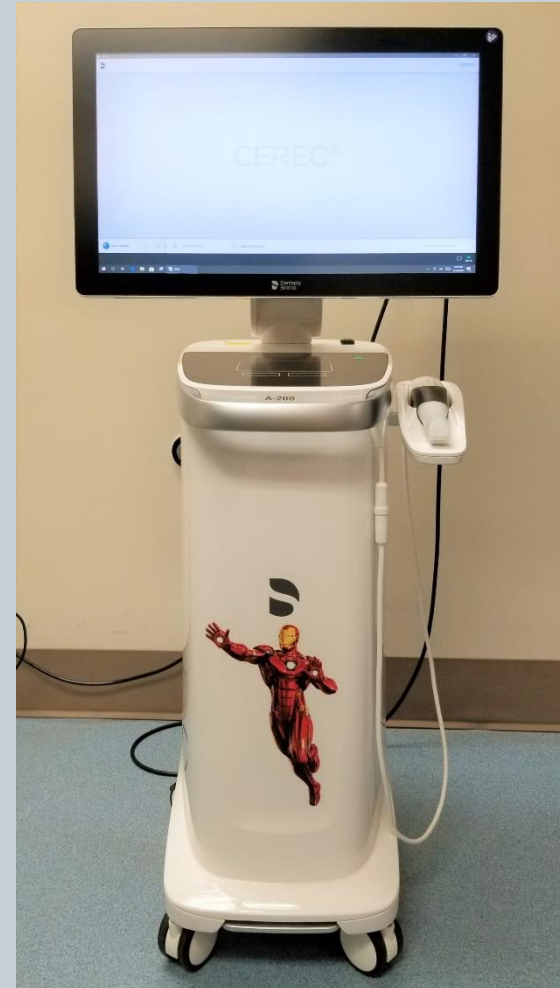


- An in-vitro study (Kim-Pusateri et al 2009) compared the accuracy and reliability (consistency) of four dental shade-matching devices
  - Accuracy = getting the correct shade repeatedly
  - Reliability = getting the same shade repeatedly
- The study found all shade-matching devices had similar reliability (87.4-99.0%), but the VITA Easyshade had the highest accuracy (92.76%)

# Background



- The Sirona Primescan is an intraoral scanner with a new color-detecting feature.
- Only a few studies have been published on its new color-detecting feature.



# Background



- Ebeid et al (2020) examined four intraoral scanners (VITA Easyshade, 3Shape Trios, Cerec Omnicam, Cerec Primescan) and concluded that all intraoral scanners showed less than expected accuracy and repeatability so caution should be exercised.
- A recent study looked at the TRIOS 3 intraoral digital scanner and found an accuracy of 27.5% for the VITA Classical shade guide and 53.3% for the VITA 3D Master shade. (Rutkunas et al. 2020)

# Objective



- The purpose of this study is to compare the accuracy and reliability of the shade analysis feature of a new intraoral scanner system, Primescan, to the dental shade-matching device, VITA Easyshade.

# Null Hypotheses



- There will be no difference in accuracy and reliability between the VITA Easyshade and the intraoral scanner, Primescan.

