



Introduction

Zirconia restorations have become popular in recent years due to their high strength and clinically acceptable esthetics. Additionally, there is increasing demand for faster and more efficient treatments. To address this, a speed sintering protocol was developed to accelerate the post processing process of zirconia restoration, although studies suggest it may reduce the restoration optical properties and strength. Recently, chairside zirconia blocks have been developed specifically for speed sintering to overcome these limitations.

Objective

The purpose of this study is to evaluate and compare Biaxial flexural strength, contrast ratio (CR), and translucency parameters (TP) of each layer of chairside zirconia block being sintered with speed sintering protocol by Programat® CS6 sintering furnace and CEREC® SpeedFire sintering furnace

Materials and Methods

A chairside speed-sintering zirconia block (shade A2) was selected for this study. A total of 40 specimens were sectioned from each of the three layers of the block: the Incisal, gradient, and dentin layers. Each set of 40 specimens was subsequently divided into two groups (n = 20) and subjected to sintering using either the Programat® CS6 sintering furnace or the CEREC® SpeedFire sintering furnace.



Fig : 1 Ips E.max ® zircad prime



Fig : 2 Programat® CS6 Sintering Furnace



Fig : 3 CEREC® SpeedFire sintering furnace

Methods

A cylindrical shape 14 mm diameter and 12 mm in height was designed and nested in PrograMill CAM software. Sixty blocks of ips E.max ® zircad prime material were dry milled using PrograMill PM7 milling machine.

Fig: 4, 5, 6

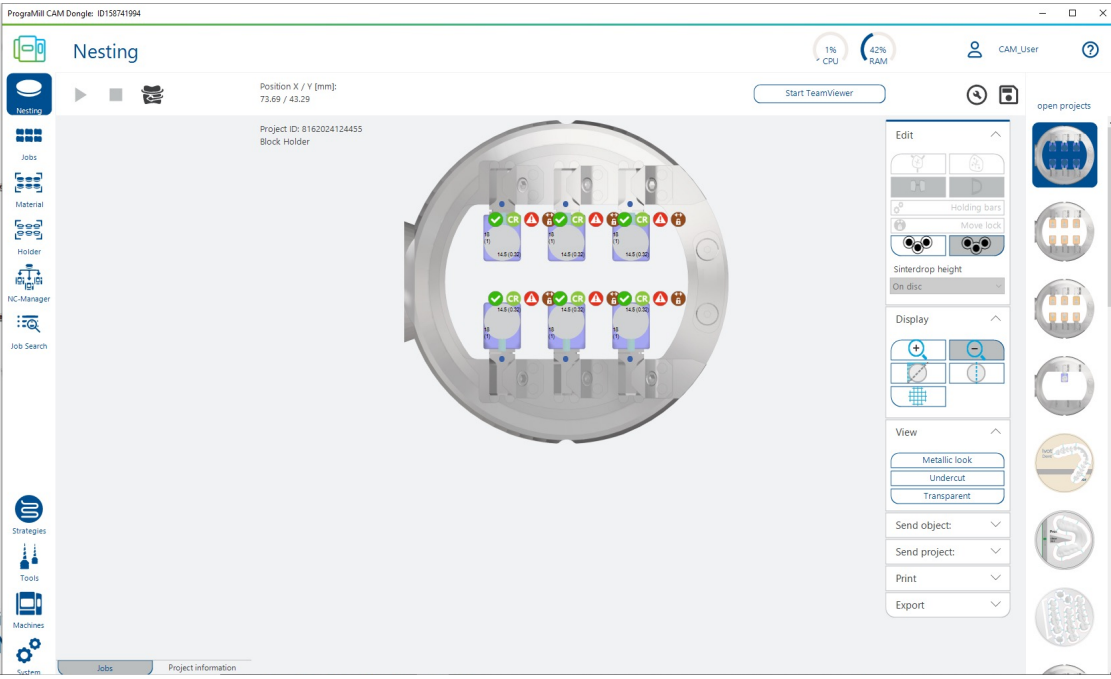
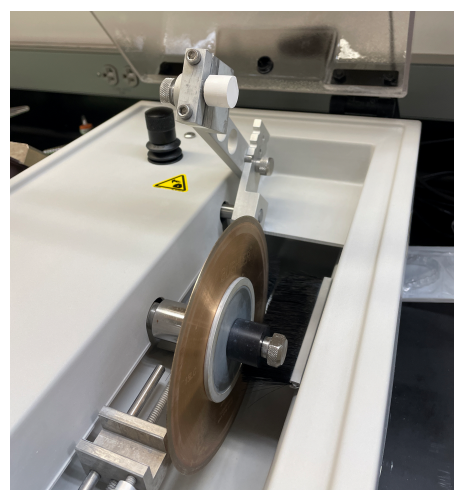


