

Objective

The aim of this study was to compare the fracture strength of CAD-CAM Lithium Disilicate indirect restorations with various preparation designs.

Introduction

Minimal invasive dentistry is driven by the primary objective of preserving healthy tooth structure. Advances in restorative materials and dental adhesives have paved the way for achieving this goal by minimizing the removal of natural tooth structure. This is accomplished through the application of either direct or indirect partial coverage restorations to replace lost tooth structure. (1) Advances in restorative materials and dental adhesives have paved the way for achieving this goal by minimizing the removal of natural tooth structure. This is accomplished through the application of either direct or indirect partial coverage restorations to replace lost tooth structure. (2) Occlusal veneers are thin, non-retentive indirect restorations that are securely bonded to tooth structures using modern luting agents. (3) Their primary advantage lies in their ability to restore masticatory function while simultaneously preserving precious tooth structure, all while relying on a predictable bond to the enamel. (4)

Materials and Methods

Sixty-four lithium disilicate indirect restorations were manufactured for four various preparation designs, 16 each, including; 1) complete coverage crown with 1.0 mm occlusal and axial reduction (CCC); 2) onlay with 1.0 mm occlusal thickness and margin width (ON), (3) occlusal veneer with 1.0 mm occlusal thickness at the central groove with margin (OVM); and 4) occlusal veneer with 1.0 mm occlusal thickness at the central groove without margin (OVNM). A model resin was used to 3D-print dies for each design. Indirect restorations were luted on their assigned dies using resin cement. They were then mounted on a mastication simulator with steatite as antagonists. Specimens were subjected to 400,000 loading cycles with a loading force of 70N at a frequency of 1.5Hz with 25°C running water and a 1mm horizontal slide. A universal testing machine was used to apply a compressive load at a cross-head speed of 1 mm/min at the central pit until failure occurred. One-way ANOVA and post hoc tests were used to analyze the impact of fracture strength between the groups.

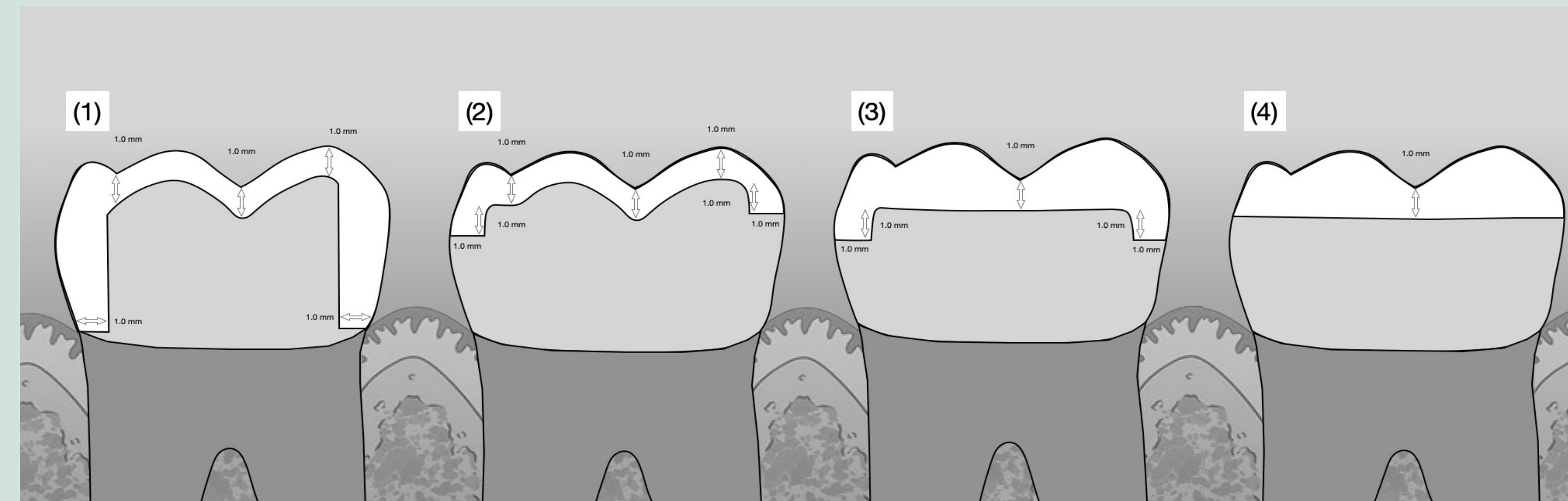


Figure 1: Schematic drawing of preparation and restoration designs: (1) CCC (2) ON (3) OVM (4) OVNM