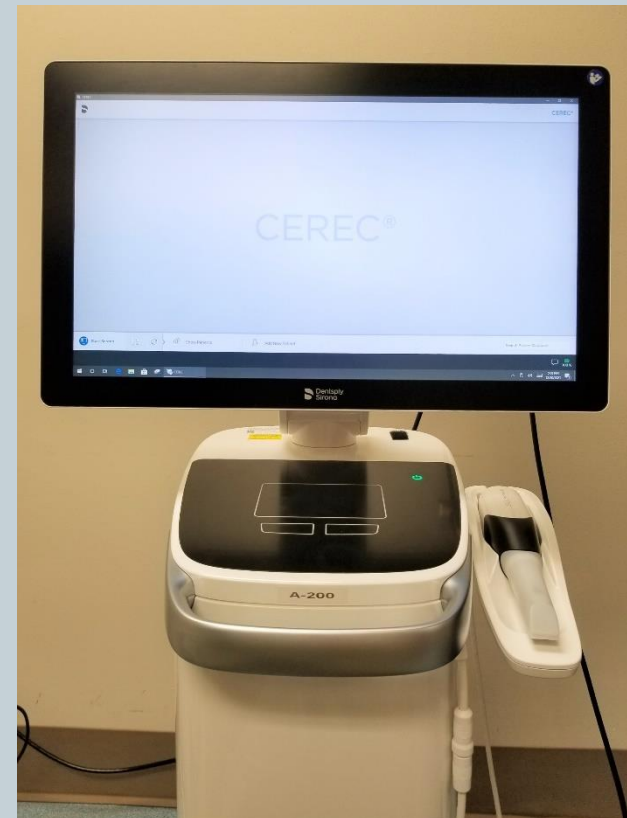
# Materials and Methods



Spectrophotometer  
VITA Easychade



Intraoral Scanner  
Primescan



# Materials and Methods



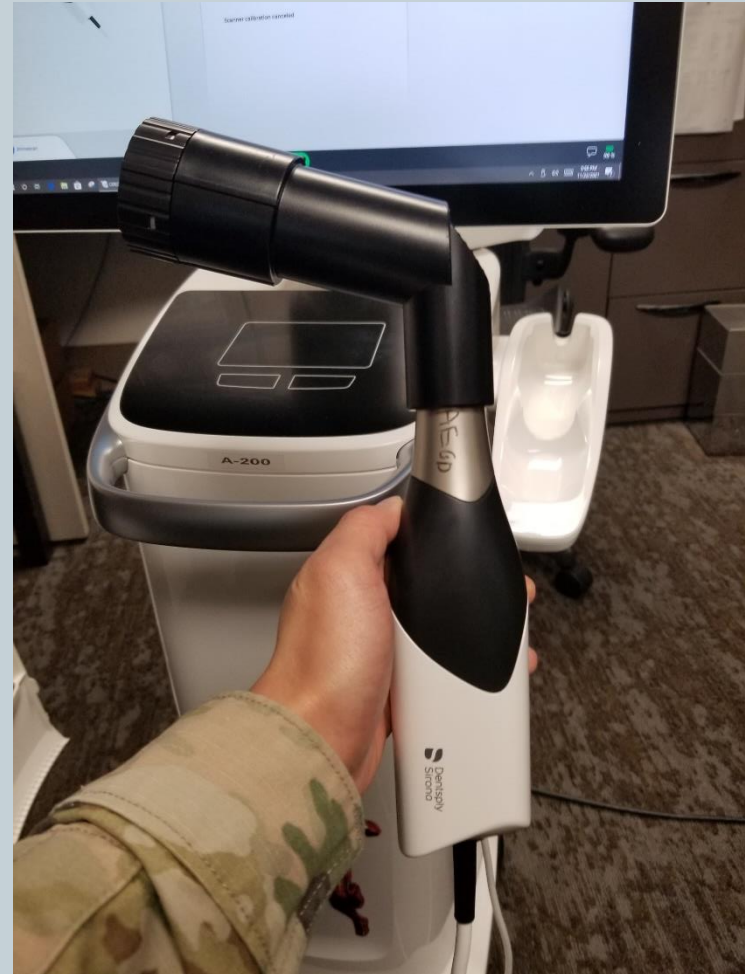
- VITA Easyshade Calibration



# Materials and Methods



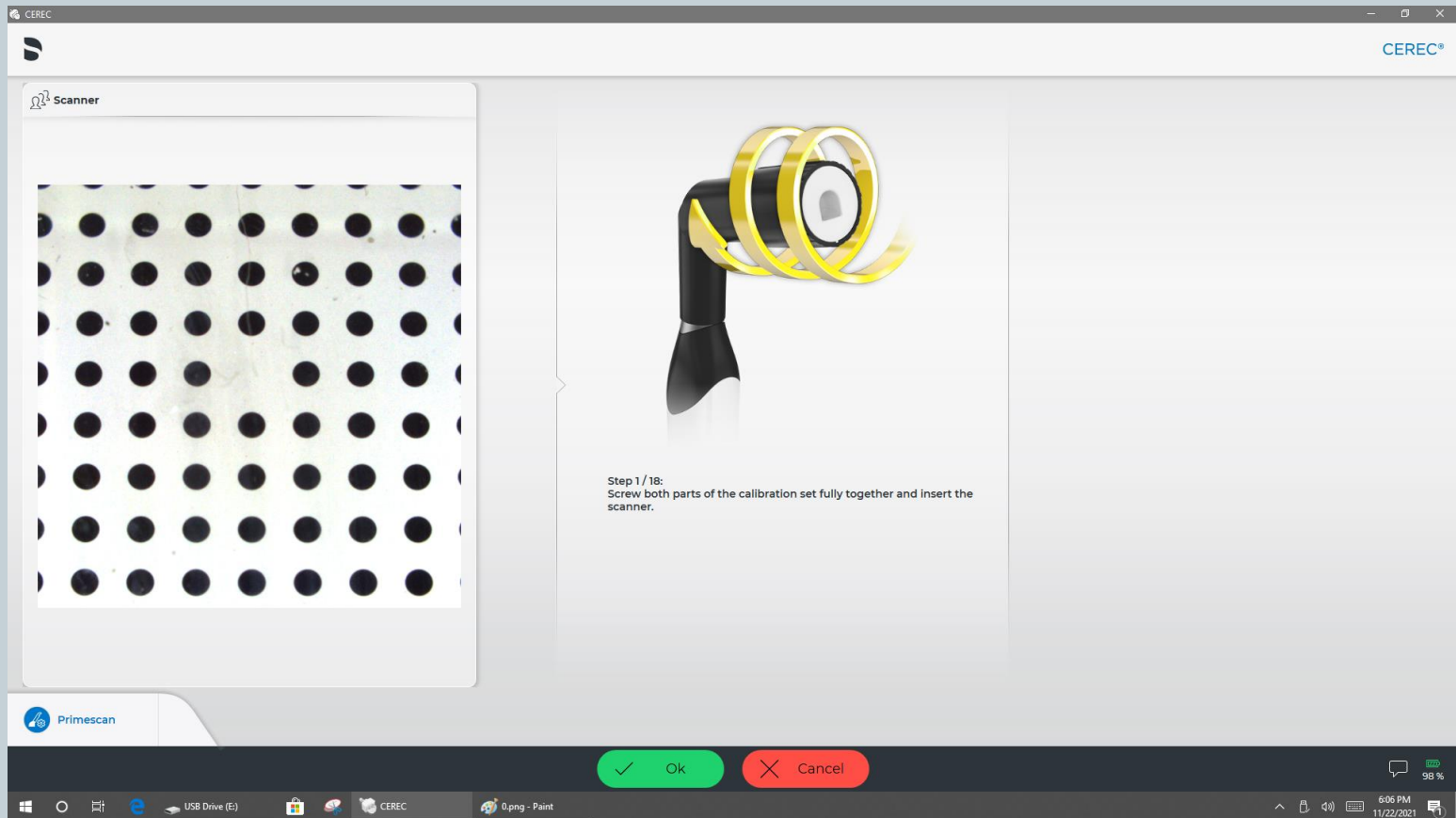