Fig 7 : Pre-sintered cylinders were sectioned with a Buehler IsoMet 1000 saw machine from the Incisal, gradient, and dentin layers to produce 1.3 mm thick specimens. Discs were then polished through 600 to 1200 grit sandpaper to achieve dimensions of 14 mm diameter and 1.24 ± 0.1 mm thickness.



Materials and Methods

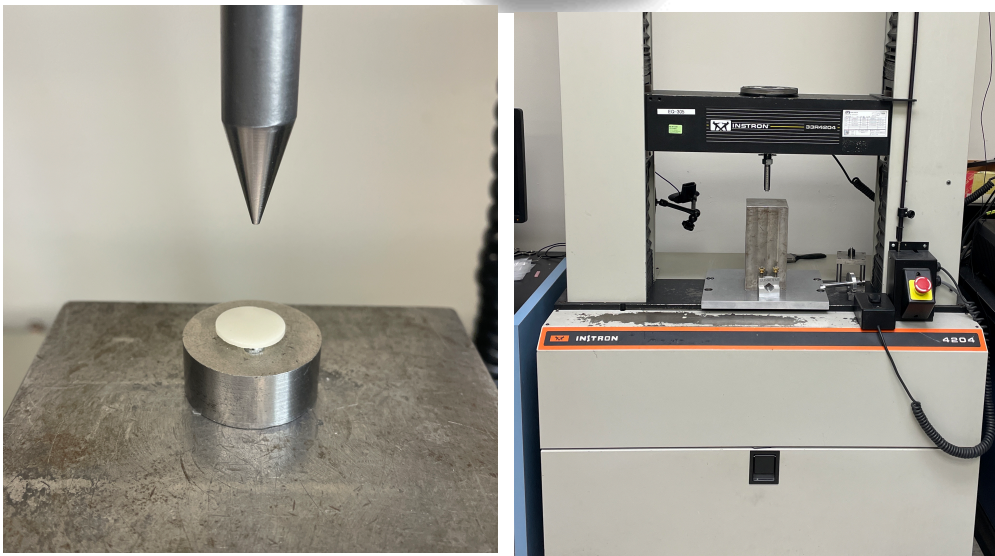
Fig. 8. Discs after sectioning, polishing, and sintering. The thickness of the disc after sintering is 1.00 ± 0.1 From left to right: Incisal layer, gradient layer, and dentin layer.



Fig 9 : Ten specimens from each layer in both furnaces were randomly selected and analyzed for Contrast ratio (CR) and translucency parameters (TP). CIE Lab* and Yxy values were measured against white (WB) and black (BB) backgrounds with glycerin applied between the specimen and background using an UltraScan VIS spectrophotometer. Five measurements were recorded per specimen.



Fig 10 : Biaxial flexural strength testing was performed using a universal testing machine, with each specimen placed at the center of an 11 mm support circle. A 1.4 mm radius load was applied using a 10 kN load cell at a crosshead speed of 0.5 mm/min until fracture, and the maximum failure load was recorded.



Results

The translucency parameter (TP) of the incisal layer sintered with the CEREC SpeedFire furnace was the highest followed by the CS6 incisal layer, CEREC SpeedFire gradient layer, CS6 gradient layer, CS6 dentin layer, and CEREC SpeedFire dentin layer (Table 1.). In Biaxial flexural strength testing, the CS6 dentin layer exhibited the highest strength, followed by the CEREC dentin layer, CS6 gradient layer, CEREC gradient layer, CEREC incisal layer, and CS6 incisal layer (Table 2.). SEM analysis revealed that the CS6 incisal layer has the largest grain boundaries. Data was analyzed using two-way analysis of variance (ANOVA) and Tukey's post hoc analysis to determine statistical difference (p≤0.05).

