ABSTRACT

Abay, S. (2026). Investigation of the Color Determination Properties of Intraoral Scanners Under Different Lighting Conditions. Istanbul University, Instute of Health Science, Department of Prosthodontics. Doctoral Thesis. Istanbul.

The aim of this study was to investigate how different light intensity and color temperature conditions affect the shade determination performance of TRIOS 3 (3Shape A/S, Copenhagen, Denmark) and CEREC Primescan AC (Dentsply Sirona, Bensheim, Germany) intraoral scanners and to evaluate the behavior of these intraoral scanners under these lighting conditions. In this in vitro study, six artificial teeth shades from the VITA 3D-Master shade system (VITAPAN Anterior; VITA Zahnfabrik, Bad Säckingen, Germany) were used. Scans were performed under seven different lighting conditions (0, 500, 1000, and 10,000 lux; 4000 K and 6500 K) from the cervical, middle, and incisal regions of teeth #11 and #13, resulting in a total of 5040 measurements. Measurements were evaluated in terms of accuracy, repeatability, directional deviation (ΔValue, ΔHue, ΔChroma), and absolute deviation values. The obtained data were statistically analyzed using the Kruskal–Wallis and Mann–Whitney U tests. Statistical analyses revealed that the shade determination, accuracy and repeatability of the devices were significantly affected by both environmental lighting conditions and the anatomical region of the tooth ($p<0.05$). For all devices, the most accurate measurements were obtained from the middle third of the tooth, whereas measurement errors increased in the incisal region. The TRIOS 3 scanner was particularly negatively affected by high light intensity (10,000 lux) in terms of the value and chroma components ($p=0.000$), whereas Primescan demonstrated low overall accuracy (Value-Hue-Chroma) despite its high repeatability (0.80–0.87), with V-H-C accuracy values ranging from 13.9% to 17.8%. To obtain standardized and reliable results in digital shade determination, controlling intense environmental lighting and performing measurements from the middle third, which is the most optically stable region, are clinically recommended.

Keywords: Intraoral Scanner, Shade Measurement, Accuracy, Lighting Conditions, Repeatability