



INTRODUCTION

The increasing demand for durable and aesthetically pleasing restorations has led to significant advancements in dental ceramics, particularly zirconia. Monolithic and multi-layered zirconia are widely used due to their mechanical properties, biocompatibility, and high esthetic potential. However, matching the natural tooth shade—especially VITA Classical A3—remains a clinical challenge due to zirconia’s limited translucency. Recent innovations in high-translucency and multi-layered zirconia aim to bridge this gap, but concerns remain about their ability to achieve optimal color accuracy post-fabrication.

OBJECTIVE

To assess the color accuracy of commercially available monolithic multilayer zirconia materials in replicating the VITA Classical A3 shade using the CIELAB (L*= white (+) to black (-), a*=red (+) to green (-), b*= yellow (+) to blue (-)) system under standardized in vitro conditions. The null hypothesis states that there is no statistically significant difference in shade matching accuracy of different brands of milled monolithic multi-layered zirconia when compared to the VITA Classical A3 shade.

MATERIALS & METHODS

Forty samples were prepared from three multi-layered (ML) zirconia dental ceramics—KATANA YML, LayZir, and 3D Pro Zir Aidite—and compared against feldspathic porcelain (VITA Classical A3 shade tab) as the control. Each ML zirconia group (n = 10) was milled using standardized CAD/CAM STL design files to replicate the VITA A3 shade tab. Ten new VITA Classical A3 tabs served as the control group. All samples were cleaned with 70% isopropyl alcohol to remove surface residues prior to testing. A custom-fabricated positioning stent ensured consistent sample alignment during measurement. CIElab color parameters (L*, a*, b*) were recorded using a Konica Minolta CM-700d spectrophotometer, recalibrated every five readings with the manufacturer-provided white calibration cap. Spectrophotometric analysis was used to calculate color differences (ΔE) between groups. Normality was assessed using the Shapiro-Wilk test. Given the distribution results, non-parametric comparisons were conducted via the Friedman test (n = 10), followed by Wilcoxon signed-rank pairwise comparisons with Holm correction.

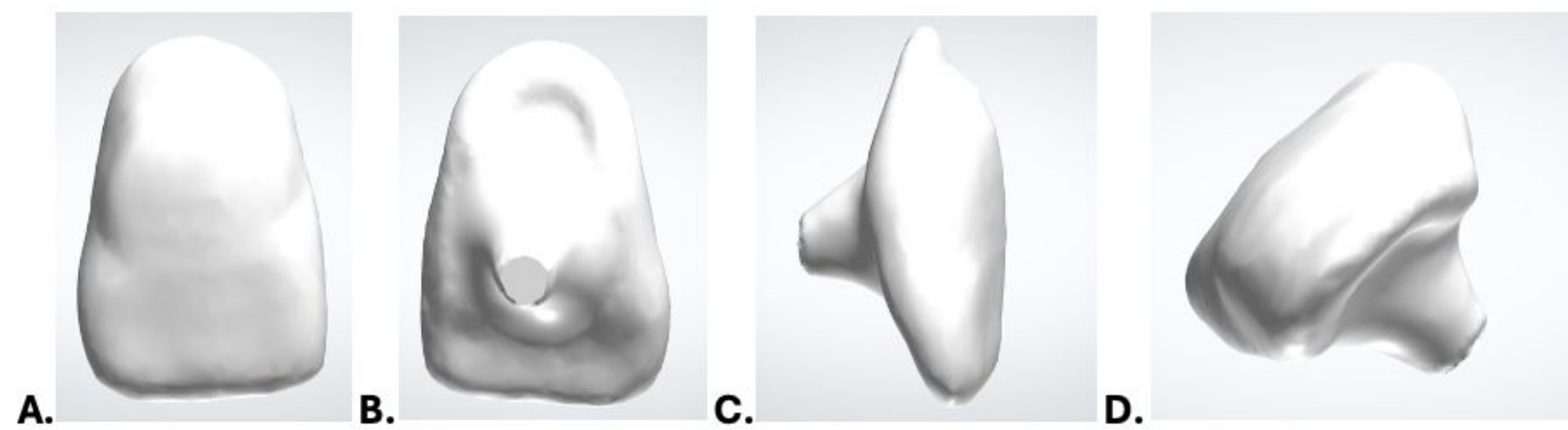


Figure 1. Standard Tessellation Language (STL) 3D model generated for sample preparation: **A.** Facial View **B.** Lingual View **C.** Lateral View **D.** Cervical View

MATERIALS & METHODS Contd.

