



Bond strength of vinyl polysiloxane tray adhesive to 3-D printed tray materials: A comparison study

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Objective

Understand the effectiveness of traditional vinyl polysiloxane tray adhesive on 3-D printed custom tray material due to the absence of 3-D printed resin-specific adhesive in the dental materials market.

Methods

Custom tray specimens were designed using Meshmixer (Meshmixer, San Rafael, CA, USA) and made of UDMA Megatray (Select Dental, New York, USA), Formlabs Custom Tray Resin (Formlabs, Somerville, MA, USA), and Asiga DentaTRAY (Asiga, Sydney, Australia). Each tray was designed to have a flat 25mm x 25mm base, 6mm height angled at 45 degrees and an attachment hole for testing. The UDMA samples served as the control group. Printed trays were unaltered or abraded with 100-µm Aluminum Oxide at 2 bar. V.P.S. Tray Adhesive (Kerr, Michigan, USA) was placed on the trays and allowed to dry in accordance with the manufacturer’s instructions for use. Aquasil Ultra + Smart Wetting Tray Impression Material (Charlotte, North Carolina, USA) was placed on the tray and allowed to set. A universal testing machine Instron, Model E10000 (Instron Corp, Massachusetts, USA) was used to place 1.4kg of pressure on the tray specimen to mimic intraoral pressure then pulled to conduct the tear test, separating the custom tray from the VPS.