- Primescan Calibration



# Materials and Methods



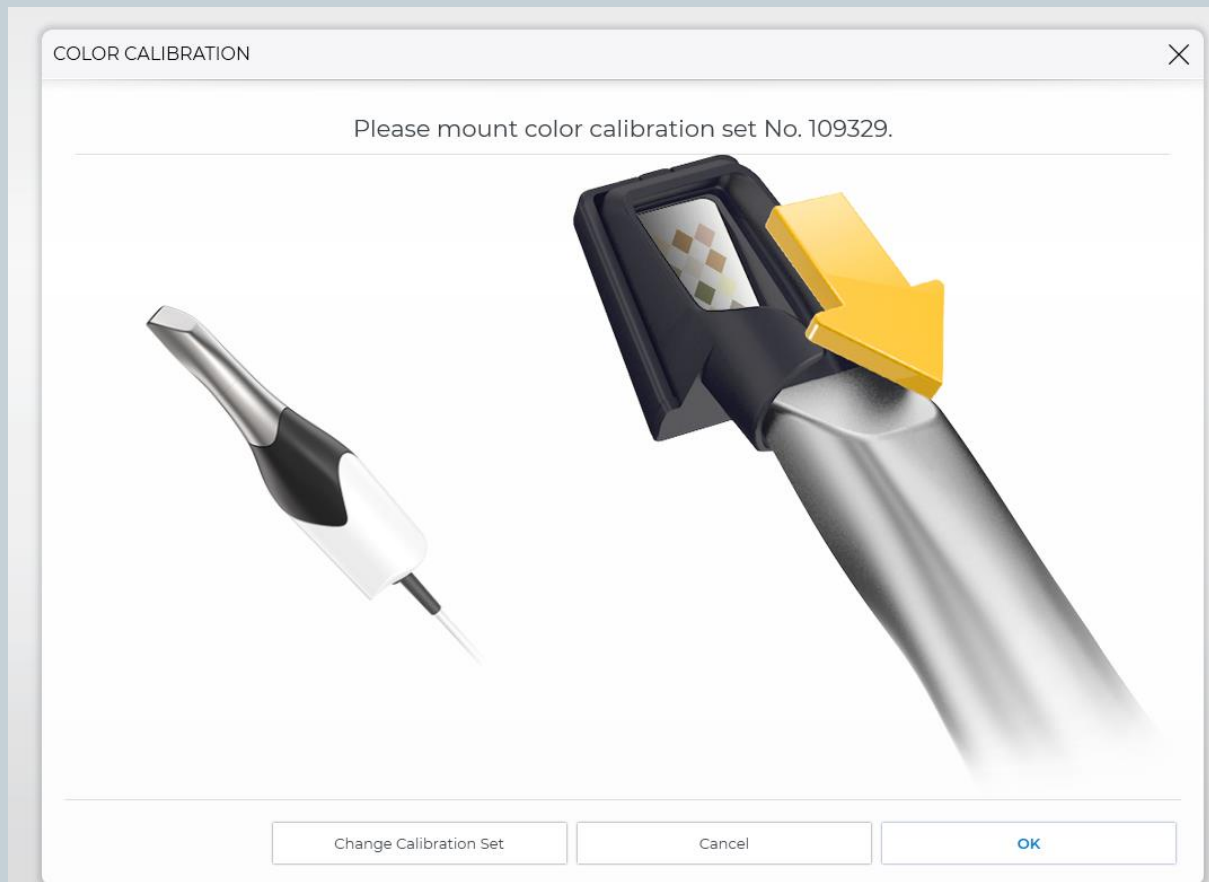
- Primescan Calibration



# Materials and Methods



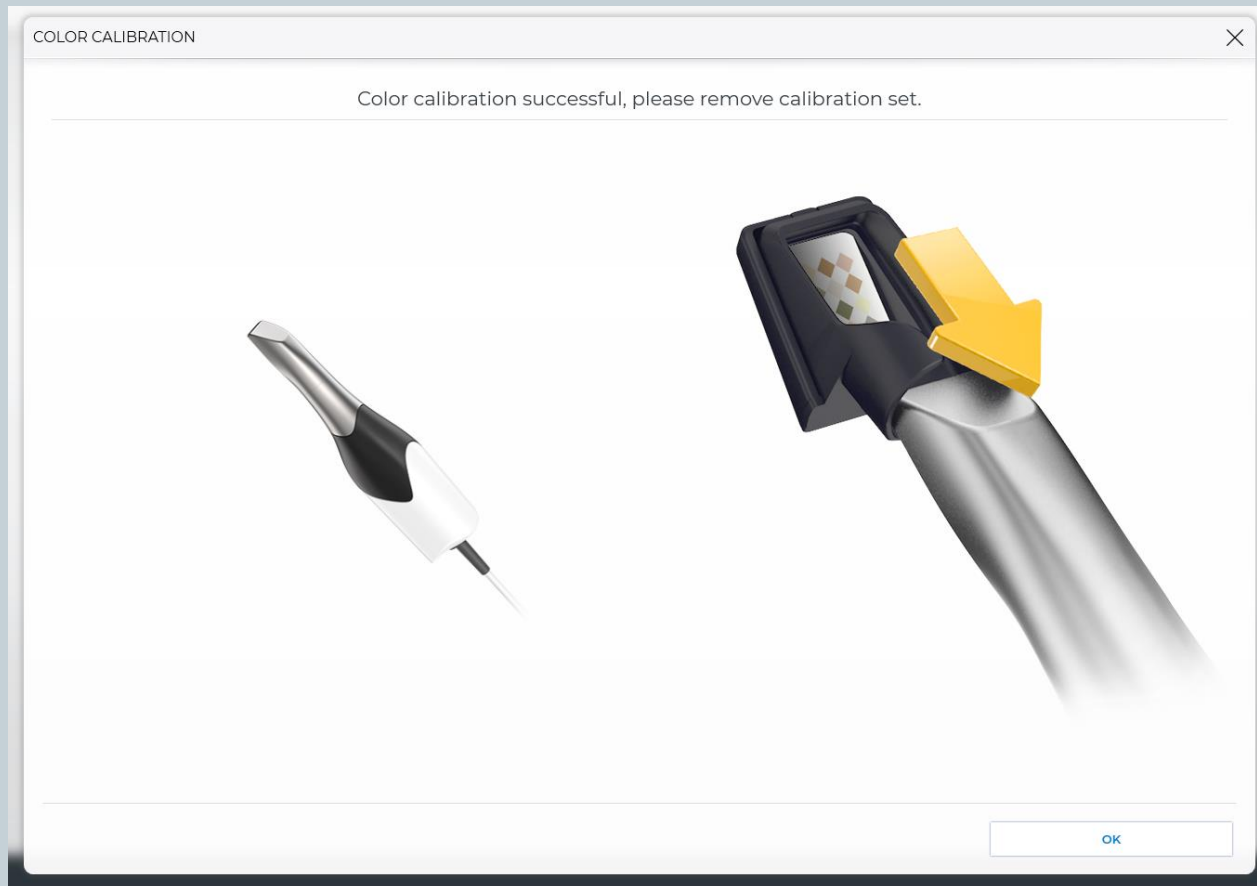
- Primescan Calibration



# Materials and Methods



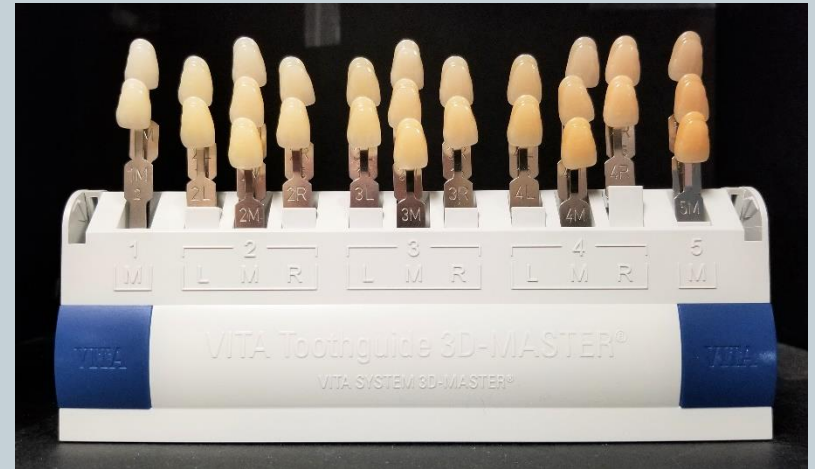
- Primescan Calibration