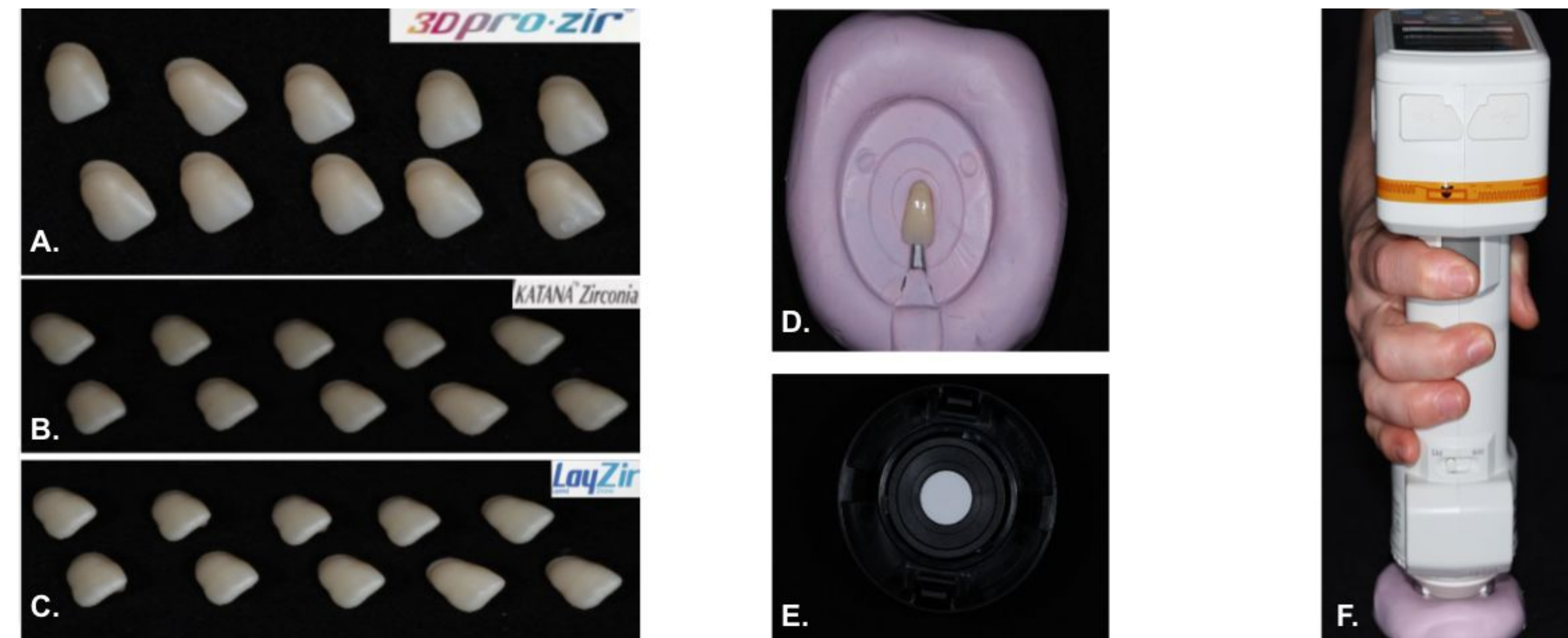


Figure 2. **A.** Milled 3D Pro Zir Aidite Shade Tab **B.** Milled Katana Shade Tab **C.** Milled LayZir Shade Tab **D.** Custom stent with shade tab in place **E.** White Calibration Cap CM-A177 by Konica Minolta **F.** Spectrophotometer in use with stent and shade tab specimen to record color measurements

