

Mechanical & adhesion properties of Adhesive, remineralising & anti-bacterial dental composite

Objectives:

Determine whether antibacterial chlorhexidine, reactive calcium phosphate fillers, level of adhesive monomers, and acid conditioning, will maintain adequate mechanical strength and ivory dentine bonding of dental composites.

Methods:

Base monomer UDMA and diluent monomer TEGDMA in 3:1 were mixed with (5 or 10 wt %) of HEMA, and 5 wt % of 4-META. This was mixed with silane treated glass particles along with chlorhexidine diacetate (5 wt %), calcium phosphate (0 or 10 wt %), and fibres (5 wt %). Powder to liquid ratio was 4:1.

For Biaxial flexural strength samples were made by light curing the composite from both sides (10 mm diameter, 1 mm thick), and placing it for 24 hours in distilled water.

Bonding was determined by ivory dentine blocks. Cylindrical holes (3mm diameter, 5 mm deep) were drilled. These were filled by composite after acid etching with 37 % H₃PO₄ for 0 or 20 s, along with ibond for 0 or 20 s.

Results were compared with commercial materials Z250, Gradia and Ecusphere using factorial analysis.

Results:

Experimental composite (with HEMA and 4-META) strength was comparable to Z250 and Ecusphere, and better than Gradia. Addition of reactive fillers decrease the strength by 50 MPa, but still maintain a better strength than Gradia. Varying adhesive monomer type had negligible effect.

Adhesion with 4-META was better in varying conditions. Composites with HEMA work only with acid etching. With 4-META the debonding force increased from 700 to 850 N with acid treatment. With other monomers and commercial materials, debonding force increased from ~100 to > 1000 N with acid pre-treatment. Reactive fillers addition helps in adhesion.

Conclusions:

Anti-bacterial, adhesive and remineralising composite produced with strength and adhesion comparable to commercial materials. Adhesive monomer 4-META and reactive calcium phosphate helps in adhesion under varying conditions.

Sample	Biaxial flexural strength		Debonding force					
	Avg Strength (MPa)	S.D	No Acid Tx (N)	S.D	Acid Tx (N)	S.D	Acid+ Ibond Tx (N)	S.D
Z250	170	6	100	50	450	20	950	50
Gradia	70	3			360	80	1050	60
Ecusphere	175	13					950	125
Composite with HEMA	175	9	100	10	800	70	1300	50
Composite with 4-META	170	6	700	100	850	80	1050	100
Composite with reactive fillers	125	10	720	60	860	50		