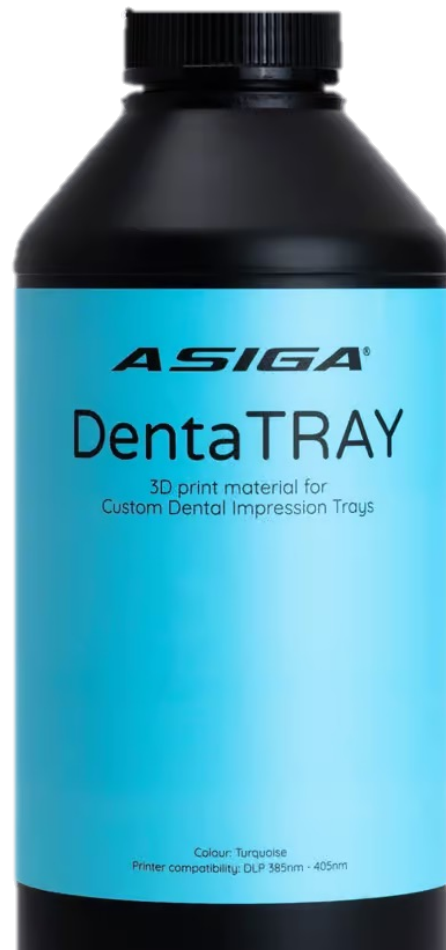
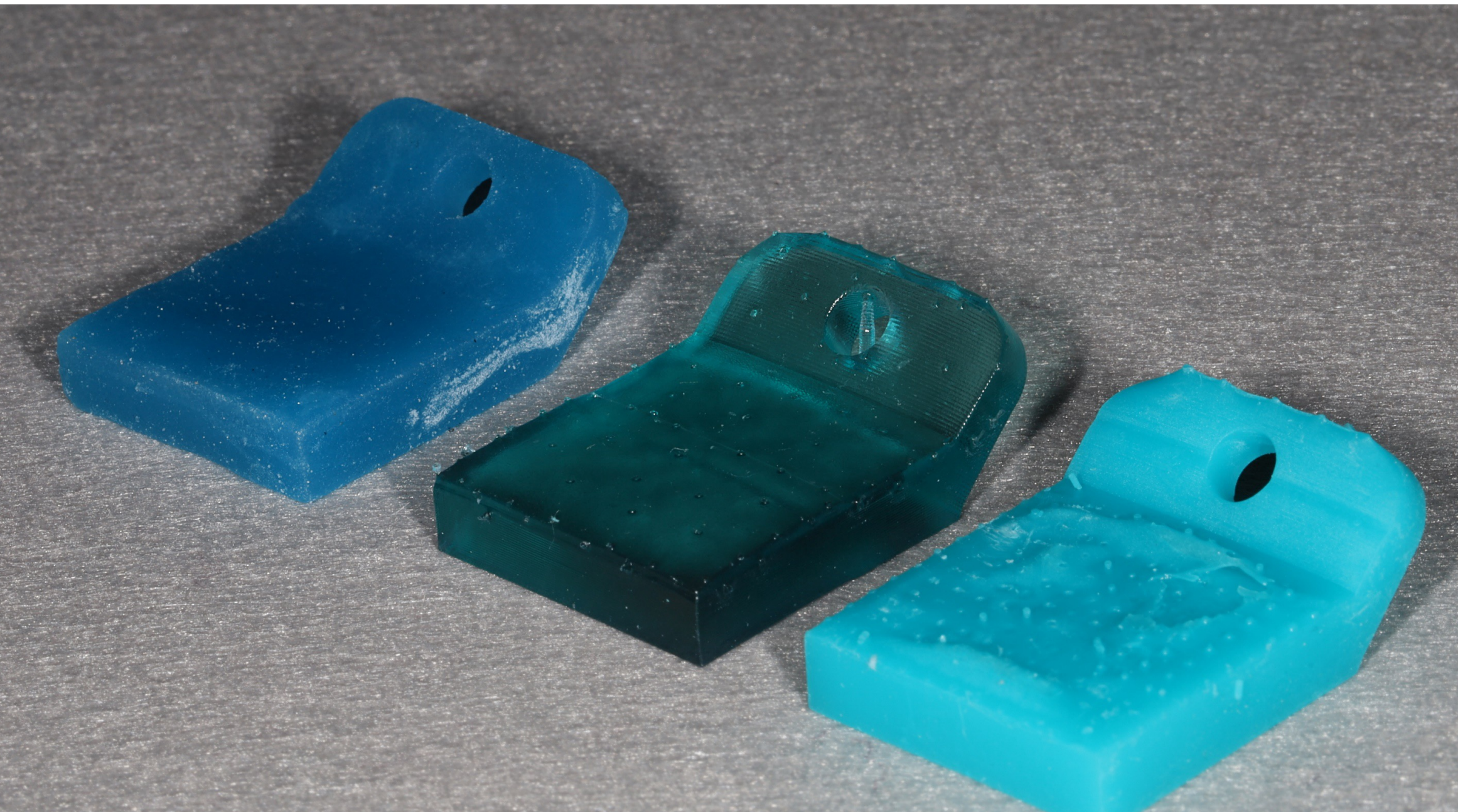
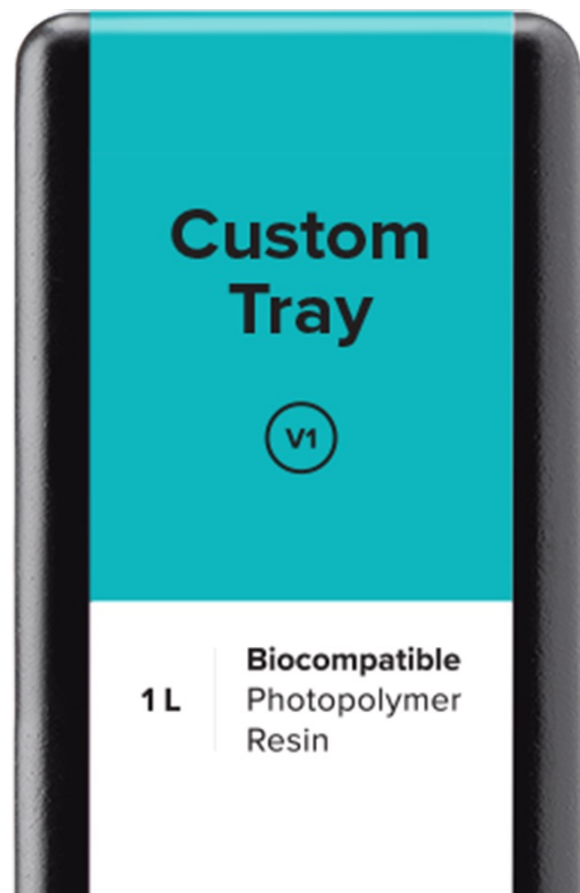
