



Comparison between Vickers hardness of Ceramic and Hybrid-Ceramic materials

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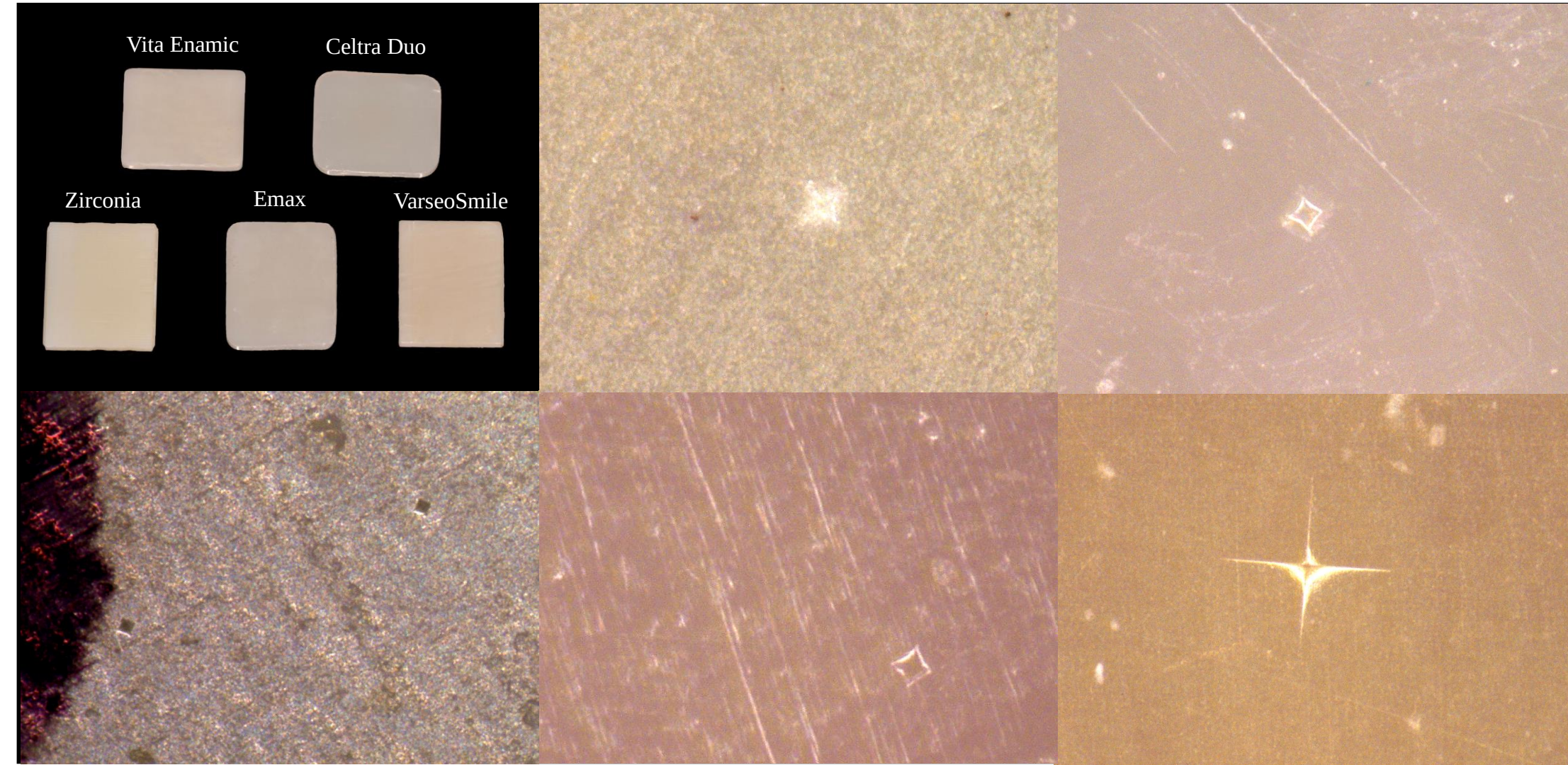
Background & Objective

Material selection for dental restorations has a direct impact on success. This depends on multiple characteristics of the material that include mechanical properties, surface texture, translucency, and color stability among others. New CAD-CAM materials presented in the market should fulfil these characteristics and present optimal esthetic and mechanical properties.