# Materials and Methods



VITA Classical shade guide  
**x10**



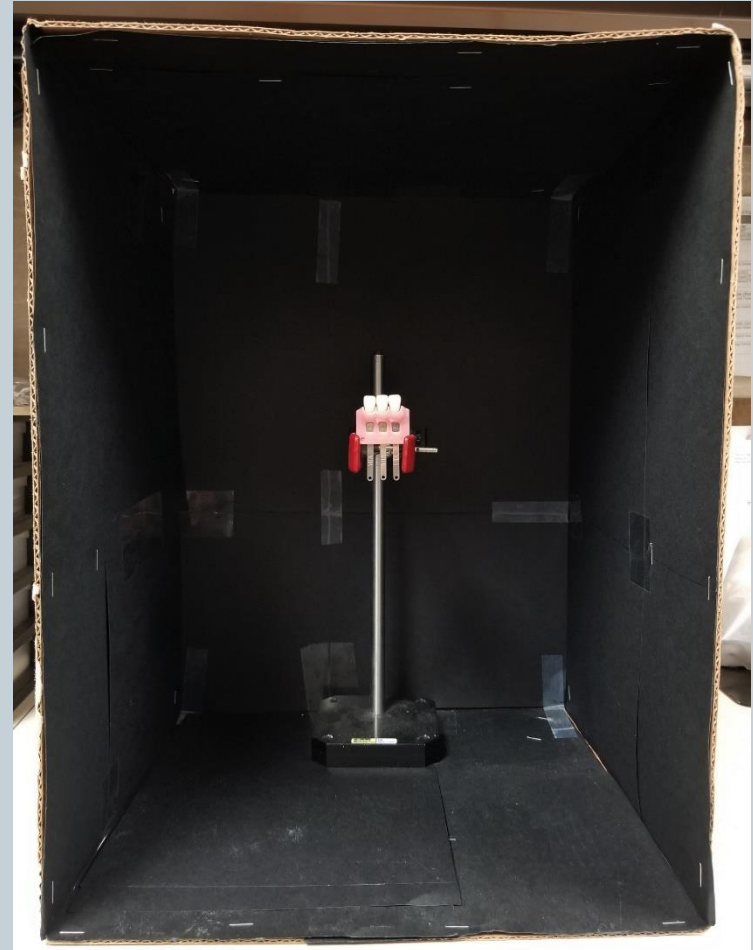
VITA 3D-Master shade guide  
**x10**

# Materials and Methods



Cardboard box with black construction paper attached inside

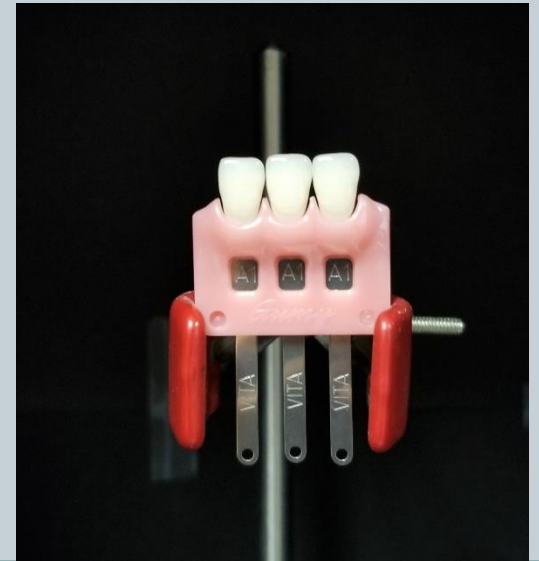
Stand to hold medium gingiva-colored matrix