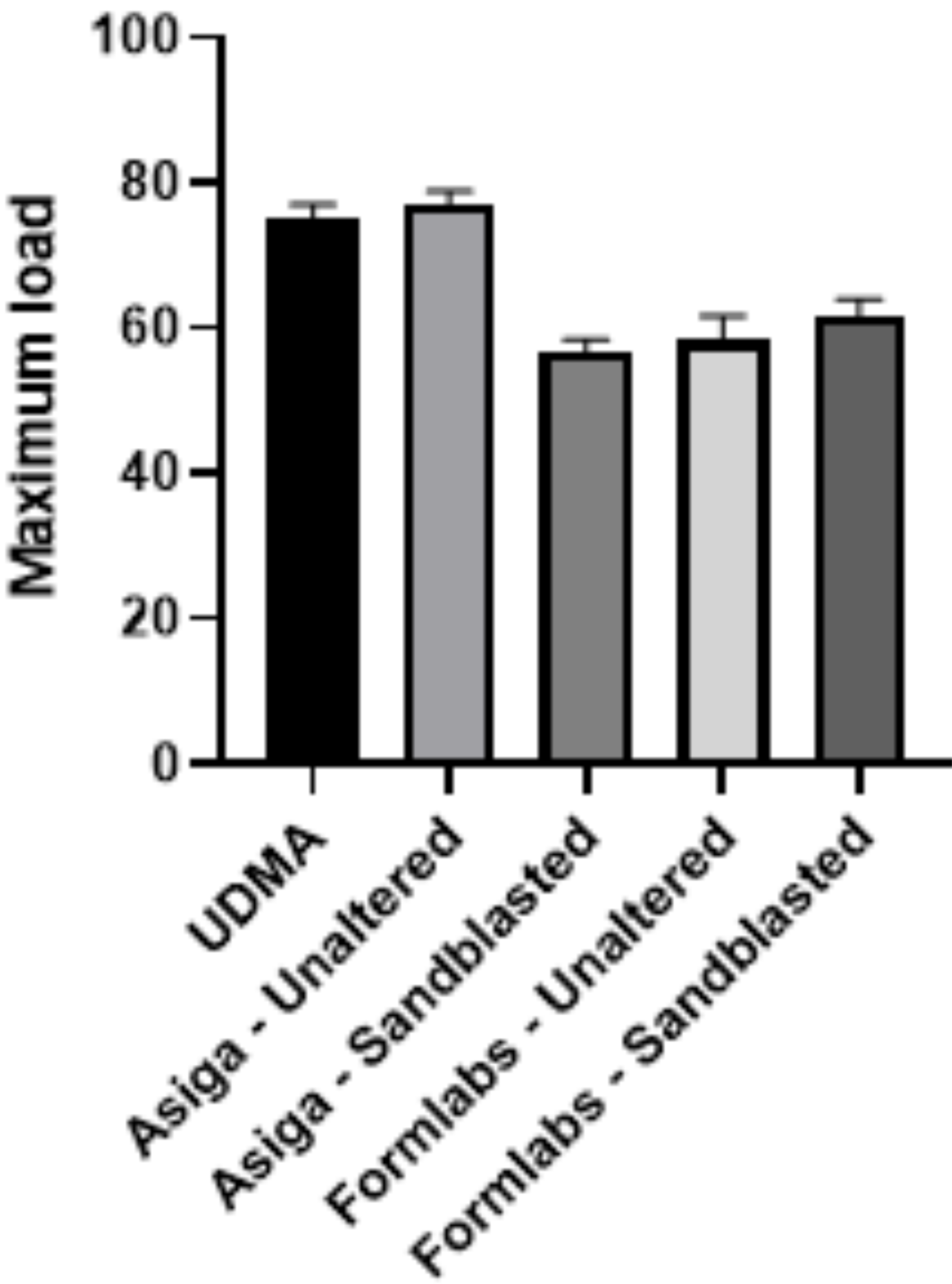
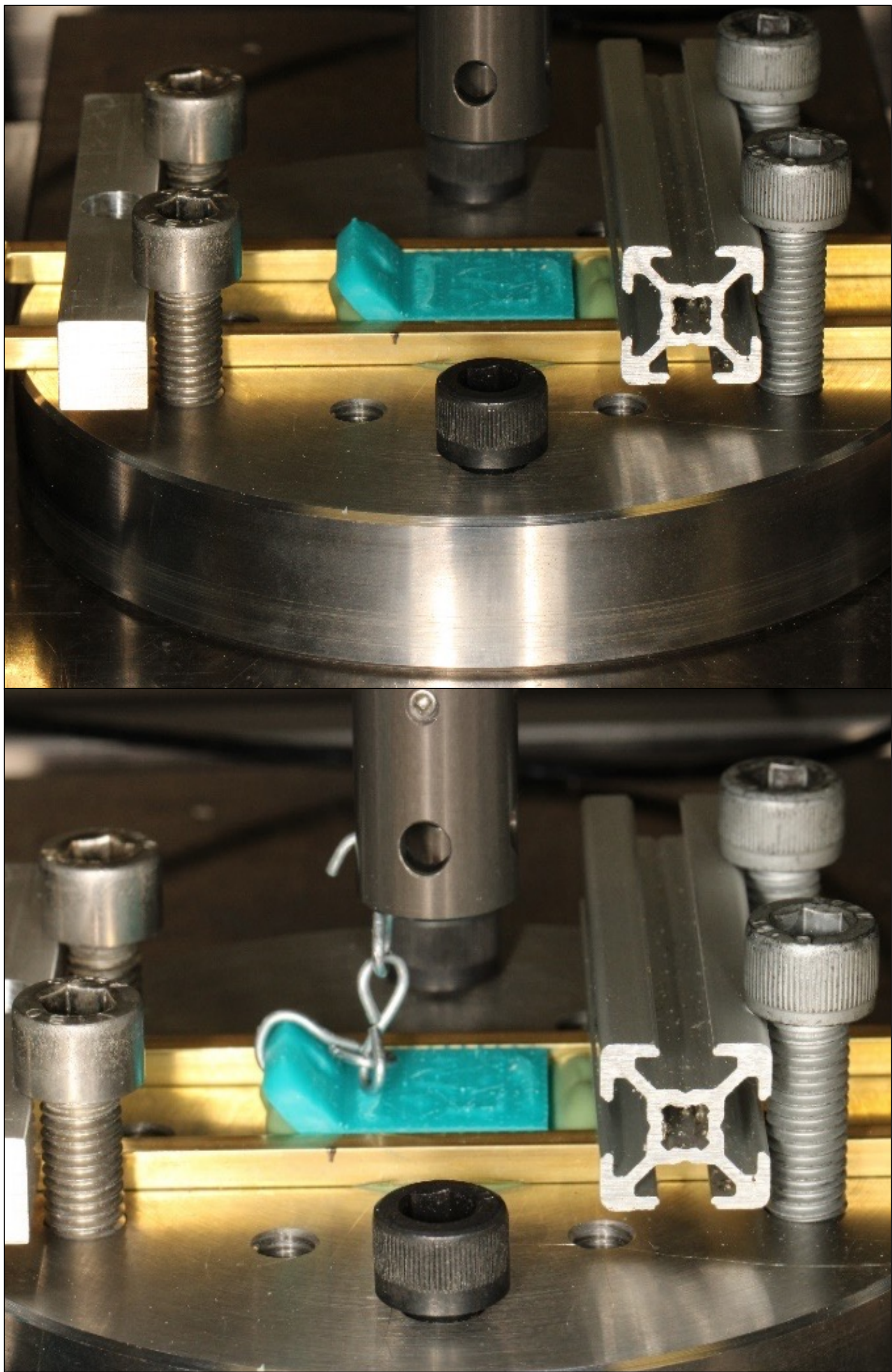
Hypothesis

