



Figure 1-3: Zirconia veneer.



Figure 4-6: Zirconia anterior crown.

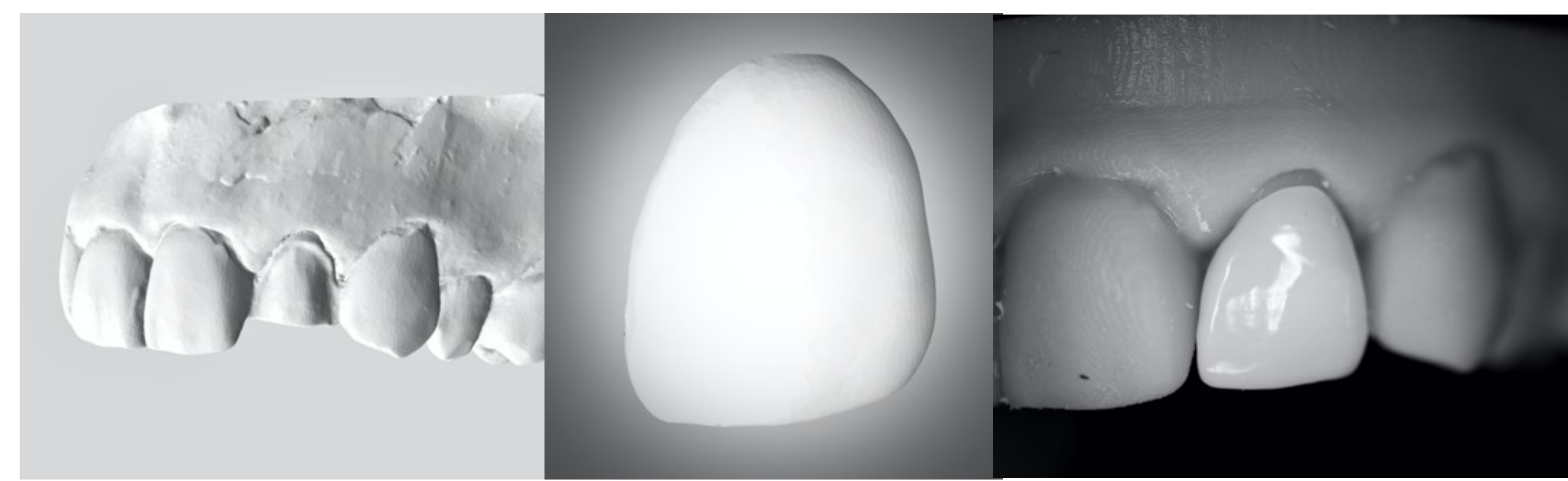


Figure 7-9: Zirconia veneer digital workflow.

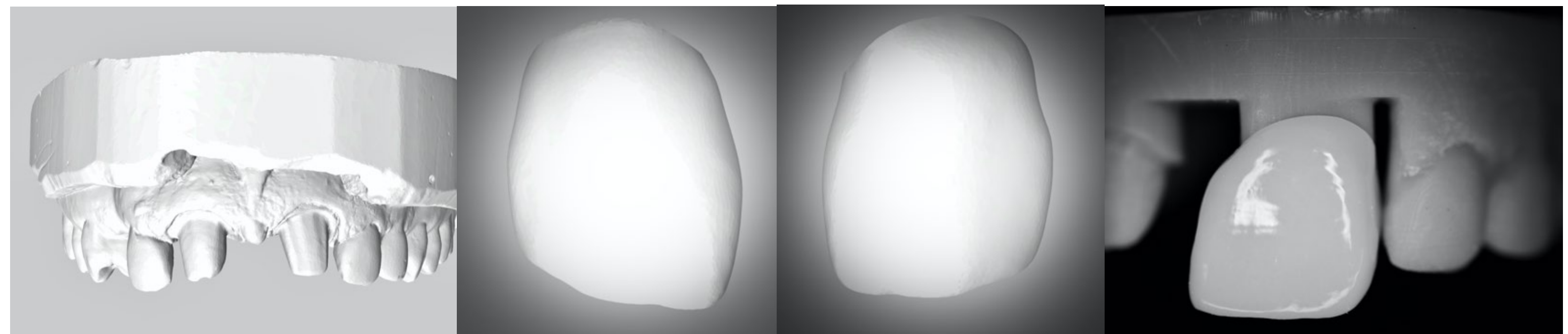


Figure 10-13: Zirconia crown digital workflow.