# Materials and Methods



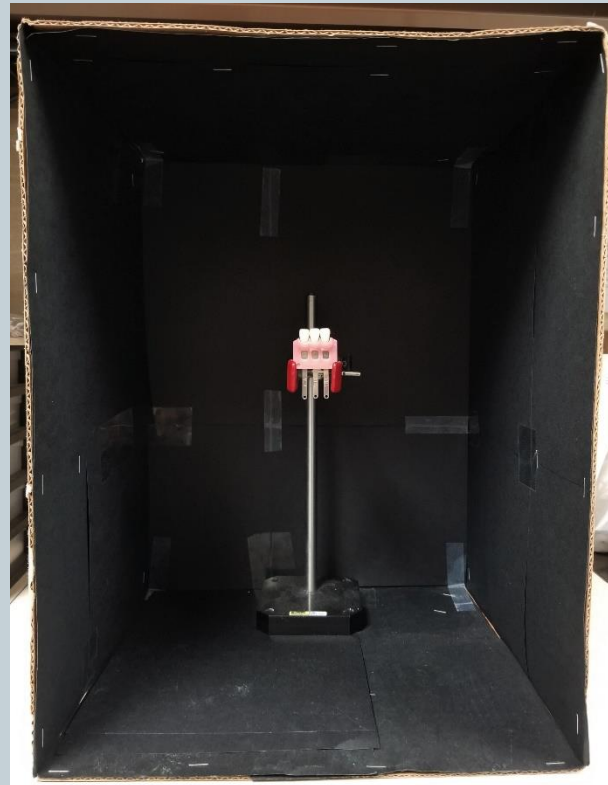
- 3 identical shade tabs were placed into a medium gingiva-colored matrix
- Each shade tab from VITA Classical (16 tabs) and VITA 3D-Master (26 shade tabs) shade guides was placed in the middle position and scanned by both the VITA Easyshade and Sirona Primescan.
- 840 recordings were performed in total



# Materials and Methods



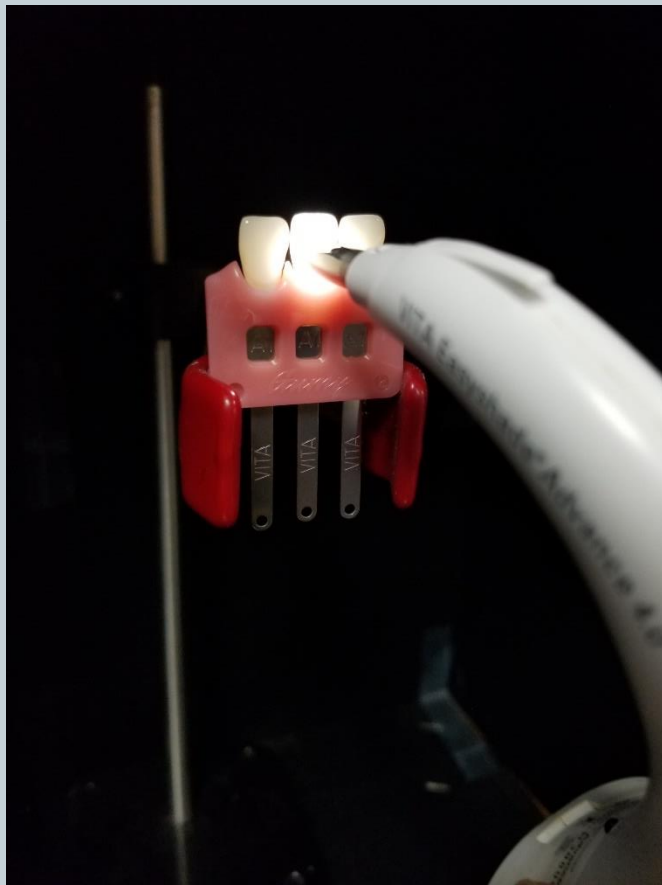
- The gingiva matrix was held in place and placed in a black box to simulate the oral cavity



# Materials and Methods



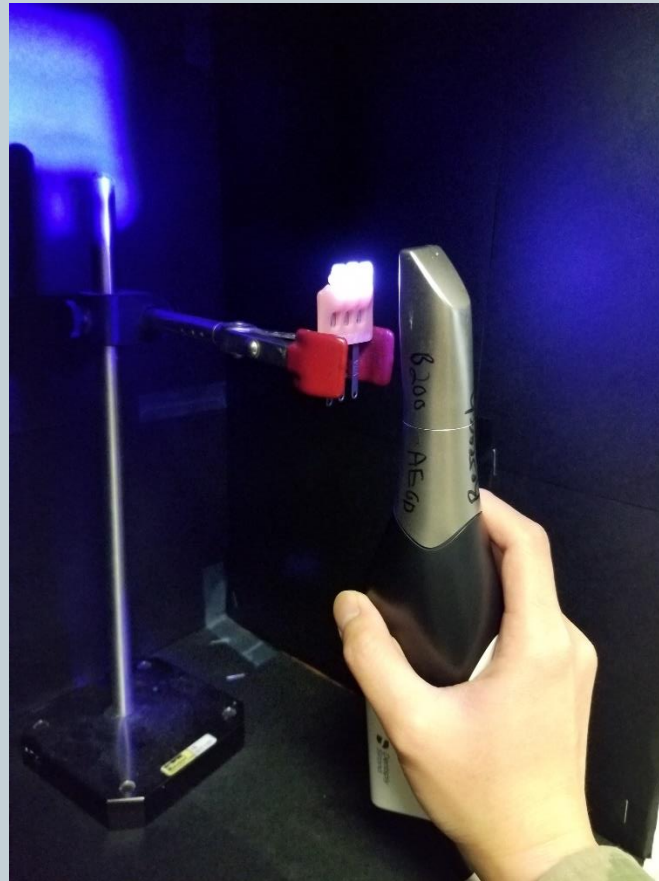
- Shade tabs scanned with VITA Easyshade



