Supporting information

Polybetaine-enhanced hybrid ionomer cement shows improved total biological effect with bacterial resistance and cellular stimulation

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Table S1. Composition of different groups of hybrid ionomer cement (HIC). Powder/liquid ratio: 0.33 g/0.10 g

		Composition (g)			
Group	MPC:SB	MPC	SB	Powder	Liquid
CTRL	0	0	0	16	5
α-*m*ZM	1:1	0.315	0.315	15.52	4.85
β-*m*ZM	1:2	0.21	0.42	15.52	4.85
γ-*m*ZM	2:1	0.42	0.21	15.52	4.85

Powder; Strontium fluoroaluminosilicate dental glass, Lot no: 2008051, MPC; 2-methacryloyloxyethyl phosphorylcholine, SB; sulfobetaine methacrylate

Table S2. Major elemental compositions of investigated materials determined with energy-dispersive x-ray spectroscopy surface analysis

	Element (Wt.%)							
Group	O	Sr	Si	Al	F	P	Na	Ca
CTRL	32.75	22.95	17.85	12.95	11.32	1.02	0.66	0.48
α-*m*ZM	28.92	25.28	19.36	13.98	10.19	1.64	0.29	0.33
β-*m*ZM	30.88	24.19	18.69	13.54	10.86	1.33	0.36	0.15
γ-*m*ZM	32.04	23.15	17.98	13.38	11.23	1.42	0.3	0.5

Table S3. LDA score for differentially abundant taxa

Significantly different taxonomic marker	**LDA score (log10)**
Veillonella dispar	4.6282
Streptococcus pneumoniae group	4.35581
Haemophilus parainfluenzae group	4.16423
Veillonella atypica	3.95069
Veillonella rogosae	3.88056
Veillonella_uc	3.23743
Streptococcus constellatus group	3.07448
Gemella haemolysans group	2.94345
Lactobacillus fermentum	2.29111