Table 1. Result of contrast ratio (CR), and translucency parameter (TP)

Layer	Cerec Speedfire				Programat CS6			
	CR mean	SD	TP mean	SD	CR mean	SD	TP mean	SD
Incisal	0.621	0.020	17.476	0.709	0.636	0.025	16.980	0.936
Gradient	0.675	0.023	15.977	1.105	0.684	0.026	15.622	1.103
Dentin	0.757	0.013	13.269	0.726	0.755	0.011	13.495	0.489

Table 2. Result of Biaxial flexural strength test

Layer	Cerec Speedfire		Programat CS6	
	Mean (Mpa)	SD	Mean (Mpa)	SD
Incisal	703.51	76.63	674.73	67.58
Gradient	783.04	105.95	824.30	117.51
Dentin	987.59	87.70	1032.16	66.68

Results

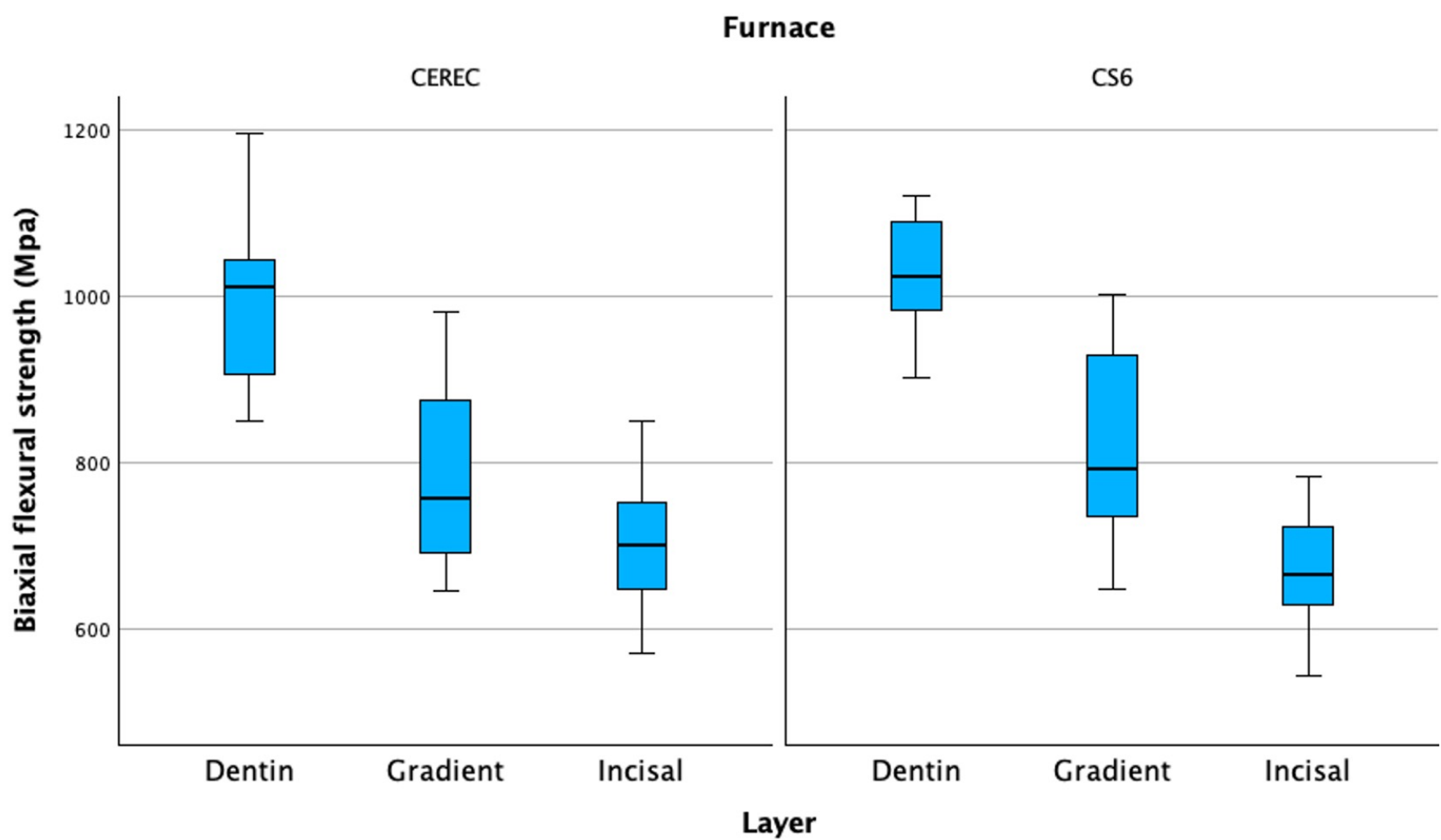