# Materials and Methods



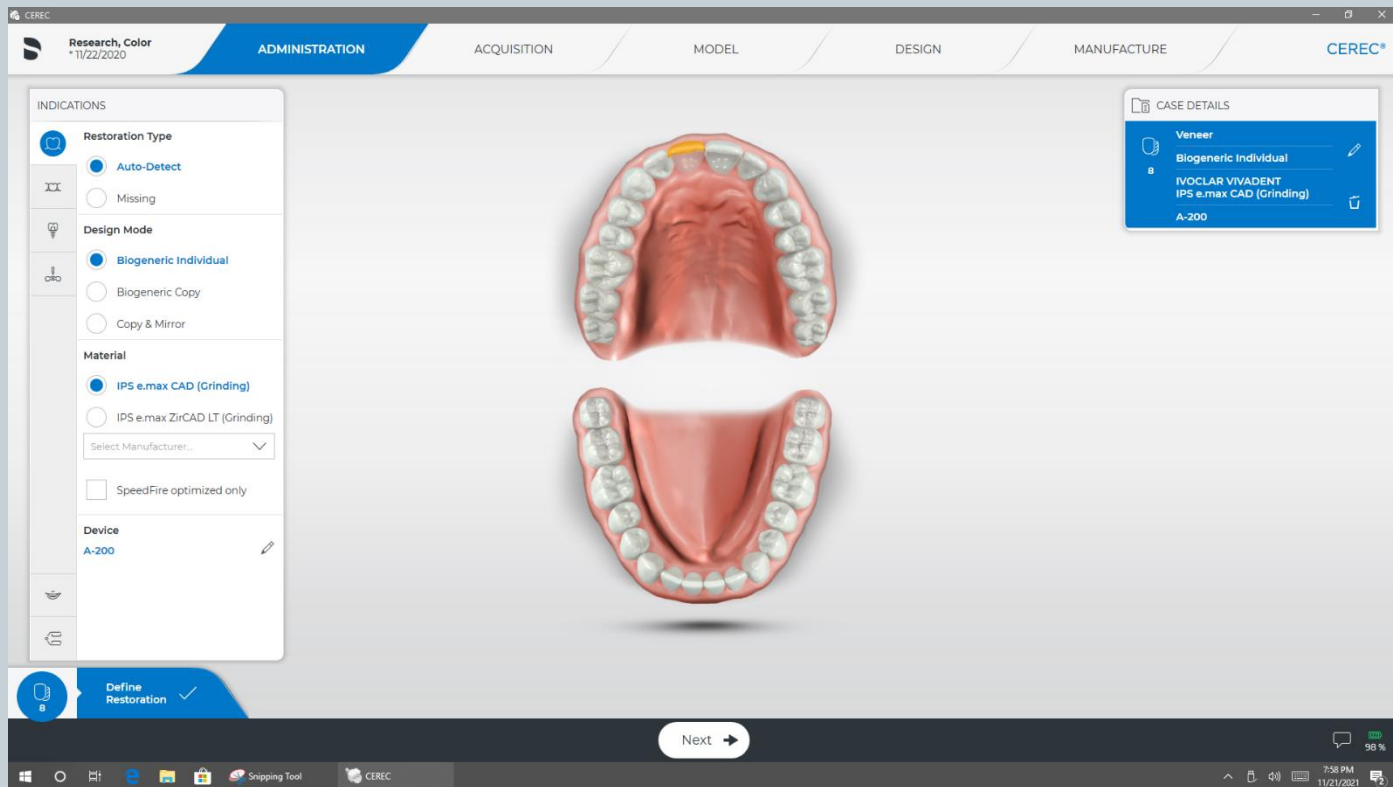
- Shade tabs scanned with Primescan



# Materials and Methods



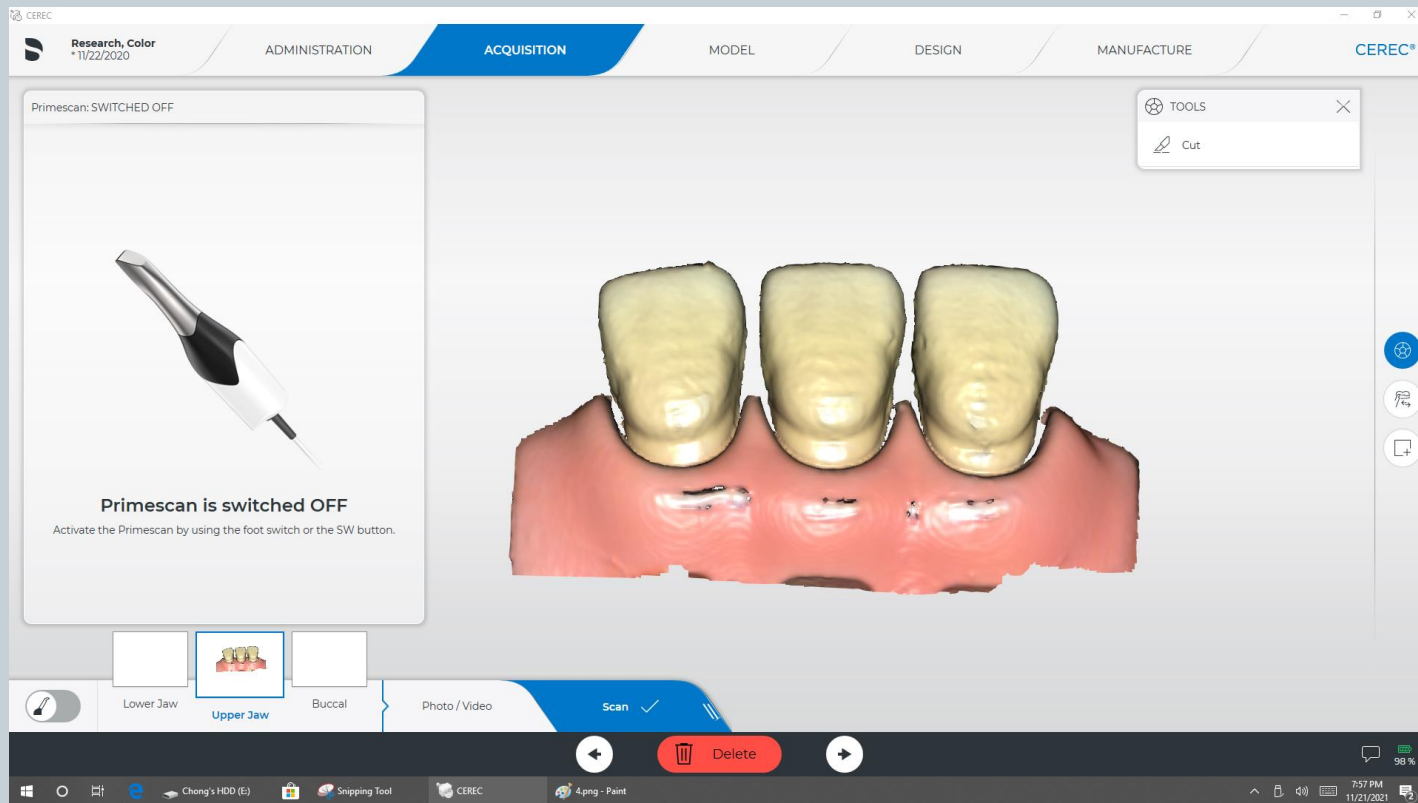
- #8 was selected
- Veneer restoration was chosen



