

Laboratory Evaluation of Stela Composites

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INTRODUCTION:

Stela from SDI is a new self-cured composite system which has indications for class I, II, III and V restorations. It has a unique offering of 2 formulations in an automix syringe or capsule. The advantage of the capsule is that it is much more highly filled and allows more shaping before curing, while the automix formulation is ideal for any case which calls for an injectable or flowable composite. **Stela** also includes fluoride, calcium and strontium which can help create a positive pH while being BPA and HEMA free.

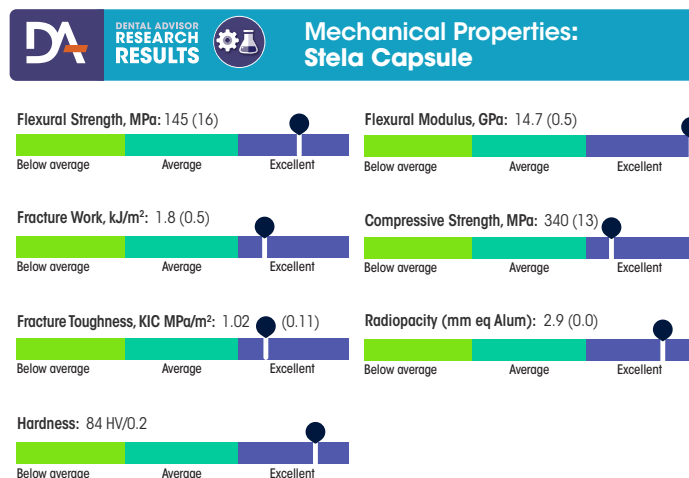
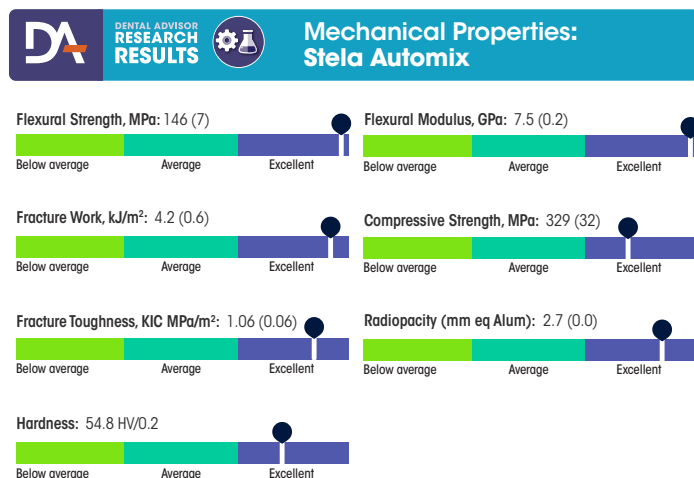
So why use a self-curing composite? The primary advantage of self-curing composite is that they can have an unlimited depth of cure ensuring that all parts of the restoration are cured evenly. Light curing can be both technique sensitive and by the nature of initiating the polymerization process at the outside of the composite, there is potential that in large filling, a gap can be created at the bottom of a restoration. Self-curing will evenly distribute the polymerization stresses across any bonding interfaces with a primer that catalyzes the **Stela** composite at the bonding interface, so the interface cures first. Contact-curing primers have a great potential to reduce sensitivity and help ensure gap free margins.



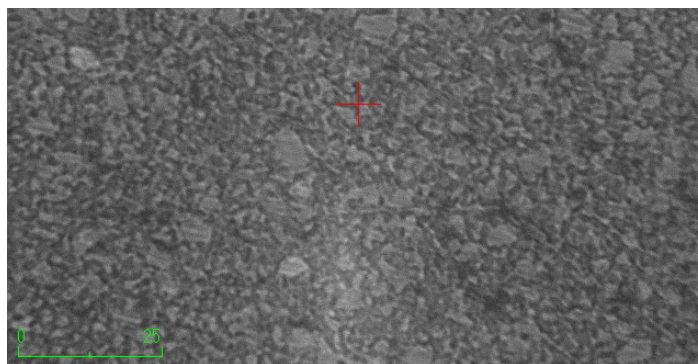
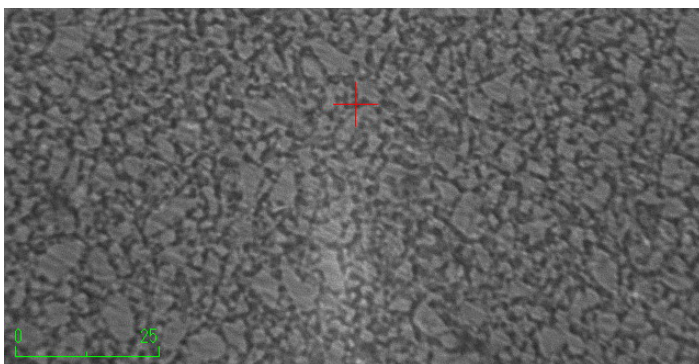
RESULTS SUMMARY:

In this study, we tested the mechanical properties of the two formulations, radiopacity, bond strength and a SEM evaluation of the dentin margins to test the gap-free claims. Overall, we found that **Stela** has mechanical strength properties which are excellent compared to other composites with an ideal radiopacity. The combination of a self-curing polymerization with a contact curing primer can help ensure good marginal integrity, especially in the bottom of large restorations. **Stela Automix** with **Stela Primer** showed excellent bond strength, marginal adaptation and no marginal gaps at the bottom of large restorations.