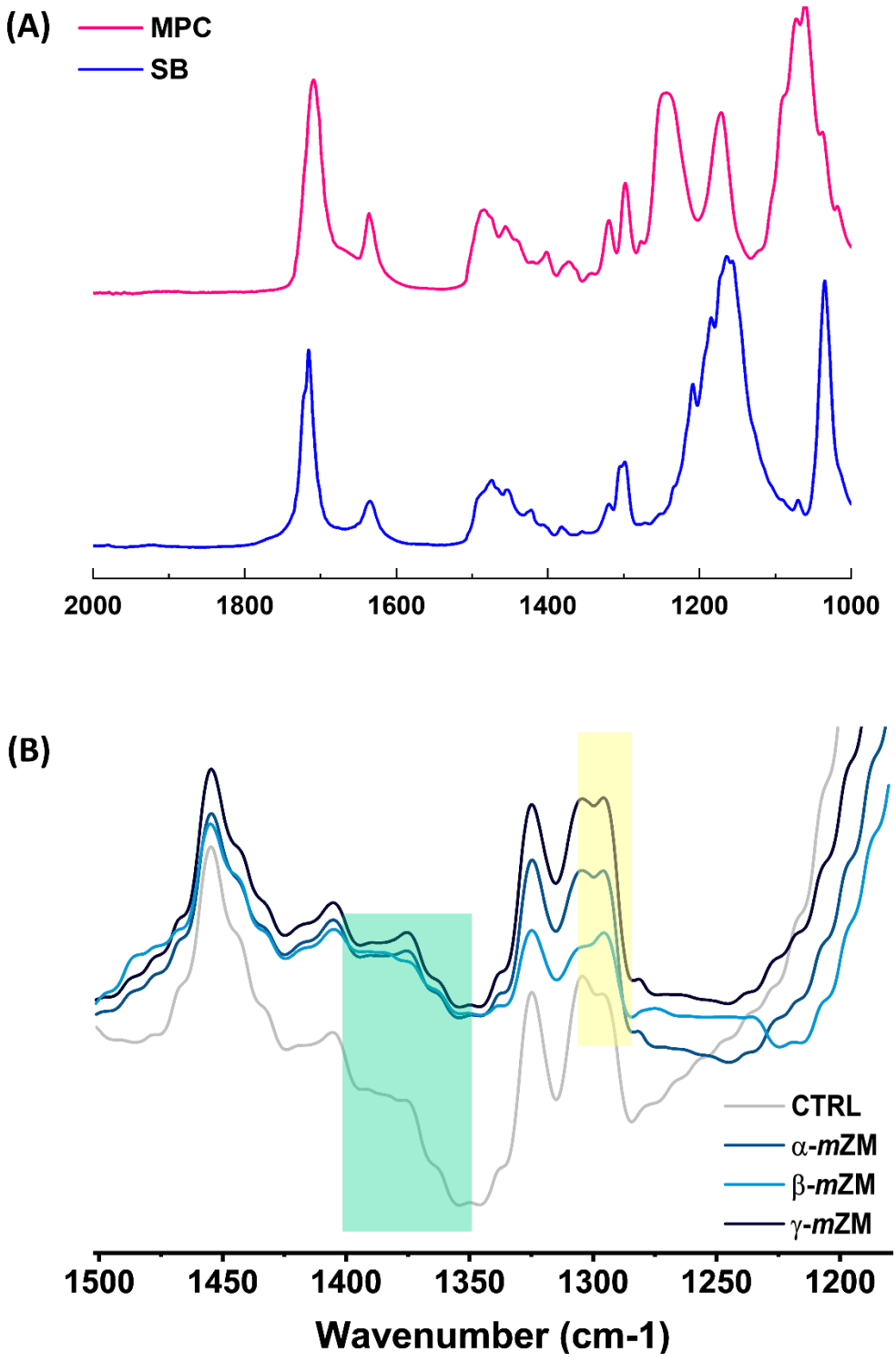

Figure S1. (A) Reference spectra for the polybetaines, 2-methacryloyloxyethyl phosphorylcholine (MPC) and sulfobetaine methacrylate (SB). (B) Inset in Figure 1A showing spectra for wavenumber range of 1200–1500 cm-1 and highlights phosphoryl halide (yellow) and S=O (green) absorbance regions.

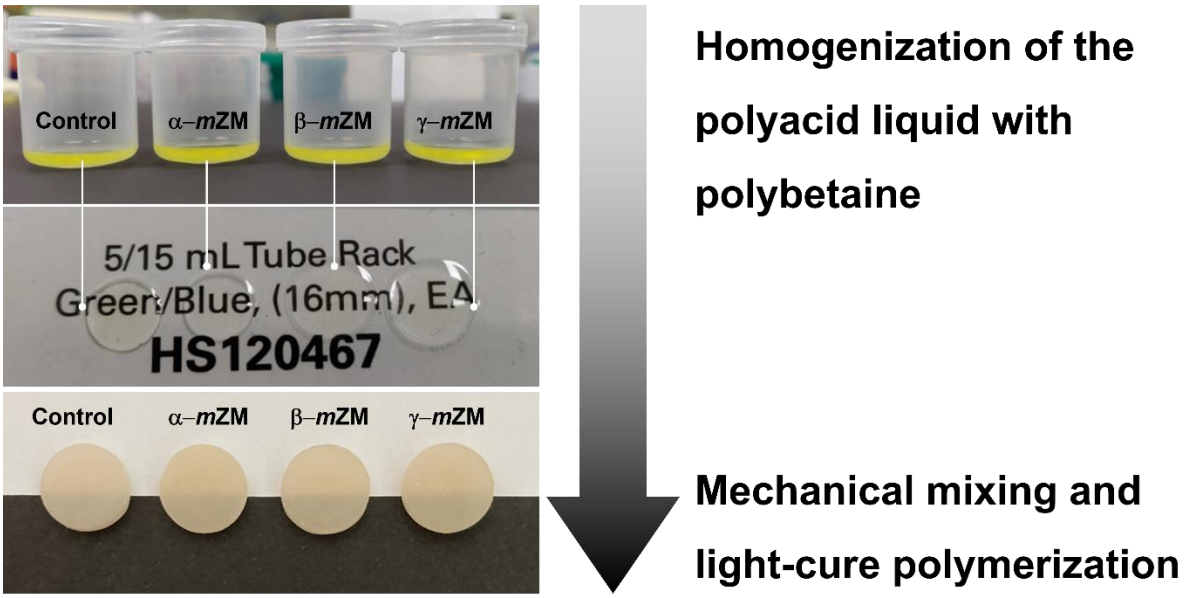

Figure S2. Fabrication of hybrid ionomer cement samples. Liquid was homogenized with polybetaine derivatives and mechanically mixed with amorphous glass powder and light cured.