# Materials and Methods



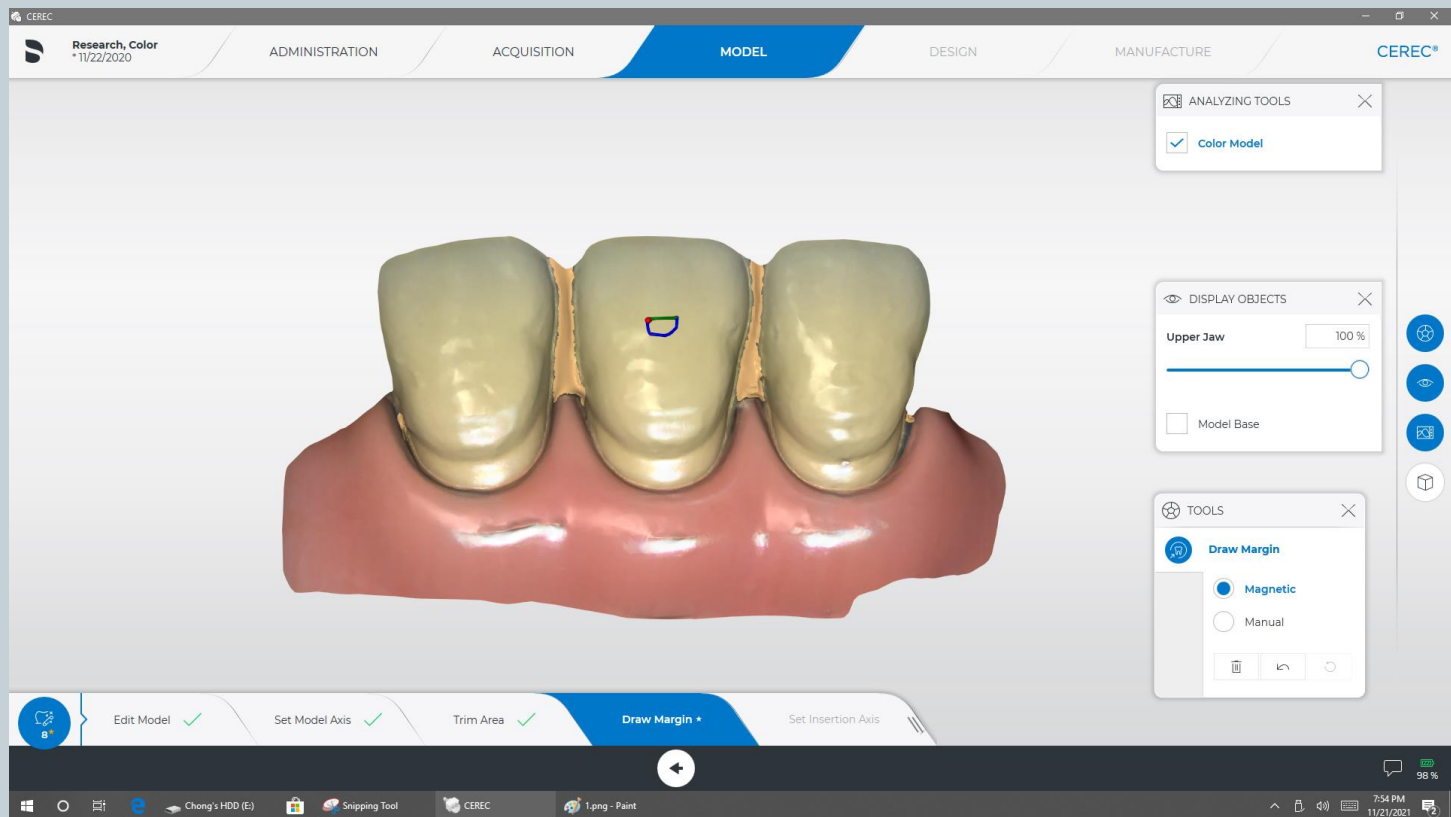
- Scan on Primescan



# Materials and Methods



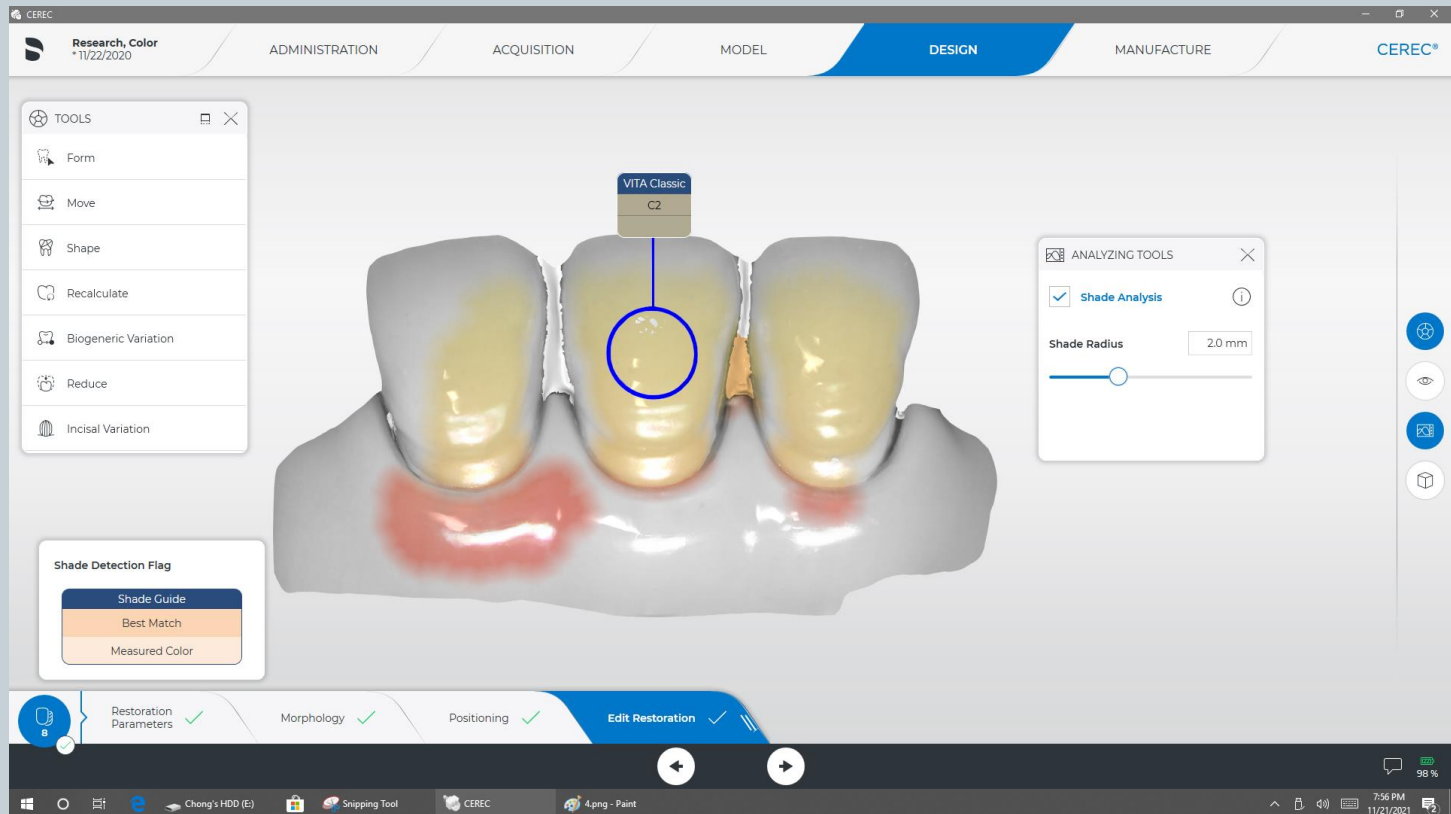
- Arbitrary margin to get to the shade analysis screen



# Materials and Methods



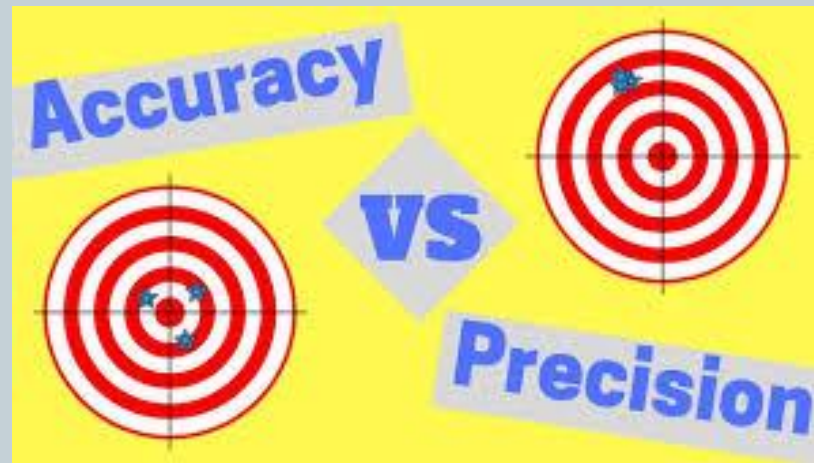
- Shade analysis screen
- Middle 1/3 of middle shade tab was selected for measurement (2mm radius)



# Accuracy



- Accuracy was calculated as the percentage of correct readings divided by 10.
- Overall accuracy was calculated as the average of all accuracy percentages.



# Reliability



- Reliability (Precision) was calculated as the percentage of the highest number of identical shades, regardless of if the shade is correct, divided by 10.
- Overall reliability was calculated as the average of all consistency percentages.

# Data Analysis



- For accuracy and consistency, a median and Interquartile Range (IQR) was determined for each group
- The data was analyzed with Mann Whitney U tests ( $\alpha=0.05$ ).

# Results



	Accuracy % Median (IQR)		Reliability % Median (IQR)	
	Vitapan Classical	Vitapan 3D	Vitapan Classical	Vitapan 3D
<b>VITA Easyshade</b>	<b>0 (100)</b>	<b>0 (75)</b>	<b>100 (0)</b>	<b>100 (40)</b>
<b>Primescan</b>	<b>0 (37.5)</b>	<b>30 (90)</b>	<b>80 (30)</b>	<b>90 (20)</b>
<b>P-Value</b>	<b>0.956</b>	<b>0.386</b>	<b>0.007</b>	<b>0.715</b>

# Discussion



## Accuracy:

- No significant difference in accuracy was found between the two devices for both Vitapan Classic and Vitapan 3D Master
- Both devices were relatively inaccurate in detecting the shade of the tabs

# Discussion



## Reliability:

- No significant difference found between the two devices with the Vitapan 3D Master shade tabs, but there was a significant difference between the Vitapan Classic shade tabs

# Conclusion



- Both shade matching devices had relatively low, but similar accuracy.
- Both shade matching devices had relatively good reliability
  - But VITA Easyshade had better reliability when using the Vitapan Classic shade tabs

# Questions?

