 DOI: 10.21608/adjalexu.2022.273605

METAL - CERAMIC BOND STRENGTH ANALYSIS OF COBALT-CHROMIUM DENTAL ALLOY FABRICATED BY THREE DIFFERENT TECHNIQUES (IN-VITRO STUDY)

Mahmoud O. Shehata[1*] *MSc*, Sanaa H. Abdelkader[2] *PhD*, Fayza H. Al Abbassy[3] *PhD*, Rewaa G.Abo Elhassan[2] *PhD*

1. *B.Sc. in 2010, Faculty of Dentistry, Alexandria University, Egypt*
2. *Professor of Fixed Prosthodontics Department, Faculty of Dentistry - Alexandria University, Egypt*
3. *Professor of Dental Materials Department, Faculty of Dentistry - Alexandria University, Egypt*
4. *Lecturer of Fixed Prosthodontics Department, Faculty of Dentistry - Alexandria University, Egypt*

**Corresponding author*

INTRODUCTION

Cobalt-chromium alloy is used widely for fabrication of dental fixed prostheses (1).

The metal framework of the restorations can be fabricated by different techniques including, conventional lost wax, subtractive (CAD-CAM milling) and additive (selective laser sintering) manufacturing technologies (2).

METHODOLOGY

Forty-two Co-Cr specimens (25mmx3mmx0.5mm) were prepared according to ISO 9693:1999 standards using three different techniques: selective laser sintering (group1, n=14), CAD-CAM milling (group2, n=14) and lost wax technique (group3, n=14).

The metal bars were veneered by firing a porcelain layer on the center of each specimen (8mm length x3mm width x1.1mm thickness), metal ceramic bond strength was evaluated by a three-point bending test then each specimen was examined by Scanning electron microscope to evaluate the failure mode (Figure 1).

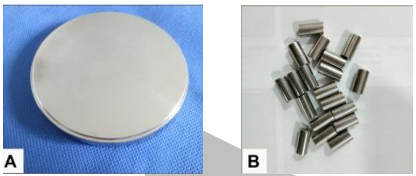

Figure1: A) Everest CAM select NEM (Co-Cr) alloy disc for CAD-CAM milling. B) Cobalt-Chromium alloy for casting (wirobond® c –BEGO)

RESULTS AND DISCUSSION

The statistical analysis of the results showed the highest bond strength values were associated with laser sintering group 1, with a Mean of 232.8 Mpa which was statistically highly significant at $P < 0.001$ than the other two test groups.

CAD-CAM milled group 2 (milling technique), gave a Mean bond strength 117.6 Mpa, while group 3 (lost wax technique) showed the lowest bond strength values with a Mean value 93.1 Mpa.

There was no statistical-significant difference between group 2 and 3 at $p > 0.05$.

Table (1): Comparison between bond strength

Tb	Laser sintering (n=14)	Cad / Cam (n=14)	Casting (n=14)	F	p
Min. – Max.	139.4 – 297.6	94.2 – 139.4	71.6 – 116.8	147.395^*	$<0.001^*$
Mean ± SD.	232.8 ± 35.4	117.6 ± 12.8	93.1 ± 12.9		
Median (IQR)	229.8 (222.3–241.1)	118.7 (109.2–128.1)	90.4 (82.9–101.7)		
Sig. bet. grps	$p_1<0.001^*$, $p_2<0.001^*$, $p_3=0.020^*$				

Selective laser sintering produces the metal substrate by fusing metal powder in layers without much porosity. This technique uses a focused high-power laser beam and results in products of nearly 100% density.

The laser could also be the key to harden metals and ceramics.

Furthermore, objects with complex geometries are achievable with a high-dimensional accuracy.

Compared to casting and milling processes, SLS reduces the probability of operator errors, minimizes defects, wastes since the remaining powder can be used further.

The disadvantages of milling are the waste of materials and limited potential for complex products compared with casting and SLS (3).

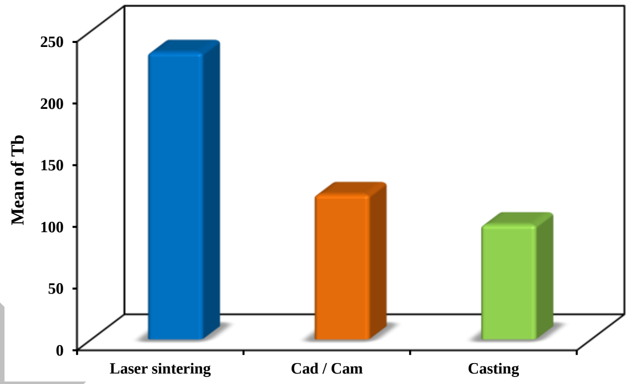

Figure 2: Comparison between the bond strength of the three studied groups.

CONCLUSION

The alloy fabricated by the Selective laser sintering technique provided the best metal– ceramic bond strength when compared to CAD-CAM milling and traditional lost wax techniques.

ACKNOWLEDGMENT

I would like to express my deepest appreciation and love to Prof. Dr. Sanaa Hussein Abdelkader, Dr. Fayza Hassan Al Abbassy, Dr. Rewaa Gaber Abo Elhassan, for her motivation, patience, enthusiasm, and support throughout all stages of this thesis. Her invaluable help, and constructive comments throughout the work; have enriched this research.

REFERENCES

1. Hong JK, Kim SK, Heo SJ, Koak JY. Mechanical properties and metal-ceramic bond strength of Co-Cr alloy manufactured by selective laser melting. Materials (Basel). 2020;13:5745.
2. Van Noort R. The future of dental devices is digital. Dent Mater. 2012;28:3-12.
3. Wysocki B, Idaszek J, Zdunek J, Rożniatowski K, Pisarek M, Yamamoto A, et al. The Influence of Selective Laser Melting (SLM) Process Parameters on In-Vitro Cell Response. Int J Mol Sci. 2018;19:1619.

Mahmoud O. Shehata, Rashid, Behaira, Egypt, dr_mah_omar@yahoo.com, 01008840738