Figure 14: Six identical zirconia veneers.



Figure 15: Six identical zirconia crowns.

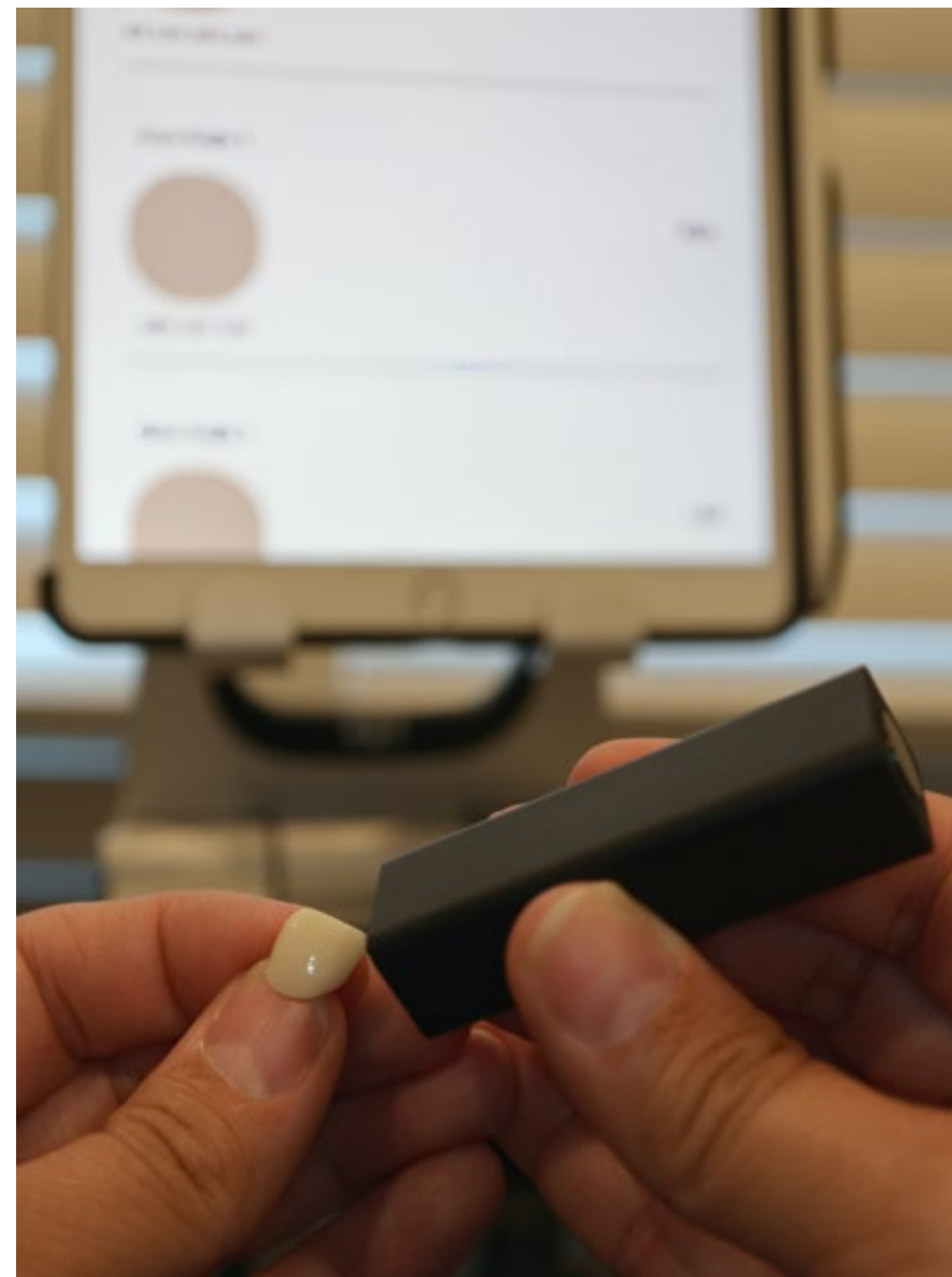


Figure 16: Novel workflow.



Figure 17: Novel workflow application.



Figure 18: Novel workflow video demonstration.