Mechanical Properties



Both formulations exhibit very similar ultimate flexural strength, fracture toughness, compressive strength and radiopacity and closely match the values from SDI's internal testing. The flexural strength is above average for composites, and especially other competitive flowable and capsule-based restoratives we've tested. The main difference between the two formulations mechanically is that the capsule has a larger percentage of fillers which also includes larger filler particle sizes, and this results in a stiffer composite. The capsule version has a modulus that's higher than nearly all composites on the market (typical range 5-12 GPa) which makes it closer to the ideal of enamel modulus. This helps resist occlusal forces better as the composite will bend less during chewing. The advantage of lower modulus of the automix formulation composite is that it can spread stress placed upon them on a larger area which allows them to absorb more total energy represented in the fracture work energy value.



400 X images showing differences in filler distribution. The capsule formulation (left) has larger filler particles which adds to the stiffness of the composite. Any mixed flowable composite needs a larger resin component in order to be able to be extruded, however **Stela** has a particularly strong resin matrix which allows it to have a high flexural and compressive strength.

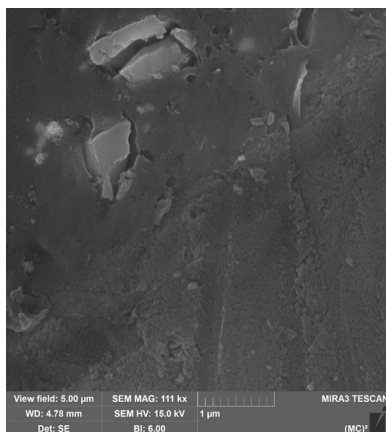
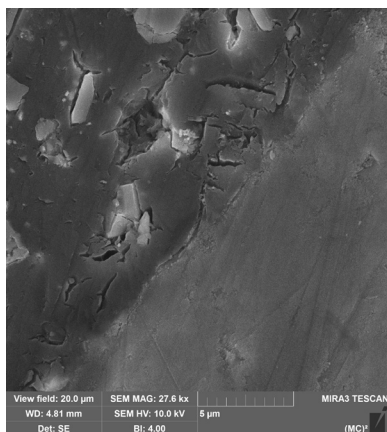
SEM Evaluation: An evaluation of the margins in tooth restorations placed with very large restorations which would be challenging for light-cured, bulk-filled composites was performed using the Automix Formulation. Tooth restorations were sectioned producing 1 mm cross-sections to evaluate the interfaces.

Photo courtesy of Dr. Adam Hodges

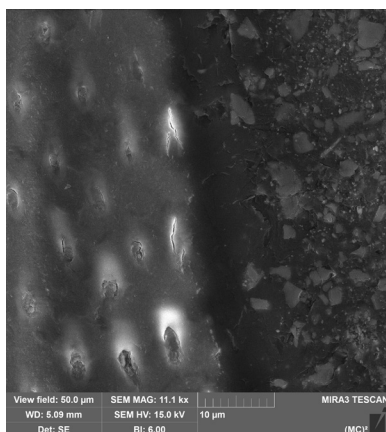
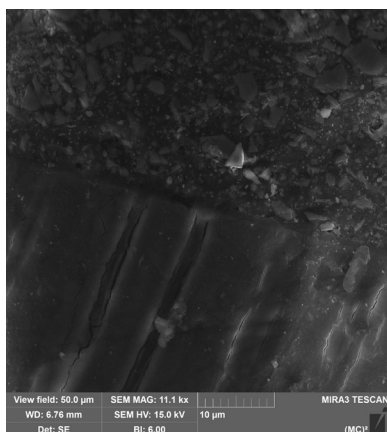


Radiopacity: Dentin on average has about the same radiopacity as aluminum which is why this is used as the comparison in studies, while sound enamel has about 2X the radiopacity of aluminum.

Stela which has a radiopacity of 2.7-2.9X aluminum should be distinct from tooth structure in restorations.

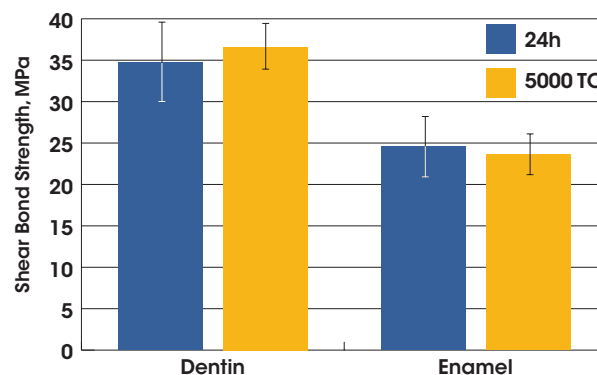


Enamel margins show good adaptation. Overall, the bonding interfaces to enamel are similar to other composites, with an advantage in dentin margins compared to light-cured composites.



Dentin Margins have continuous margins in all reviewed specimens, with evidence of good penetration into dentin tubules. There couldn't be a better result in dentin bonding from this evaluation.

ISO 29022 Bond Strength Results



There is good bond strength to dentin and enamel in combination with **Stela Automix** and **Stela Primer** with no significant loss of bond strength after accelerated aging. Mixed failure modes were predominately seen in both enamel and dentin specimens, before and after thermocycling indicating a strong bond as the failure wasn't at the bonding interface.