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EFFECT OF STRUCTURE ON FLEXURAL PROPERTIES OF A SPLINT MATERIAL

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Introduction

Dental splints are used in a variety of applications including stabilizing loose teeth, reinforcing provisional partial dentures, repairing dentures and other restorations, etc. As an example, avulsed teeth due to trauma may be replanted and supported with a dental splint to protect and immobilize the tooth to allow for reintegration of periodontal fibers. In many of these applications, the splint material requires significant flexural properties for proper function. Consequently, many dental splints are resin-based materials reinforced with glass fibers. The orientation of fibers, however, has the possibility of influencing the flexural properties of the dental splint.

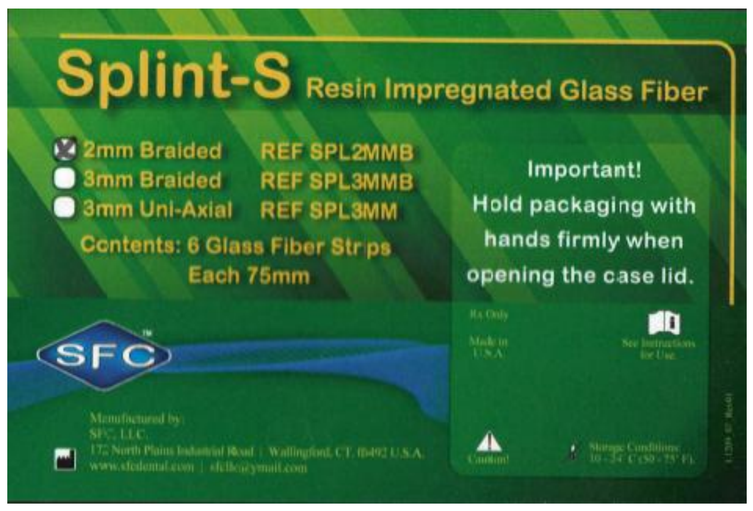
Objective

The objective of this research was to compare the flexural properties of four structural configurations of a dental splint product made from glass fiber-reinforced resin material.

Materials and Methods

Splint-S from SFC, LLC was used to make four structural configurations based upon fiber arrangement:

Group I: All Braided
Group II: All Uni-directional
Group III: Top and bottom uni-directional, center braided
Group IV: Top and bottom braided, center uni-directional



The four splint group specimens (n=5/group; approximately 25 x 2 x 1.5 mm) were stored for 24 hours in distilled water at 37°C. After storage, the splint material beams were tested in 3-point flexure at a crosshead speed of 1 mm/min and bottom supports separated by 20 mm. Flexural strength and flexural modulus were determined from the flexure curves. Specifically, flexural strength was determined as the maximum stress before failure/permanent deformation; this coincided with a drop in force. Flexural Modulus was computed within the elastic region of the flexure curves. Mean and standard deviation values for flexural strengths and flexural moduli of all test groups were determined and compared with one-way ANOVA and a post hoc Tukey test, if indicated. Significance was set to $p<0.05$.

Results

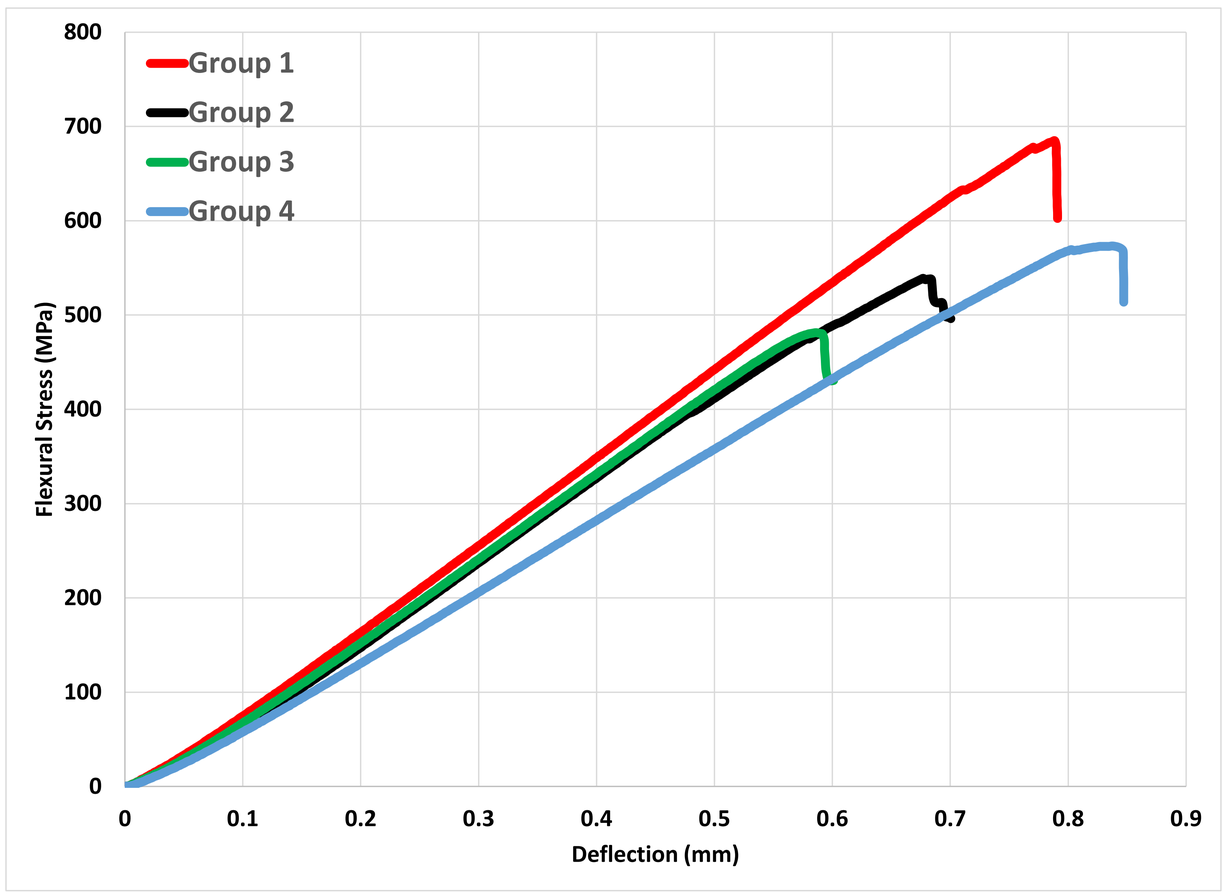
The flexural strengths and flexural moduli are shown below.

Splint Material	Flexural Strength (MPa)	Flexural Modulus (GPa)
Group I	657 ± 32 A*	27.2 ± 2.2
Group II	510 ± 31 C	24.5 ± 0.6
Group III	544 ± 35 BC	27.7 ± 1.7
Group IV	583 ± 23 B	25.1 ± 2.1

*Groups with different letters are significantly ($p<0.05$) different from each other.

Group I (All braided) was significantly ($p<0.05$) stronger than the other 3 groups. Group IV (Top and bottom braided, center uni-directional) was significantly ($p<0.05$) stronger than Group II (All uni-directional); Group III (Top and bottom uni-directional, center braided) was statistically similar to Groups II and IV in flexural strength. No significant ($p<0.05$) differences were found among groups with respect to flexural modulus.

Flexural Stress vs Deflection curves are shown below. Consistent with the values in the Table, Group I was the strongest of the four groups.



Conclusions

For glass fiber-reinforced resin dental splint material, fiber arrangement influenced flexural strength with a braided arrangement producing greater strength than uni-directional.

Acknowledgement

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