Figure 2: Printed Resin Die

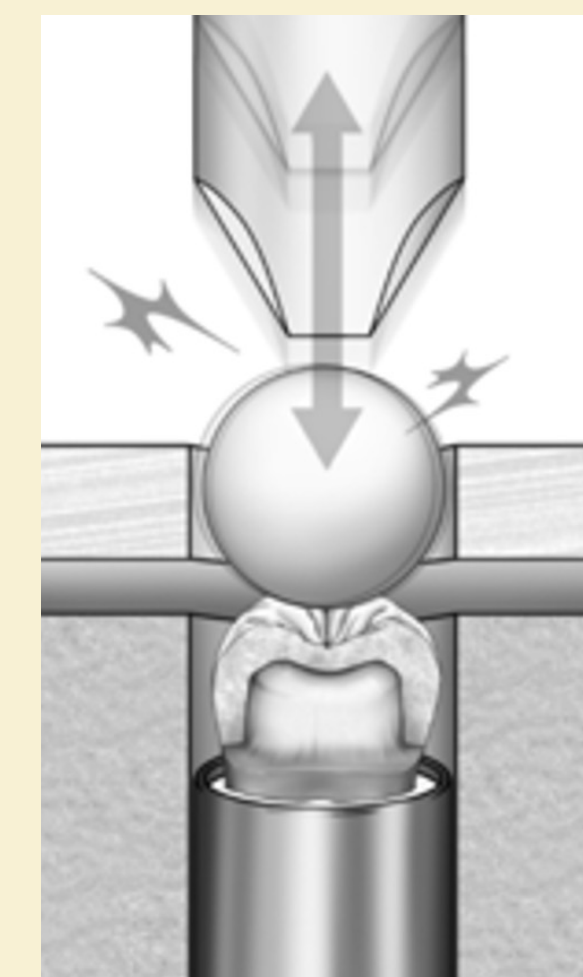


Figure 3: Mastication Simulator

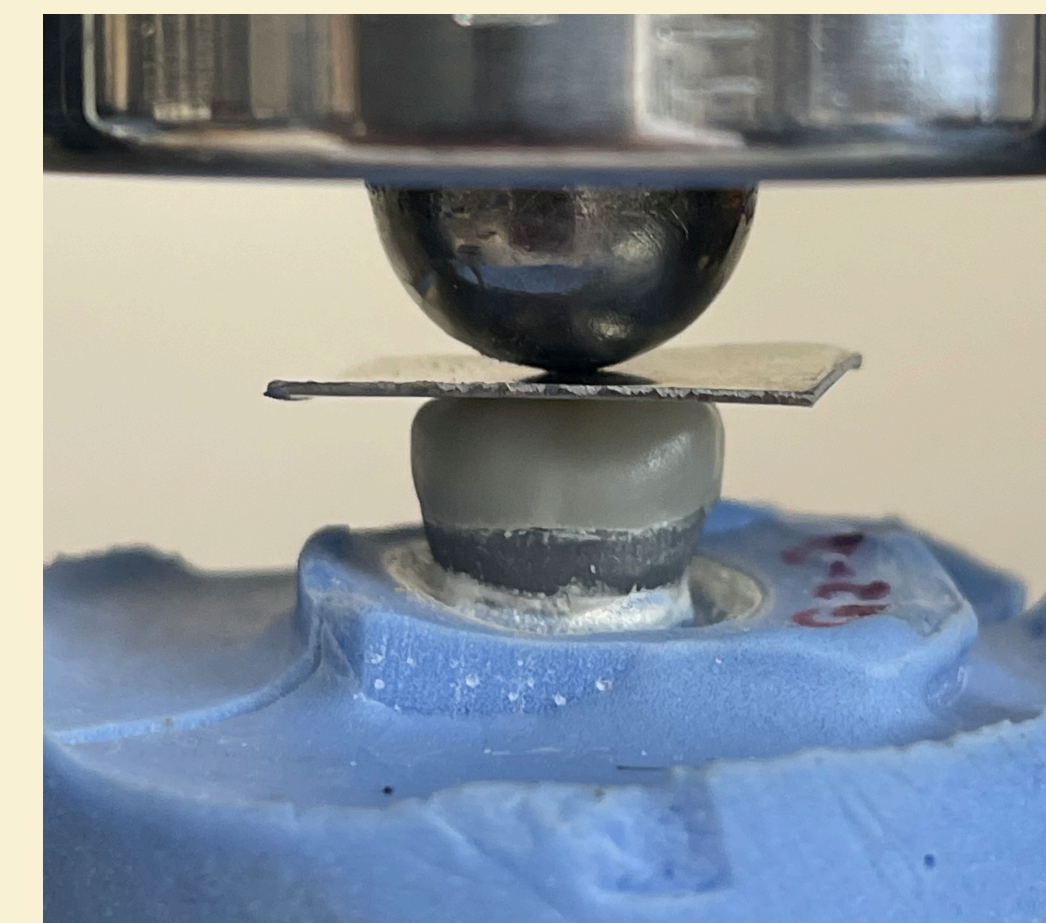


Figure 4: Compression Load in Instron

Results

ON and OVM had the highest fracture strengths (2549 N) followed by OVNM (2407 N) and CCC (2389 N); however, there were no significant differences between groups ($p=0.640$).

ANOVA - Fracture Strength