RESULTS

Table 1. Excel Sheet used to record the CIE L*, a*, and b* in each group (ceramic system)

	Ceramic Systems											
	VITA Classical			3D Pro Zir Aidite			Katana YML			LayZir		
Samples	L	a*	b*	L	a*	b*	L	a*	b*	L	a*	b*
1	42.77	0.55	5.42	49.55	-1.09	2.11	55.72	-1.33	4.38	57.54	-1.11	4.85
2	44.58	0.43	5.17	50.95	-1.07	1.94	53.35	-1.36	4.19	57.54	-1.13	4.79
3	43.44	0.4	4.82	50.89	-1.09	1.74	55.39	-1.34	3.77	56.71	-1	5.17
4	41.86	0.44	4.46	49.56	-1.07	1.73	54.37	-1.59	3.99	56.92	-1.2	4.76
5	43.91	0.39	5.2	51.8	-1.01	1.25	54.65	-1.12	3.9	57.59	-1.1	5.1
6	41.2	0.54	4.88	48.6	-0.97	2.34	55.92	-1.38	3.94	59.07	-1.1	4.26
7	41.78	0.38	4.49	47.95	-0.98	2.04	54.49	-1.43	4.36	56.35	-1.15	4.53
8	42.56	0.37	4.77	48.04	-1.24	2.14	54.17	-1.37	4.21	57.54	-1.1	5.24
9	40.21	0.52	5.23	51.6	-1.08	1.71	52.36	-1.61	3.86	58.89	-1.02	4.63
10	45.12	0.28	5.17	50.61	-1.04	1.97	54.11	-1.41	3.85	57.81	-1.08	4.94