Hypothesis 1

Traditional VPS tray adhesive will have lower adhesive qualities when used on 3-D printed custom tray material compared to traditional UDMA custom tray material.

Hypothesis 2

Post-cure surface alteration will result in higher retention of VPS to the 3-D printed tray material.



Results

Asiga Unaltered tray group exhibited the highest adhesive properties of all trays with a mean force of adhesive failure of 76.94N while the lowest was Asiga Sandblasted group with a mean value of 56.78N. The Asiga Unaltered test group results reflected the most similar results to the UDMA control group with values of 76.94N and 75.12N respectively. Two independent planned comparisons were performed to test impression materials (Asiga vs. Formlabs) and effects of abrasion (Unaltered vs. Sandblasted). Asiga was shown to require a higher load to peel as did the Unaltered specimen groups.

Conclusions

Overall, the Asiga DentaTRAY Resin performed the best with the highest load to peel values when compared to the control and Formlabs Custom Tray Resin. It was determined that grit-blasting the 3-D printed trays resulted in lower values of adhesion. Specific 3-D printed resins can provide comparable, if not better retention of VPS compared to traditional UDMA tray material.

References

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Tray Group	Mean (N)			
UDMA (Control)	75.12410			
Asiga - Unaltered	76.94082			
Asiga - Sandblasted	56.78661			
Formlabs - Unaltered	58.32246			
Formlabs - Sandblasted	61.73693			

Tray Group	Mean Diff.	95.00% CI of diff.	Significant ?	P Value
Asiga vs. Formlabs	13.67	4.71 to 22.63	Yes	0.003
Unaltered vs. Sandblasted	16.74	7.78 to 25.70	Yes	0.0004