	Sum of Squares	df	Mean Square	F	p	η^2
Group	338061	3	112687	0.565	0.640	0.030
Residuals	1.10e+7	55	199333			

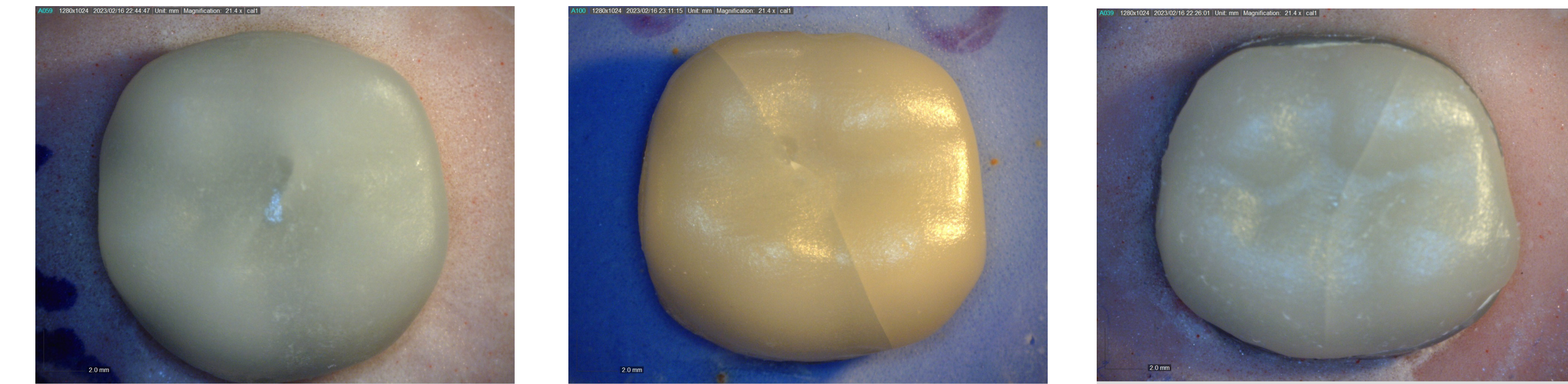


Figure 5: Microscopic images of restorations with crack after mastication simulation at 20 $\times$ magnification; complete coverage crown; non-anatomical occlusal veneer with margin; non-anatomical occlusal veneer without margin (left to right)