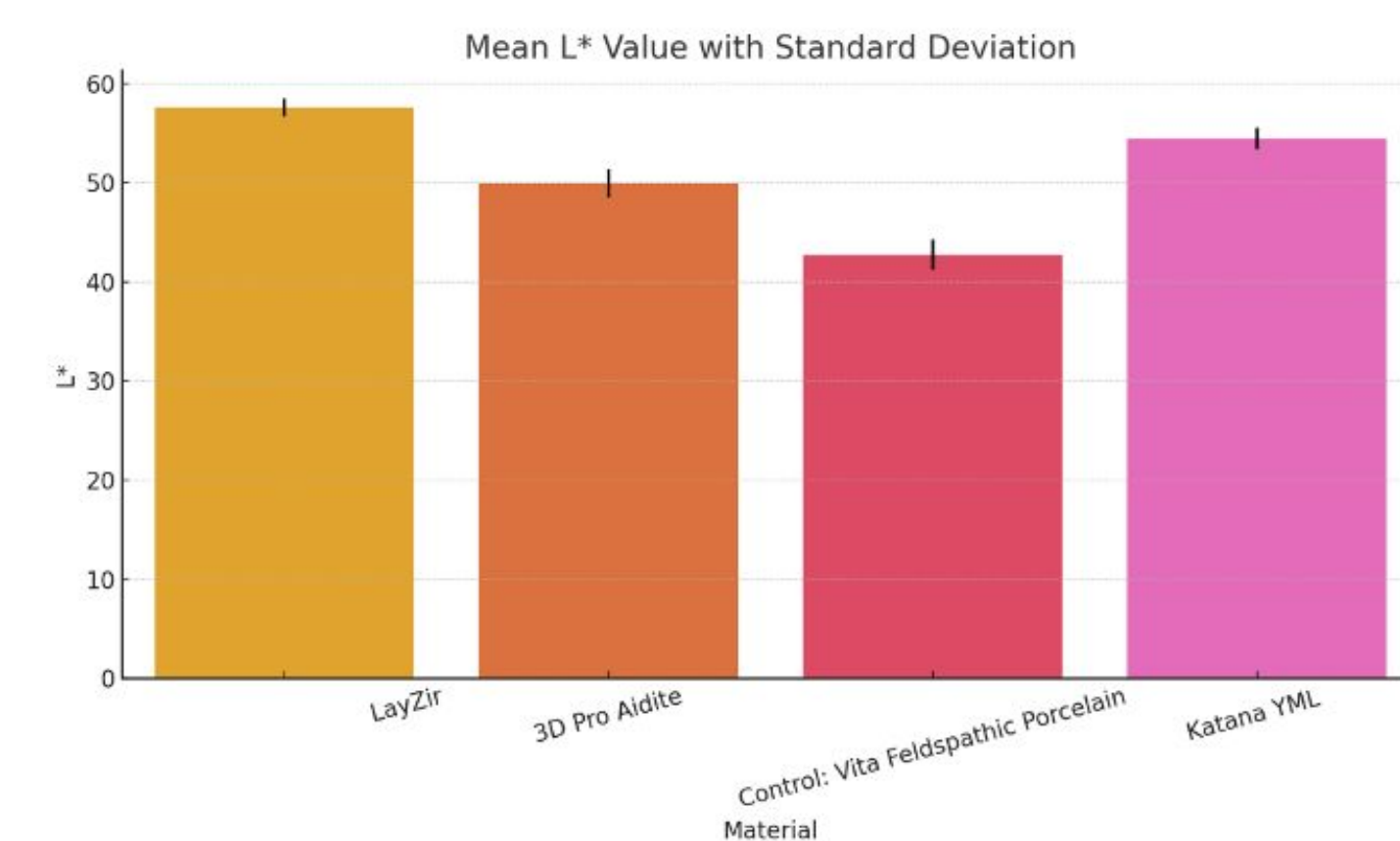


Figure 3. Means of L* according to three types of three types of multi-layered zirconia brands compared to the control