The objective is to measure Vickers Hardness of several CAD/CAM materials, including lithium disilicate (e.max CAD), Zirconia (Lava Esthetic), lithium silicate/zirconia (Celtra Duo), a polymer infiltrated ceramic (Vita Enamic), and resin ceramic hybrid (VarseoSmile Crown Plus).

Materials & Methods

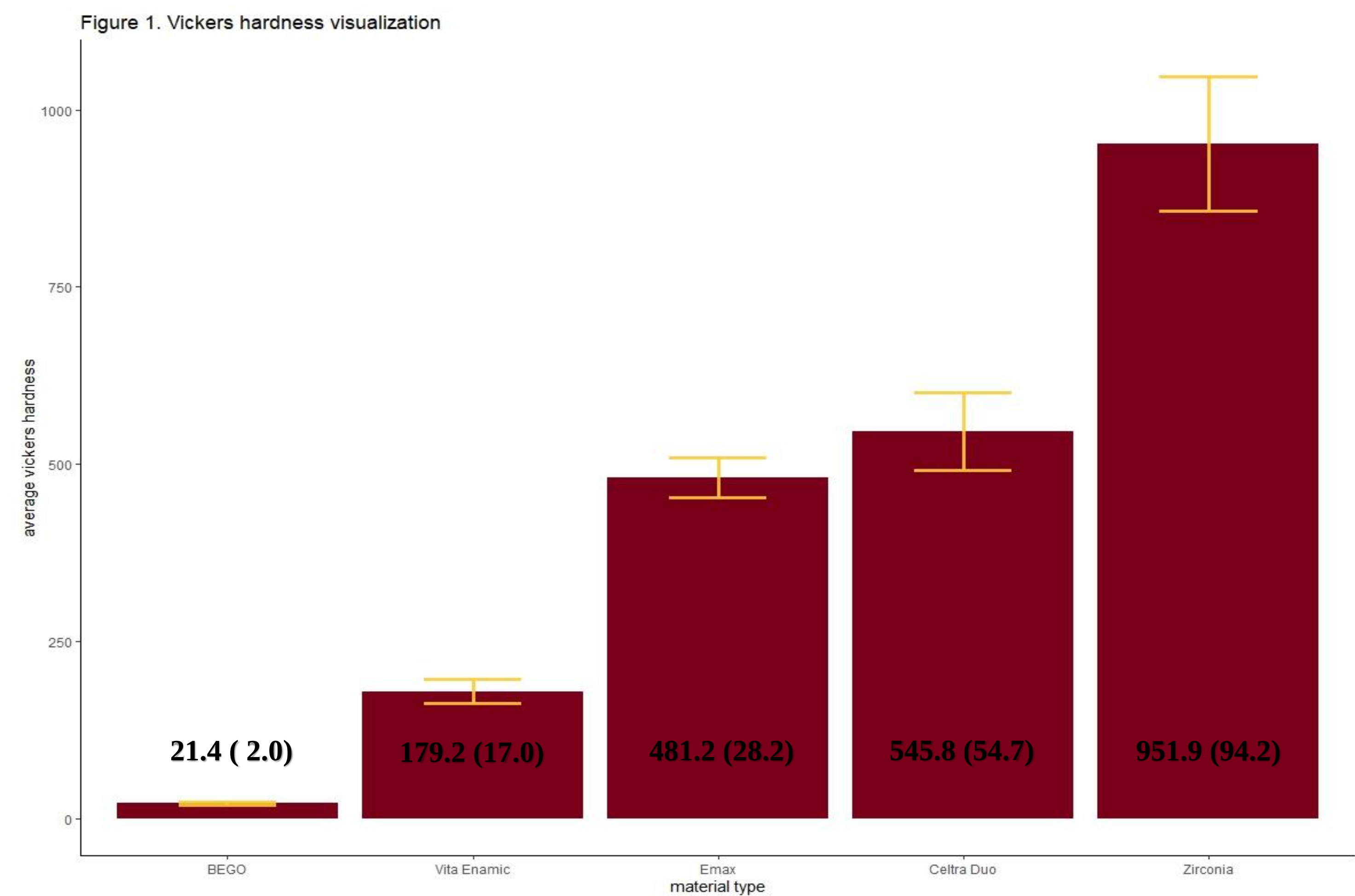
Five square-shaped specimens (15 x 12 x 1.5 mm thick) were obtained from each CAD-CAM material.



- Vickers hardness was measured using a digital microhardness tester (Wilson VH3100, Buehler) using a 1 kgf (= 9.8 N) load for 20 s dwell time.
- A pyramid-shaped diamond Vickers indenter was used to create thirty indentations per material (six per specimen).
- Statistical analysis was performed using linear mixed effect model. P-value was adjusted using Benjamini–Hochberg Method.

