Influence of Firings and Thickness on Biaxial-Flexural-Strength of Lithium-Disilicate Ceramics

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Introduction

CAD/CAM lithium disilicate reinforced glass-ceramic materials (LDS) have been affected in their esthetic properties by multiple firings. Effects on the mechanical properties have yet to be investigated.

Purpose

Evaluate the effect of different thicknesses and repeated firings on the biaxial flexural strength (BFS) of four CAD/CAM LDS: IPS e.max CAD (EX) and Amber Mill (AM) as "lab-side"; Initial LiSi Block (LS) and n!ce (NC) as "chair-side".

Methods

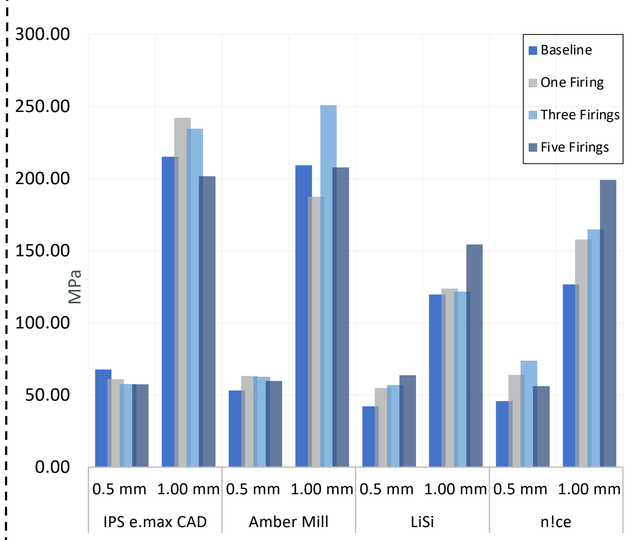
Discs (n=120 per material, ø 12.00 mm) were fabricated with two different thicknesses (0.5/1.00 mm) and were subdivided according to the number of firings: baseline (BL)/one firing (1F)/three firings (3F)/and five firings (5F). Firing cycles were performed according to the manufacturers' instructions. BFS test was performed according to ISO 6872-2015 (1) and data were analyzed using ANOVA and Weibull analysis.

Results

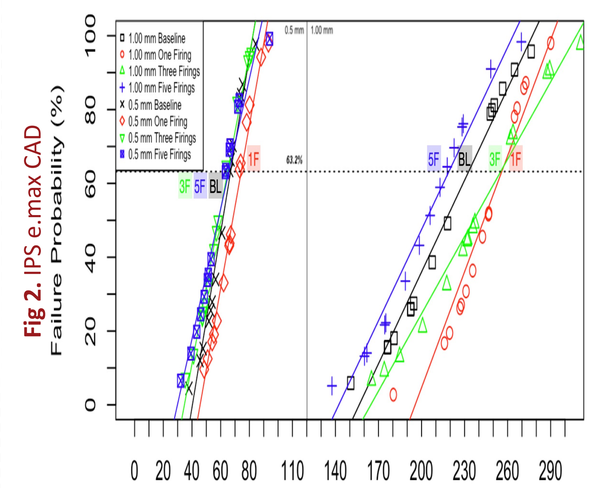
- The biaxial flexural strength of the materials differed from each other (EX=AM>NC>LS).
- A significant difference was found between the firings, regardless of the thickness, and the general ranking of firings was (3F>5F>1F>BL).
- Higher thickness (1.00 mm) presented a higher biaxial flexural strength value.
- Higher Weibull modulus and characteristic strength values were observed with lab-side vs. chair-side materials.

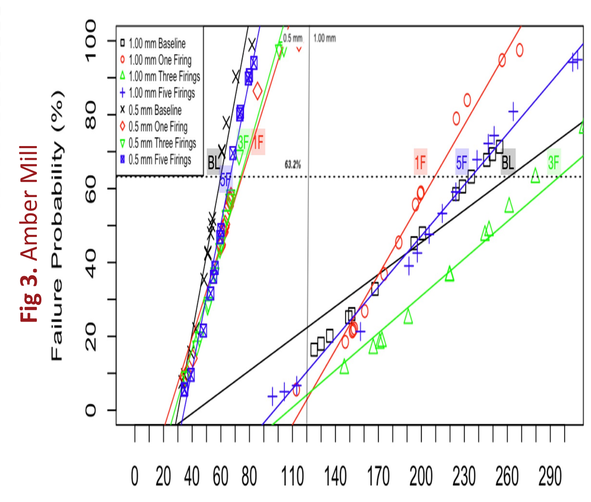
Results (cont.)