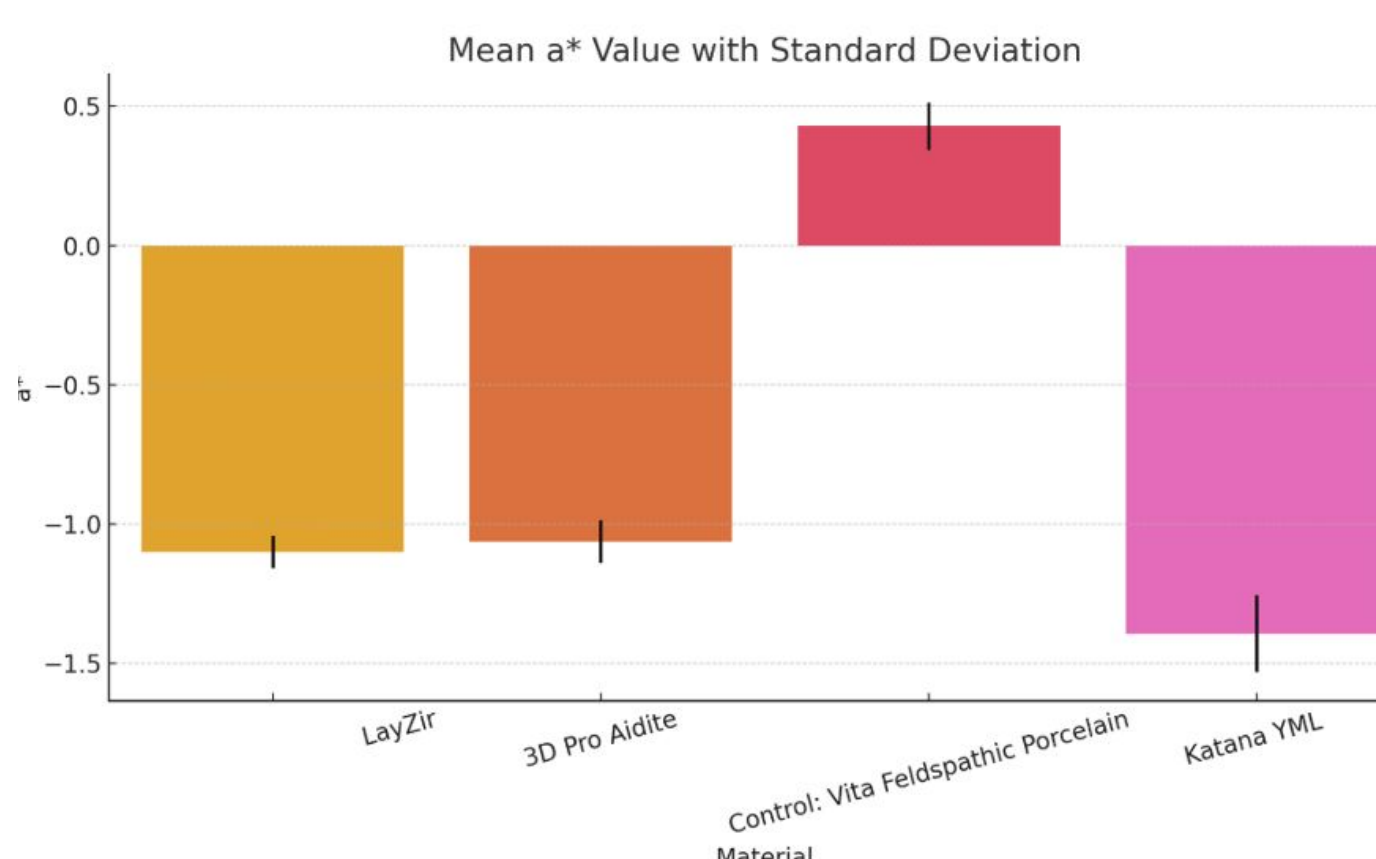


Figure 4. Means of a* according to three types of multi-layered zirconia brands compared to the control

