



Influence of Different Lighting Conditions on the Accuracy of Two Intra-oral Scanners : In Vitro Study

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INTRODUCTION

The utilization of digital impressions using intraoral scanners (IOSs) has become more common in dentistry.¹ The accuracy of scanned digital files is shown to be influenced by machine calibration, tissue surface characteristics, the presence of reflective restorations, and/or saliva.² In recent years, some studies have investigated the influence of ambient light on the accuracy of scanned files using IOSs. In 2018, one study³ evaluated the light intensity and color temperature on the accuracy of digital scans using a single IOS. The 500 lux and 3900 K had the highest accuracy. A series of studies^{4,5} in 2020 also investigated the light intensity on complete arch scans with 3 IOSs in-vitro and one IOS in-vivo. They concluded that 10000 lux provided the most accurate scan. However, other studies that evaluated the influence of light intensity concluded that the effect of different light intensities varied depending upon the IOSs used.

OBJECTIVE

The purpose of this in-vitro study was to compare the influence of four different lighting conditions on the scanned files of a prepared tooth using two IOSs from different manufacturers. The null hypothesis is that different combinations of lighting conditions have no statistically significant effect on the accuracy of scanned files.

MATERIALS & METHODS

A maxillary stone model with the prepared right first premolar with a shoulder margin design was obtained for the study. Three equilateral triangular-shaped notches (1 x 1 x 1 mm) were made on the shoulder margin: two on the lingual shoulder margin (CMP1 & CMP2) and one on the buccal margin (CMP3) (Fig. 1) using a scalpel, which served as measurement points. The prepared test sample was scanned using a high-accuracy scanner (ARTEC EVA-S 3D, Santa Clara, CA), and the resulting .stl file was used as the control. Two IOSs: 3Shape Trios 3 (3Shape, Denmark) and Planmeca Emerald S (Planmeca Inc., Hoffman Estates, IL), were used in this study. The test groups were divided into eight groups with four different combinations of ambient lighting conditions and IOSs, as shown in Table 1. The IOSs were calibrated following the manufacturer's instructions before scanning. The ambient light intensity was measured and monitored using a luxmeter (Gain Express, Hong Kong). A maxillary stone model with the prepared tooth was fixed on the head support of a dental chair (A-dec, Newberg, OR) using a dental mannequin. (Nissin, Japan). Ten digital scans of the maxillary stone model were made for each group for a total of 80 .stl files were obtained. The obtained .stl files were superimposed on the control using Geomagic Control X software (3D systems, Rock Hill, SC). The triangular-shaped notches (CMP 1, 2, 3) marked on the prepared tooth's buccal and lingual shoulder margin were used to measure linear discrepancies between each scanned sample.

Light conditions tested	Scanners used	Number of scans for each test group	Total number of scans
No light	3Shape Trios 3 & Planmeca Emerald S	10	80
Room light			
Dental chair light only			
Dental chair & Room light			