Material	Classification	Manufacturer	Chemical content (wt%)	Specimen Preparation
IPS Emax CAD	Lithium disilicate based glass-matrix ceramic	Ivoclar Vivadent AG, Liechtenstein	58-80% SiO ₂ 11-19% Li ₂ O 0-13% K ₂ O 0-8% ZrO ₂ 0-5% Al ₂ O ₃	- Cut using low-speed water-cooled diamond saw (Isomet, Buehler) - Polished via rubber and silicon polishers - Thermal treatment in Programat P510, Ivoclar
Lava™ Esthetic Zirconia Disc	Zirconia	3M, US	Zirconium dioxide Yttrium oxide (5 mol%)	- 3D digital design of the specimen was created using MEDIT Link - Milled with DWX-52DCi (Roland) dental milling machine - Sintered with UPCERA
Vita Enamic	Dual polymer hybrid ceramic	VITA Zahnfabrik, Germany	86% inorganic feldspathic ceramic network - 58-63% SiO ₂ - 20-23% Al ₂ O ₃ - 9-11% Na ₂ O - 4-6% K ₂ O - 0.1% ZrO ₂ 14% organic: - Methacrylate polymer (UDMA, TEGDMA)	- Cut using low-speed water-cooled diamond saw (Isomet, Buehler) - Polished via Vita Enamic polishing burs
Celtra Duo CAD	Lithium silicate reinforced with zirconia	Dentsply Sirona, US	58% SiO ₂ 18.5% Li ₂ O 10.1% ZrO ₂ 1.9% Al ₂ O ₃ 1% Tb ₂ O ₃ 2% CeO ₂ 5% P ₂ O ₅	- Cut using low-speed water-cooled diamond saw (Isomet, Buehler) - Polished via diamond polishing bodies - Thermal treatment in Programat P510, Ivoclar
VarseoSmile Crown Plus	Resin ceramic hybrid	BEGO, Bremen, Germany	Dental glass Methyl benzoylfor-mate Diphenyl (2,4,6-trimethylbenzoyl) Phosphine oxide 30-50% inorganic fillers (particle size 0.7 µm)	- 3D digital design of the specimen was created using MEDIT Link - Printed with Asiga Max printer - Final curing performed in Form Cure (Formlabs), 90 seconds on each side.

Results



- Zirconia has highest Vickers hardness.
- VarseoSmile BEGO has lowest Vickers hardness.
- Celtra Duo has higher mean microhardness than Emax, yet still lower than Zirconia
- Vita Enamic has lower microhardness than both Emax and Zirconia
- VarseoSmile BEGO has lower microhardness than both Emax and Zirconia.

Material	Mean (SD)	Difference estimate	95% CI	p-value
Celtra Duo	545.8 (54.7)	-524.4	(-545.1,-503.8)	<0.001
BEGO	21.4 (2.0)			
Celtra Duo	545.8 (54.7)	-366.7	(-387.5,-345.8)	<0.001
Vita Enamic	179.2 (17.0)			
Celtra Duo	545.8 (54.7)	406.1	(352.9,459.3)	<0.001
Zirconia	951.9 (94.2)			
Celtra Duo	545.8 (54.7)	-64.6	(-89.7,-39.5)	0.001
Emax	481.2 (28.2)			
BEGO	21.4 (2.0)	157.8	(151.6,163.9)	<0.001
Vita Enamic	179.2 (17.0)			
BEGO	21.4 (2.0)	930.5	(881.5,979.5)	<0.001
Zirconia	951.9 (94.2)			
BEGO	21.4 (2.0)	459.8	(445.5,474.1)	<0.001
Emax	481.2 (28.2)			
Vita Enamic	179.2 (17.0)	772.8	(723.7,821.8)	<0.001
Zirconia	951.9 (94.2)			
Vita Enamic	179.2 (17.0)	302.1	(287.5,316.7)	<0.001
Emax	481.2 (28.2)			
Zirconia	951.9 (94.2)	-470.7	(-521.7,-419.7)	<0.001
Emax	481.2 (28.2)			

Conclusion

- There’s statistically significant difference in Vickers Hardness between studied CAD-CAM materials.
- Vickers Hardness for tested materials can be classified as follows:
VarseoSmile > Vita Enamic > Emax > Celtra Duo > Zirconia