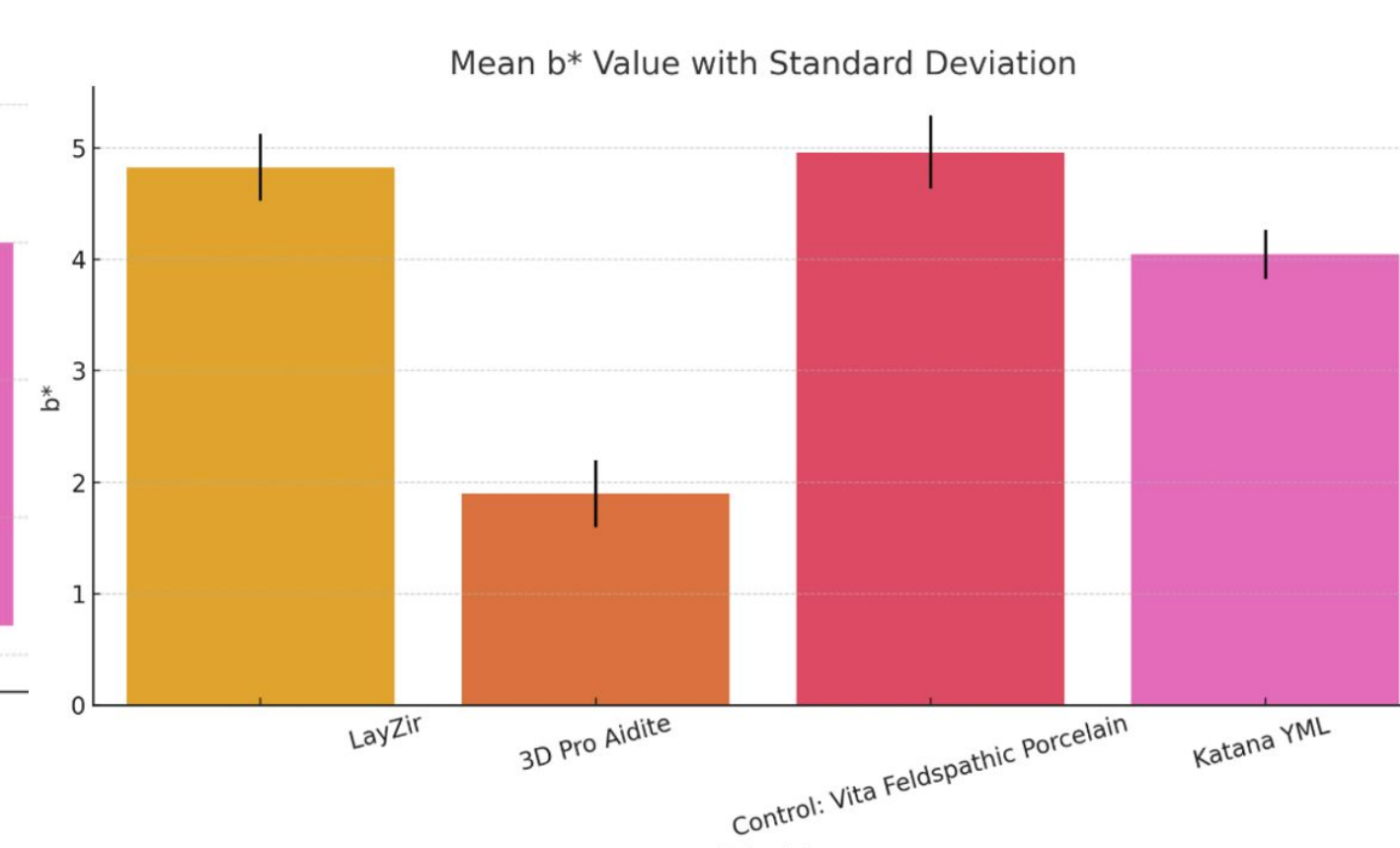


Figure 5. Means of b* according to three types of multi-layered zirconia brands compared to the control

RESULTS Contd.

Table 2. Color Difference (ΔE) Relative to VITA Control

Ceramic System	L* (Mean $\pm$ SD)	a* (Mean $\pm$ SD)	b* (Mean $\pm$ SD)
VITA Feldspathic Porcelain (Control)	42.75 $\pm$ 1.50	0.43 $\pm$ 0.08	4.96 $\pm$ 0.29
3D Pro Zir Aidite	50.16 $\pm$ 1.28	-1.08 $\pm$ 0.08	1.93 $\pm$ 0.32
Katana YML	54.56 $\pm$ 1.03	-1.39 $\pm$ 0.14	4.07 $\pm$ 0.22
LayZir	57.56 $\pm$ 0.78	-1.10 $\pm$ 0.06	4.83 $\pm$ 0.28