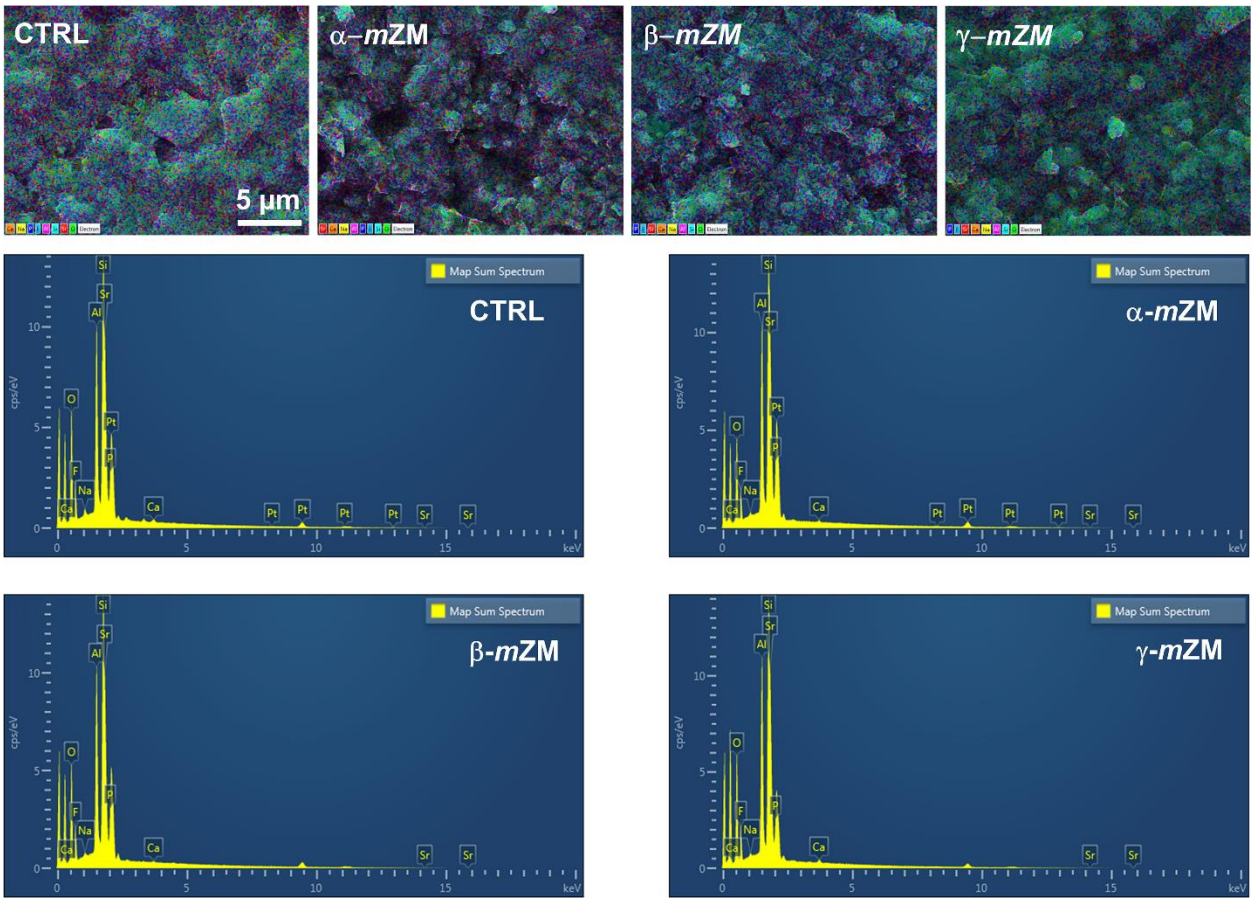

Figure S3. Energy-dispersive X-ray spectroscopy (EDS) mapping spectra of surfaces of HIC specimens and corresponding electron microscopy images. Scale bar is 5 µm. Corresponding elemental weight percentages are as described in Table S2.