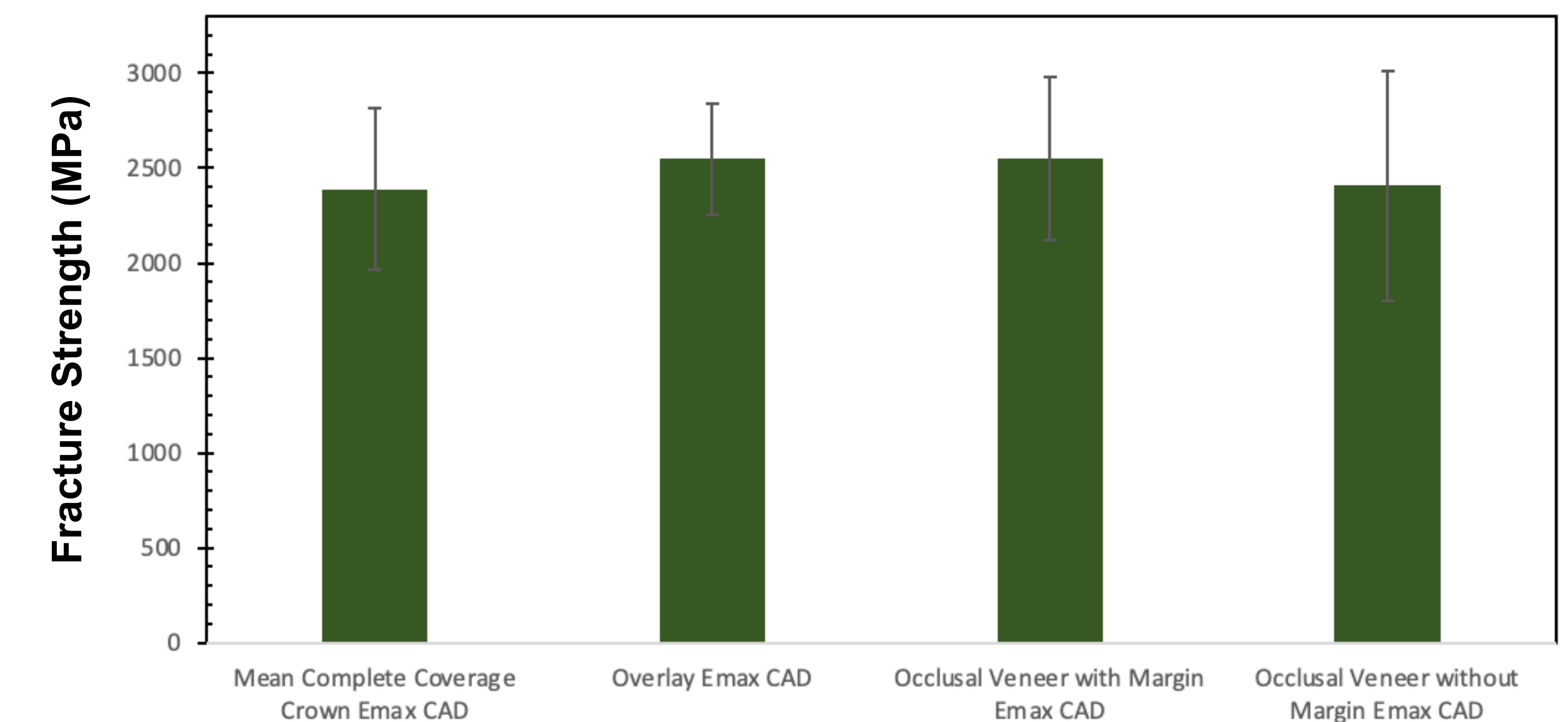


Figure 6: Fracture strength of indirect restorations with various designs

Conclusions

Within the scope of the study:

1. Conservative restorations are a viable option with comparable fracture resistance to complete coverage restorations.
2. Preparation and margin design does not have a significant impact on the fracture strength of the restorations

References

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2. Stappert CF, Att W, Gerds T, et al. Fracture resistance of different partial-coverage ceramic molar restorations: an in vitro investigation. *J Am Dent Assoc.* 2006;137:514-522.
3. Magne P, Schlichting LH, Maia HP, Baratieri LN. In vitro fatigue resistance of CAD/CAM composite resin and ceramic posterior occlusal veneers. *J Prosthet Dent.* 2010;104:149-157.
4. Sasse, M., Krummel, A., Kloss, K., & Kern, M. (2015). Influence of restoration thickness and dental bonding surface on the fracture resistance of full-coverage occlusal veneers made from lithium disilicate ceramic. *Dental Materials*, 31, 907–915