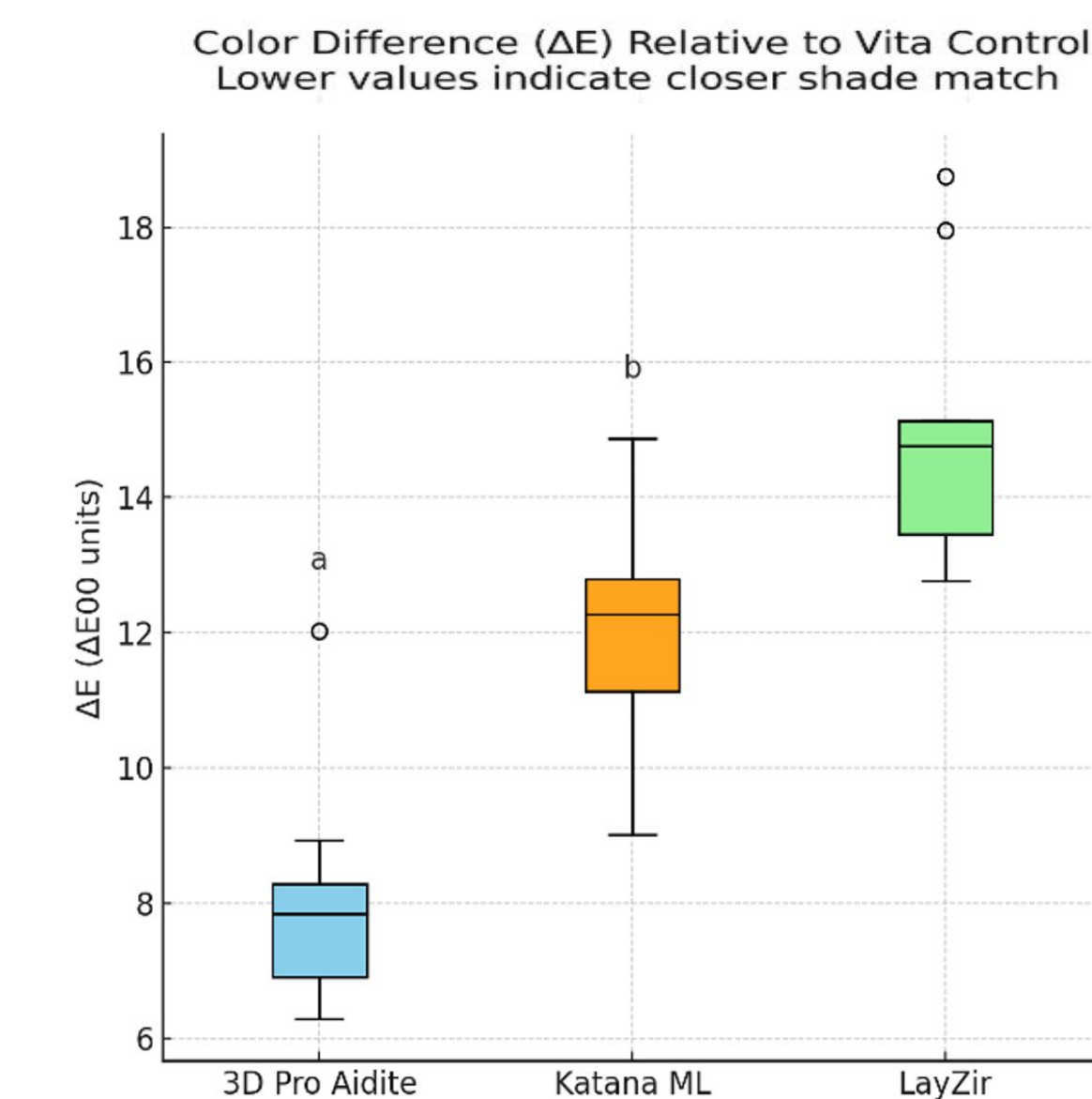


Figure 6. Color Difference (ΔE) Relative to VITA Control

Table 3. Summary of Mean Color Difference (ΔE) and Standard Deviation (SD) and Rank of Ceramic Systems Color Accuracy

Ceramic Systems	Mean $\Delta E \pm$ SD	Rank of Color Match Accuracy (1 = closest to control Vita A3 Shade)
3D Pro Zir Aidite	8.00 $\pm$ 1.65	1
Katana YML	11.90 $\pm$ 1.78	2
LayZir	14.94 $\pm$ 2.00	3

CONCLUSIONS

Significant differences in shade accuracy were observed among multilayer monolithic zirconias. 3D Pro Zir Aidite most closely matched VITA feldspathic porcelain, followed by Katana YML and LayZir. These results emphasize the need for material-specific selection and close clinician-laboratory technician collaboration. Using cross-polarized photography enhances shade communication and improves esthetic outcomes. Customization and cementation protocols should be tailored to each zirconia system to ensure lifelike results, long-term durability, and high patient satisfaction.

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REFERENCES



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