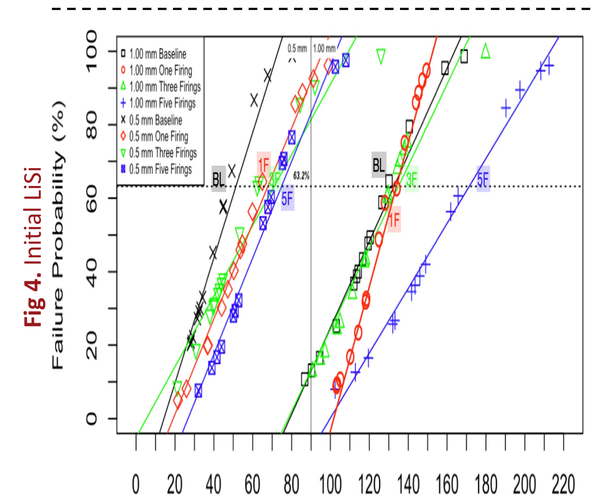
Figure 1: Mean biaxial flexural strength

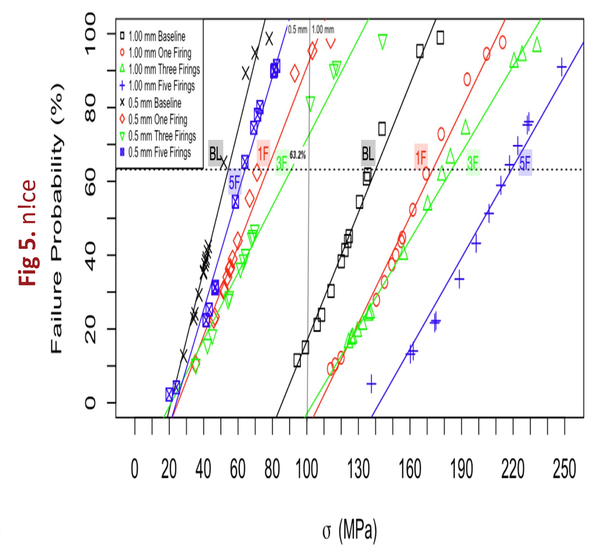


Figures 2-5: Weibull plots









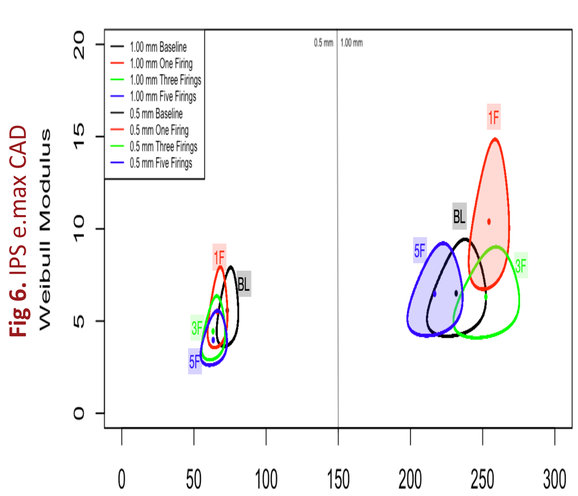
Results (cont.)

