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Aluminium-Free Glass Polyalkenoate Spinal Cements.

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I. Introduction

Glass polyalkenoate cements (GPCs) are prepared by the reaction of an ion-leachable glass with an aqueous solution of polyacrylic acid (PAA). GPCs are traditionally based on glass phase, however aluminium (Al) has been implicated in the pathogenesis of degenerative brain diseases. The authors have previously shown that GPCs can be formulated from Al-free CaO-ZnO-SiO_2 glasses where the Al has been replaced with zinc (Zn)[1]. These materials are currently being evaluated as injectable bone cements.

This work determines the effect of adding Titanium (Ti) to novel GPCs as Ti is used in the fabrication of many implantable materials due to some of its beneficial properties and excellent biocompatibility[1].

II. Experimental Methods

A novel glass series was developed containing four different glasses;

Table 1. Glass Compositions.

	BT 101	TW-X	TW-Y	TW-Z
SiO_2	0.480	0.464	0.448	0.430
TiO_2	0.000	0.016	0.032	0.050
ZnO	0.360	0.360	0.360	0.360
CaO	0.120	0.120	0.120	0.120
SrO	0.040	0.040	0.040	0.040

Reagents were fired in a platinum crucible (1480°C, 1Hr) and the resulting frit was ground & sieved (<45μm). GPCs were produced by mixing the glass in a 2:1.5 (powder: liquid) ratio, with 50wt% E9 (80,800) & E11 (210,000) PAA. Working (T_w) & Setting (T_s) time were conducted in accordance with ISO9917[3]. Biaxial flexural (σ_f) testing was in accordance with a publication by Williams *et al* [3]

III. Results

Fig. 1 Shows the T_w and T_s of each cement in the series. Considering BT101 and TW-Z with E9 & E11 PAA the T_w increased from 50 to 169s and 32 to 74s respectively. The T_s also increased with E9 & E11 from 76 to 303s and 47 to 232s respectively.

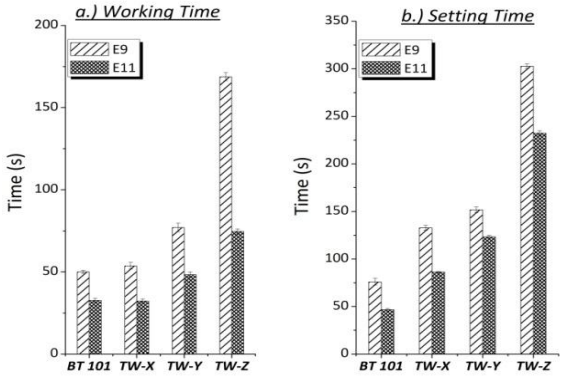

Fig 1. Working (T_w) and Setting time (T_s) of each cement.

Fig. 2 Shows the σ_f strength of each cement. E9 cements strengths increased from 11-19 MPa, and E11 cements from 25-72 MPa for BT101 to TW-Z respectively. No significant increase in strength was observed with maturation.

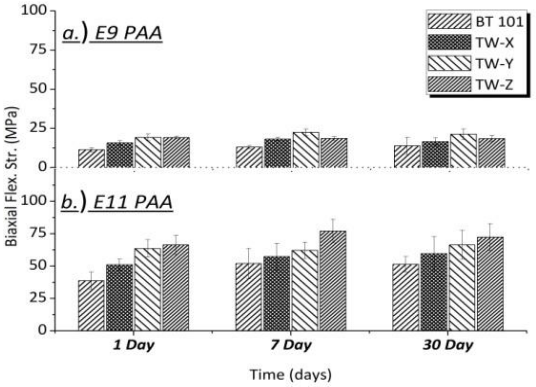

Fig 2. Biaxial Flexural strength of cement series.

IV. Conclusion

Addition of Yitanium increased theWt & St and the σ_f strength of these cements compared to the control (BT 101)

References

1. A. W. Wren, A. Kidari, N. M. Cummins and M. R. Towler, A spectroscopic investigation into the setting and mechanical properties of titanium containing glass polyalkenoate cements. *J Mater Sci: Mater Med* 21:2355–2364 2010.
2. ISO9917, Specification for dental water-based cements. 1991.
3. Williams JA, Billington RW, Pearson GJ. The effect of the disc support system on biaxial tensile strength of a glass ionomer cement. Dent Mater. 18:376–9 2002.

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