Fig 11 : Boxplot of biaxial flexural strength (MPa) by furnace and layer

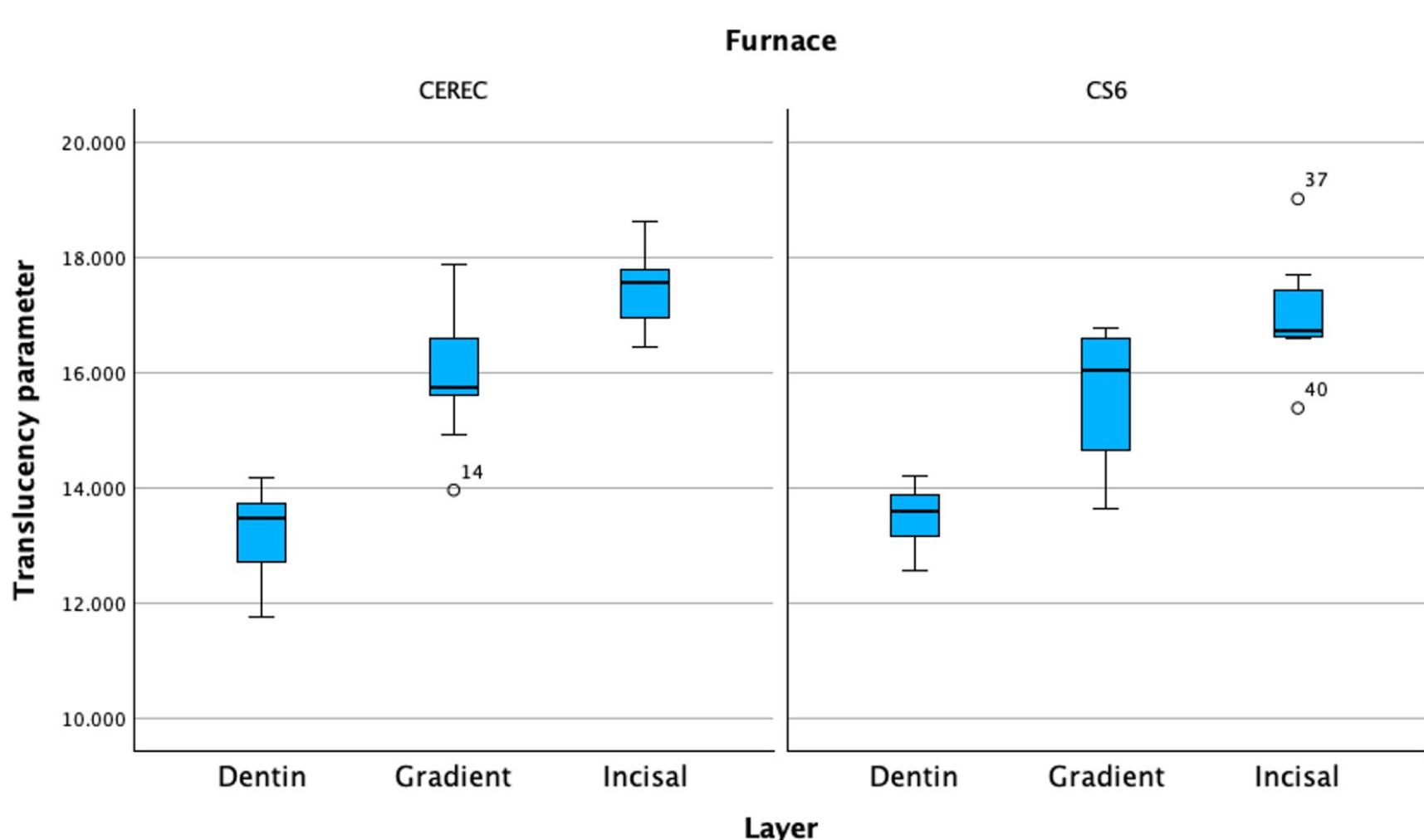


Fig 12 : Boxplot of Translucency parameter (TP) by furnace and layer

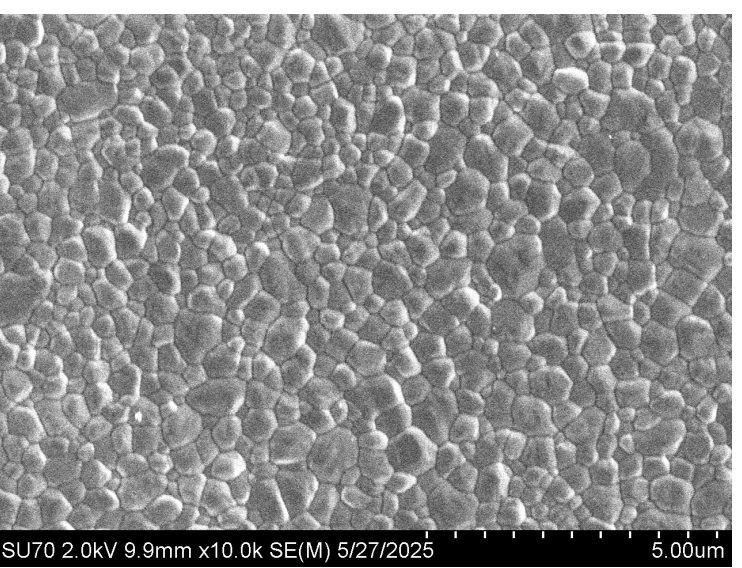
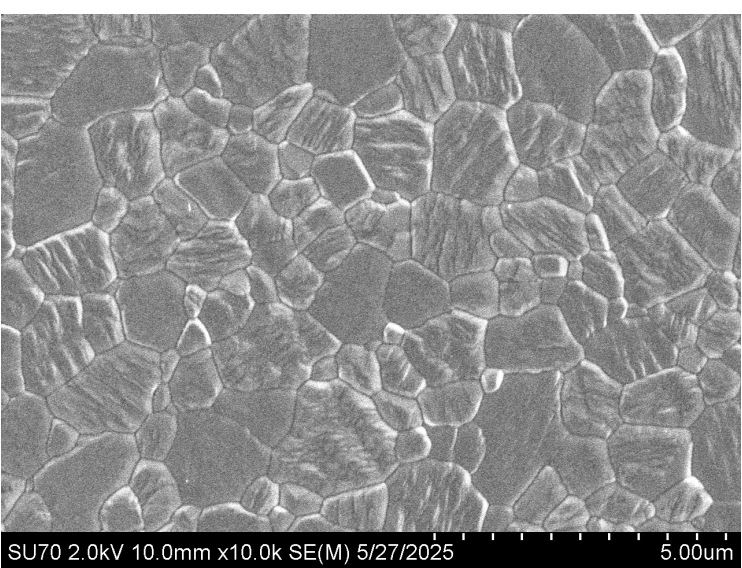
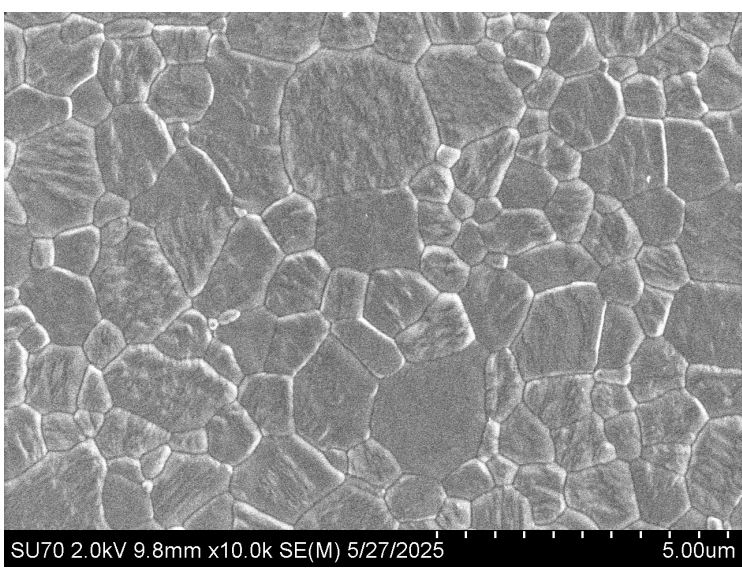