Table 1: Test groups with combination of IOS and light conditions

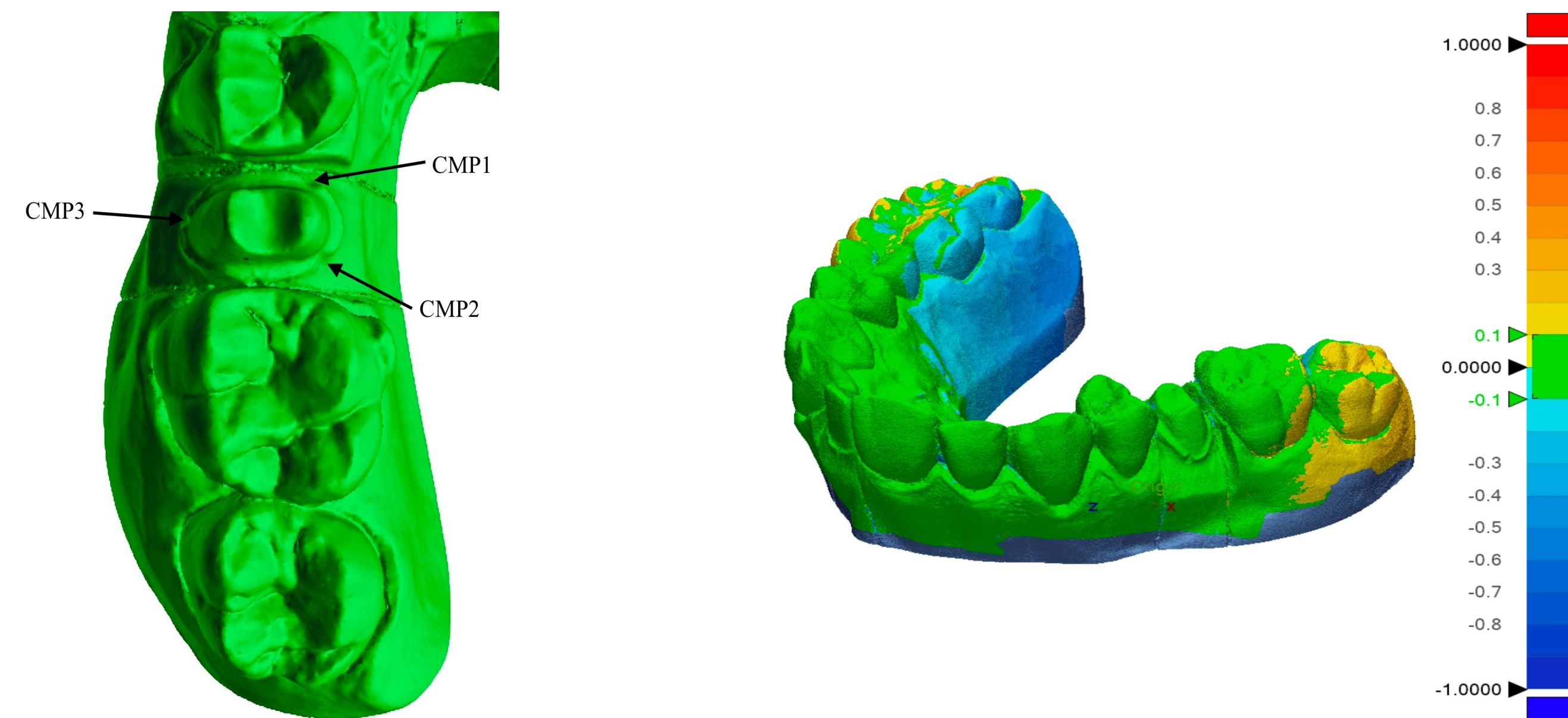


Fig. 1: Comparison measurement points (CMP) marked on the scan

Fig. 2: Color map of superimposed scans

RESULTS

The highest mean discrepancy was 98.26 μm using no light and the Planmeca Emerald S. The lowest mean discrepancy was 4.0 μm using no light and the 3Shape Trios 3. Two-way ANOVA was used to analyze the interaction between the lighting conditions and scanners used.