INTRODUCTION

Background

- Zirconia has been used for posterior regions due to its very high strength.
- Similar benefits can be seen when used in anterior regions with veneers (Figures 1-3) and anterior crowns (Figures 4-6).
- Zirconia provides translucency and minimal preparation requirements.
- Colour verification of indirect restorations has yet to transition to widely accepted digital methods and is typically completed with an intraoral comparison assessment.
- This approach is subjective, timely, costly with an inaccuracy of about 49%.

Aim

- This investigation presents a novel digital workflow for the colour verification of indirect anterior restorations, specifically zirconia veneers and anterior crowns, as an *in vitro* study.

METHODS & MATERIALS

Production of veneers & crowns

- Patient models were scanned, a #22 veneer (Figures 7-9) and #11 and #21 crowns (Figures 10-13) were digitally designed and exported as stereolithography (stl) files.
- #22 veneer and #21 crown files were transferred to a commercial lab for the fabrication of 6 identical veneers (Figure 14) and 6 identical #21 crowns (Figure 15).
- Requested shade was Vita A1, with graduations identical to the shade tab.

Colour verification Using Novel Digital Workflow

- The software (Figure 17) was used with an iPad & paired with the wireless Bluetooth colour sensor.
- The sensor contacted the restorations/shade tab, recorded the colour, and transmitted the information to the iPad, which provided a colour description, in 3 seconds (Figure 16).
- The determination of colour was expressed through Cyan, Magenta, Yellow and Key (CMYK), Red, Green, Blue (RGB), LAB and HEX.
- The shade tab was colour identified using the same digital workflow (Figure 16).
- The procedure was repeated to identify the colour of 6 veneers and six crowns.

RESULTS

- Colour identification of the Vita shade tab is presented in Figures 19-21 (left).
- Colour identification of the six zirconia veneers is presented in Figure 19-21 (middle); and the six anterior crowns in Figure 19-21 (right).
- Colour of the veneers displayed mild variability between the six units and variability with the shade tab.
- The colour of the six crowns were consistent but varied from the shade tab.

RESULTS con't

Shade Tab	Veneer 1	Veneer 2	Veneer 3	Veneer 4	Veneer 5	Veneer 6	Crown 1	Crown 2	Crown 3	Crown 4	Crown 5	Crown 6
CMYK 0% 19% 40% 18%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%	CMYK 0% 19% 39% 19%
Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1
RGB 209 170 125	RGB 188 158 146	RGB 188 158 146	RGB 198 168 156	RGB 198 168 156	RGB 198 168 156	RGB 182 158 139	RGB 192 172 147	RGB 187 167 142	RGB 187 167 142	RGB 187 167 142	RGB 182 158 139	RGB 171 139 141
Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1
LAB 45.89 20.72 34	LAB 46.72 22.13 33.99	LAB 46.58 21.33 33.94	LAB 47.14 22.33 34.16	LAB 46.28 21.42 34.42	LAB 46.09 21.12 33.02	LAB 46.18 21.12 33.02	LAB 47.12 22.33 34.16	LAB 46.18 21.12 33.02	LAB 46.18 21.12 33.02	LAB 46.18 21.12 33.02	LAB 46.18 21.12 33.02	LAB 44.27 21.28 33.73
Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1	Scan Angle 1
HEX #D3A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C	HEX #D4A77C

Figure 19-21: Colour identifications of shade tab (left), veneers (middle) and crowns (right).

DISCUSSION

- The digital workflow indicated a difference in colour between each veneer, crown, and between the indirect restorations and the shade tab.
- Identification of colour can be impacted by several variables, even external light (Figures 22-25).
- The same shade tab (A1) is present in all four images; the colour of the shade tab and the restorations may appear different.



Figure 22-23: Shade tab next to veneer with LED light (left) and no light (right).



Figure 24-25: Shade tab next to crown with LED light (left) and no light (right).

- The software detects subtle colour changes offering an accurate method for colour identification and verification using a different method to describe dental colour.
- Clinicians and technicians could both employ the novel digital workflow.
- Software modifications are in progress and further the research with a clinical case, as well as a comparison study

CONCLUSION

- The novel digital workflow provides a simple, efficient, accurate, objective and safe manner for colour verification of indirect anterior restorations.
- Alternative clinical technologies maximize accuracy and efficiency, while minimizing the environmental impact and still maintaining the highest standard of patient care.

REFERENCES -available on request