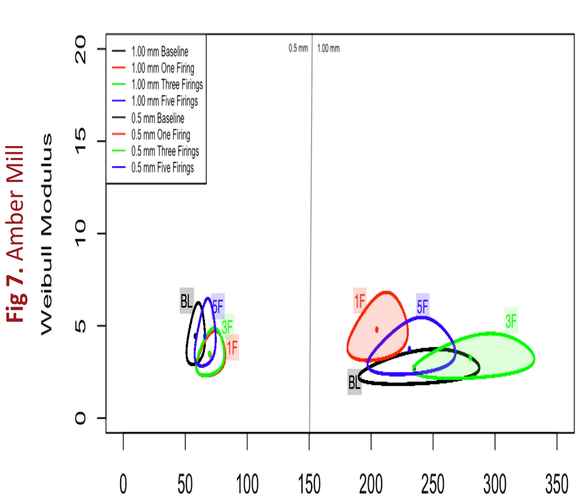
Table 1: Three-way ANOVA

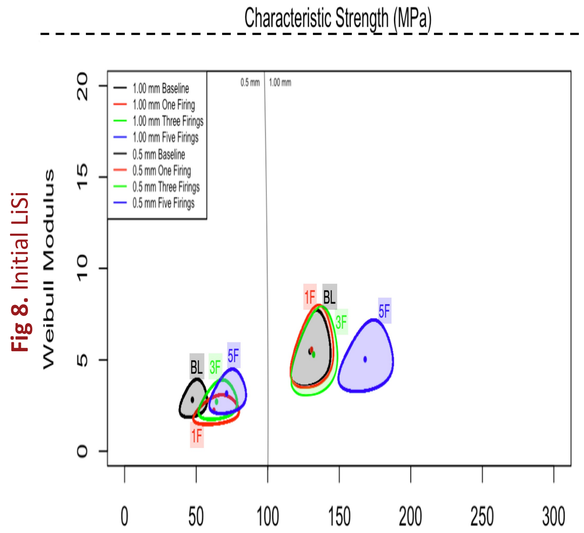
Source	Sig.
Material	0.000*
Thickness	0.000*
Firing	0.002*
Material * thickness	0.000*
Material * Firing	0.000*
Firing * Thickness	0.083
Firing * Material * Thickness	0.000*

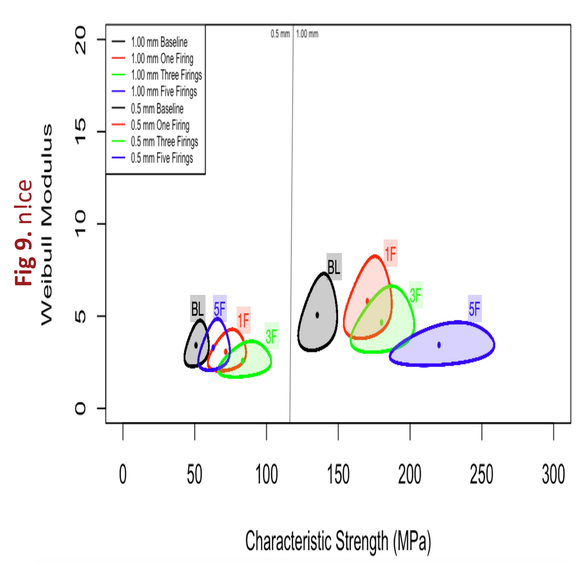
* *P* value ≤ 0.05

Figures 6-9: Contour plots









Discussion

- The mechanical strength of dental materials determines the clinical success of dental restorations. (2,3,4)
- Strength values are affected by the thickness and number of firings.
- The Weibull analysis presented an understanding of the data scattering, which is generally applied for the reliability and probability of failure of strength data for ceramic materials. (1)

Conclusions

- Repeated firings of EX, AM, LS, and NC resulted in clinically acceptable BFS values.
- Lab-side materials (EX and AM) presented higher BFS compared to chair-side materials (LS and NC).
- Higher Weibull modulus and Weibull characteristic strength values were observed with lab-side materials than in chair-side materials.
- EX decreased BFS after five firings significantly in 1.00 mm
- AM increased BFS after one firing significantly in 1.00 mm.
- LS and NC increased BFS with repeated firings significantly in 0.5 mm and 1.00 mm.

References

1. ISO 6872 Dentistry-ceramic materials (2015).
2. Gracis S. A new classification system for all-ceramic and ceramic-like restorative materials. Int J Prosthodont (2015).
3. Phark JH, Duarte Jr S. Microstructural considerations for novel lithium disilicate glass ceramics: A review. J Esthet Restor Dent (2022).
4. Höland W, Beall GH. Glass-ceramic technology: John Wiley & Sons (2019).

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