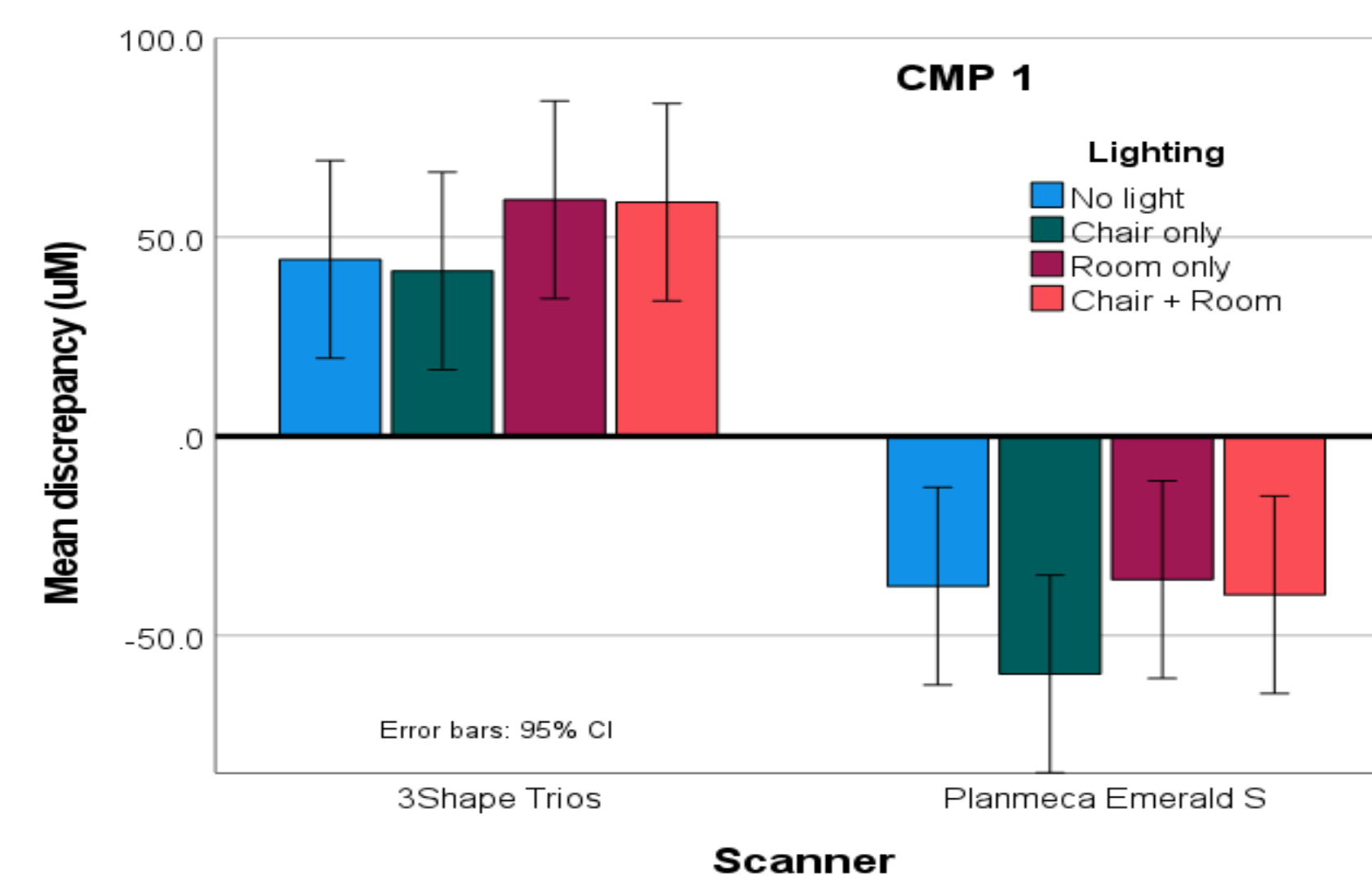


Fig. 3: Bar graph showing mean discrepancy between both IOSs at CMP1

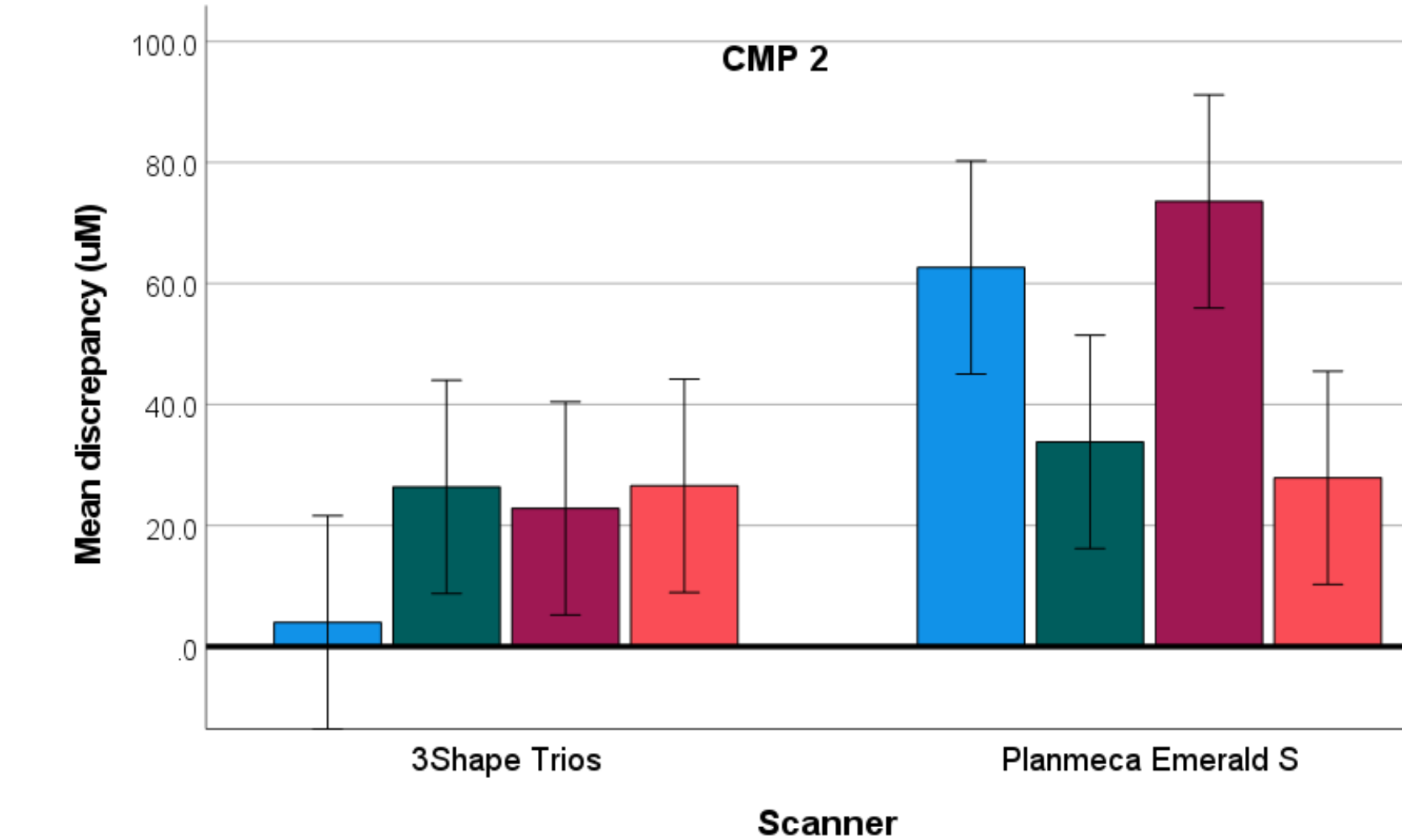


Fig. 4: Bar graph showing mean discrepancy between both IOSs at CMP2

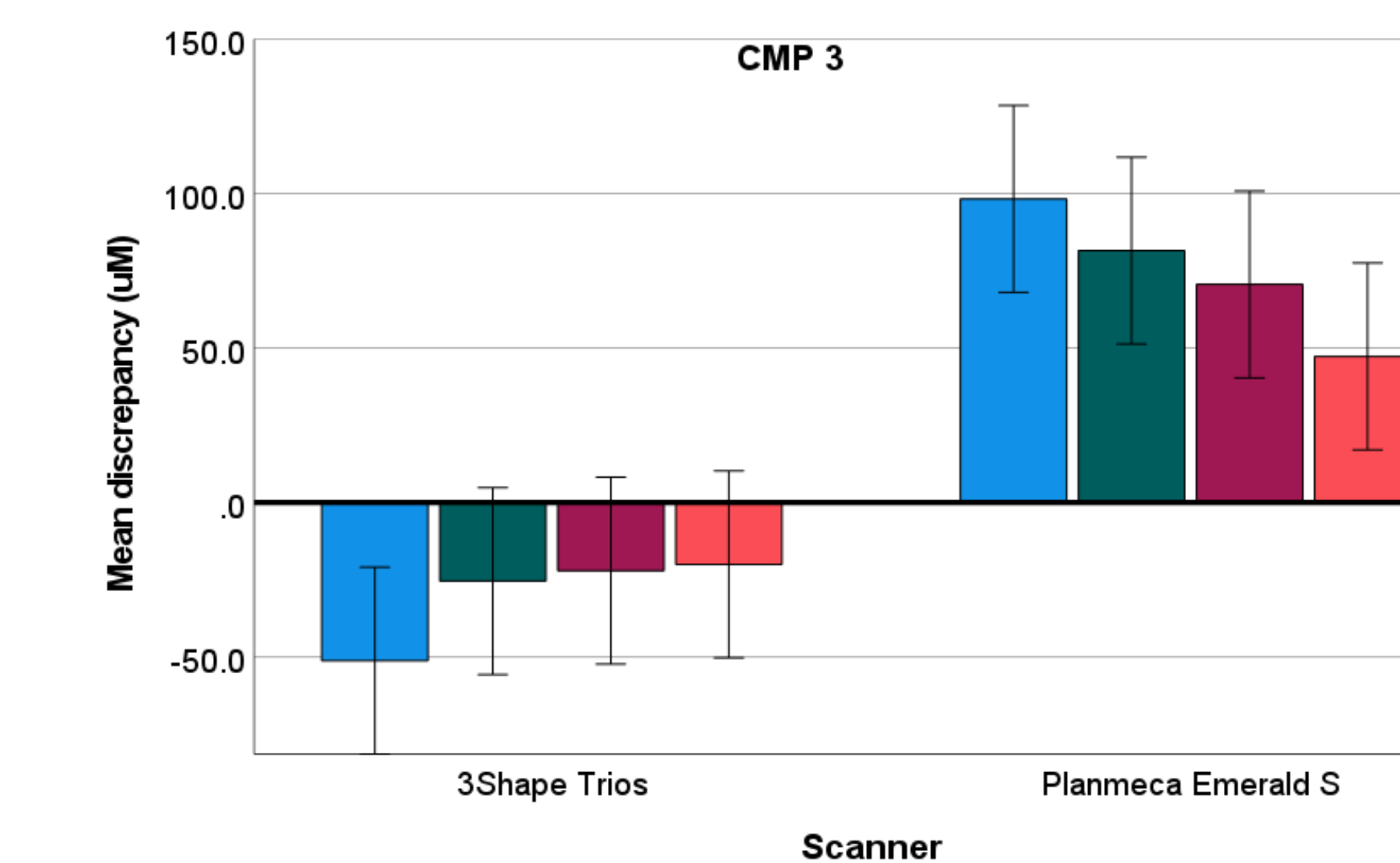


Fig. 5: Bar graph showing mean discrepancy between both IOSs at CMP3

CONCLUSION

Mean discrepancies observed in this study for both scanners and all lighting conditions were less than 100 μm . The clinical significance of such discrepancies at the scanned file phase is encouraging, but it does not address the cumulative inaccuracy that can accrue to the final restoration.

REFERENCES