Fig 13 : SEM imaging of CS6 incisal, gradient, and dentin layer

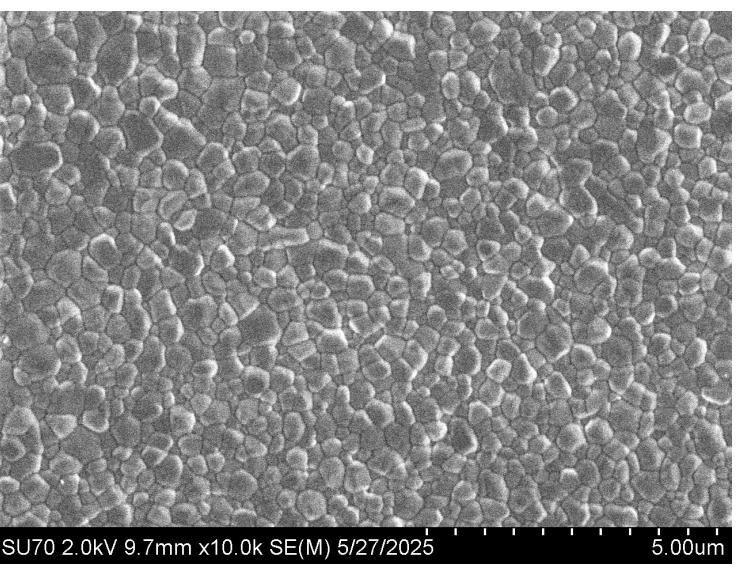
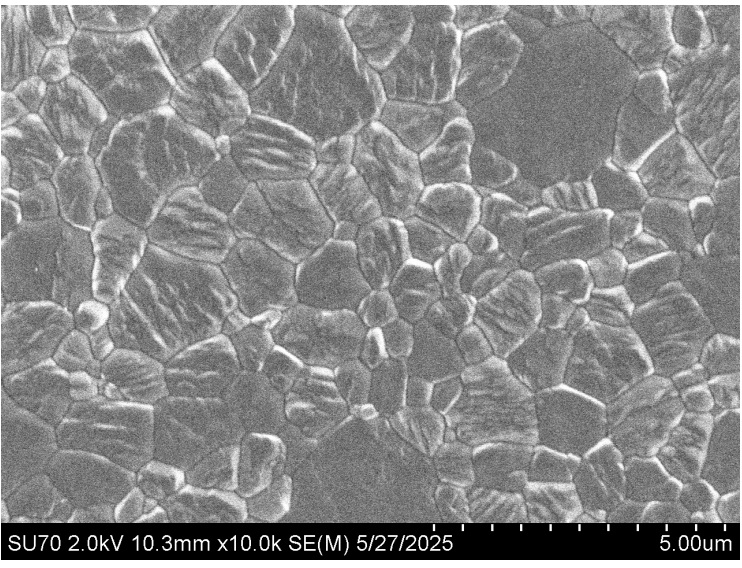
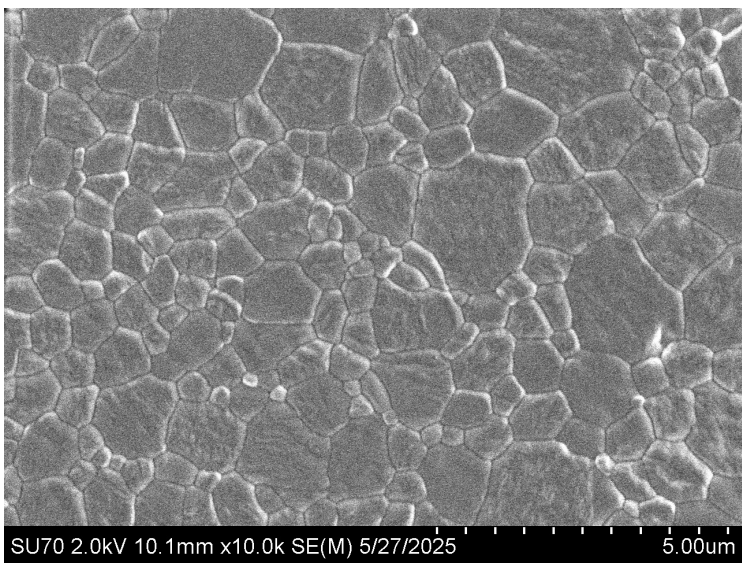


Fig 14 : SEM imaging of CEREC speedfire incisal, gradient, and dentin layer

Conclusion

The optical and mechanical properties of multilayer chairside zirconia blocks were primarily determined by the zirconia layer rather than the sintering furnace. The incisal layer demonstrated the highest translucency, while the dentin layer exhibited the greatest biaxial flexural strength. Although the CEREC SpeedFire furnace, which required 16 minutes, showed slightly higher translucency and the CS6 furnace, which required 15 minutes, showed slightly higher strength, these differences were not statistically significant. These results indicate that clinical decisions should be guided mainly by the properties of each zirconia layer, with furnace choice and small differences in sintering time considered secondary factors.

References