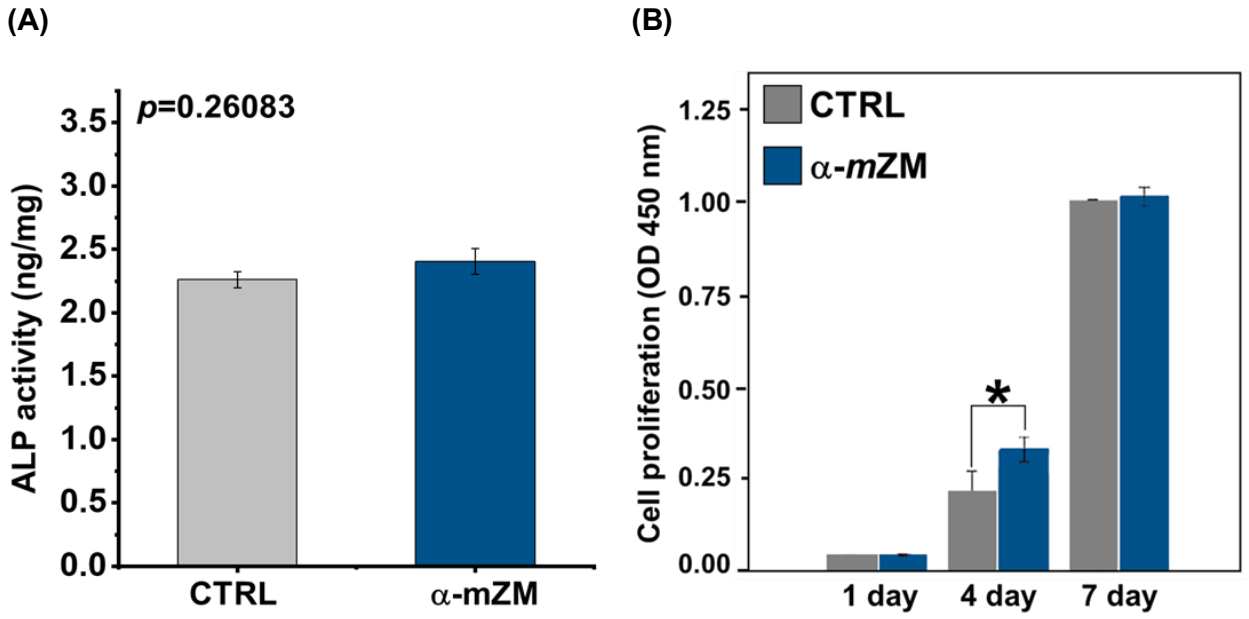

Figure S4. (A) Alkaline phosphatase expression of hDPSCs after 14-day culture. *p<0.05. (B) Cell proliferation assay from cumulative 14-day extract of HIC samples.

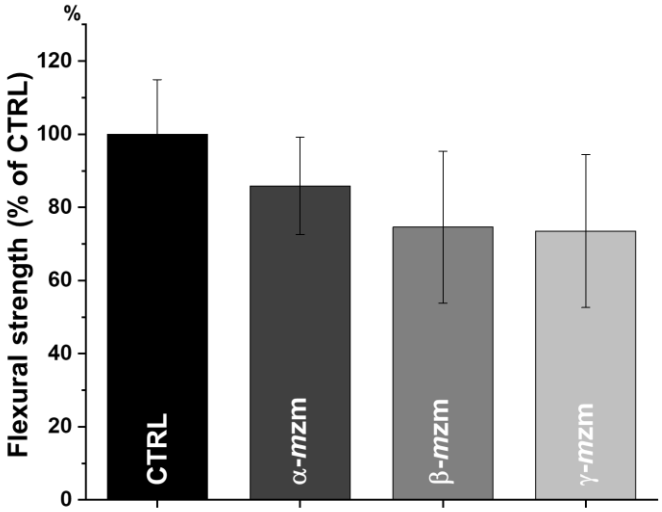

Figure S5 Change in flexural strength of the hybrid ionomer change with polybetaine enhancement with respect to CTRL group. CTRL; unmodified hybrid ionomer cement. As the mechanical properties of hybrid ionomer cement are derived from resin components, based on the inherent composition proportions the mechanical properties can show variation. However, predictable, and consistent mechanical properties can be obtained by optimizing the monomer components (e.g., molecular weights, chain length) in tandem with the polybetaine combination.