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The influence of monomeric resin and filler characteristics on the performance of experimental resin-based composites (RBCs) derived from a commercial formulation.

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Source
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Abstract

OBJECTIVE:
To explore experimental RBCs derived from a successful commercially available RBC (Grandio) to investigate resin monomer blend and filler parameters (volume fraction, density and diameter) on RBC performance.

METHOD:
Six experimental RBCs modified from a commercial RBC were tested. The three-point flexure strength (σ(3)) and modulus (E) data was determined for groups of 20 bar-shaped specimens, prepared in a custom-made knife-edge split aluminum mold and irradiated using a modification of the ISO 4049 protocol. The biaxial flexure strength (BFS) and top and bottom Vickers hardness number (VHN) determination was performed on disc-shaped specimens (n=20). Normal distribution of the σ(3), E, BFS and top and bottom VHN data was verified using the Shapiro-Wilk's test. Paired groups were compared using independent samples t-test for the individual tests investigated (σ(3), E, BFS and top and bottom VHN) at a significance level of $P<0.05$.

RESULTS:
A significant decrease in the mean σ(3) ($P<0.011$) and mean E ($P<0.001$) were identified on increasing the filler fraction (from 71.4 to 74.5 vol%) or increasing the mean filler diameter (from 1.5 to 2.5 μm). Increasing the filler density resulted in a significant increase in the mean σ(3) ($P<0.001$), mean E ($P<0.001$) and mean top VHN ($P\leq0.001$). Replacing the monomeric blend with an ormocer blend significantly reduced the mean σ(3), E, BFS and top and bottom VHNs (all $P<0.001$).

SIGNIFICANCE:
For each RBC monomeric resin and filler (type, density and diameter) combination employed, a finite filler volume fraction exists. Operating at the finite filler volume fraction increases the difficulty in improving the mechanical properties of the RBCs tailored from a commercial product.