

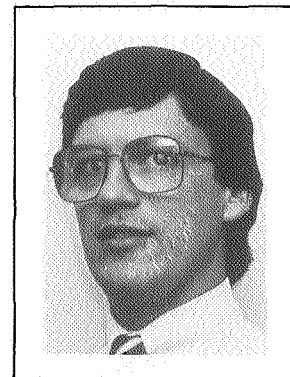
Clinical studies of glass ionomer cements

Part I -- A twelve month clinical study comparing Zinc Phosphate Cement to Glass Ionomer

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Abstract:

Zinc phosphate has long been the standard luting agent for the cementation of orthodontic bands. There has been recent interest in the use of glass ionomer cements for this purpose. A clinical trial has been conducted on 181 patients with full fixed appliances, to compare the relative efficacy of a zinc phosphate cement compared to a glass ionomer cement as an orthodontic luting agent.

It was found that 8.8% of zinc phosphate cemented bands became loose in 12 months compared to 0.6% of bands cemented with glass ionomer. Furthermore, 53% of all failures, which were all zinc phosphate, occurred during the first three months.

Key words: glass ionomer, zinc phosphate, comparison

INTRODUCTION

There are numerous factors which influence the selection of a cement in the clinical situation. Firstly, the cement must be permanent and not dissolve in oral fluids. It must also be biologically compatible with minimal effect on the oral environment, and on hard and soft tissues. The film thickness and particle size must be small enough to allow complete seating of the orthodontic band over the tooth. The cement should have a high retentive and tensile strength, and ideally there should be an adhesion between it and tooth structure and base metal. (Mitcham 1982).

Zinc Phosphate Cements

The standard luting agent since the 1880's has been zinc phosphate. (Wilson 1978). The cement powder is a mixture of zinc oxide and 2-10 per cent magnesium oxide and other oxides. The liquid is an aqueous solution of phosphoric acid containing 45-64 per cent phosphoric acid and 30-55 per cent water. The liquid also contains 2-3 per cent aluminium phosphate and 0-9 per cent zinc phosphate.

According to Smith (1983) these cements are easy to manipulate and set sharply to a firm mass after 4 to 5 minutes. At the recommended powder/liquid ratio, the compressive strength is 80-110 Mpa, after 24 hours. They have a low resistance to solubility and tend to dissolve around the margins of bands allowing bacterial penetration and demineralisation of enamel.

The main characteristics of the zinc phosphate cements which have ensured their long use in dentistry, are their ease of manipulation and adequate set strength. However their lack of adhesion to enamel and dentine and their solubility in oral fluids are distinct disadvantages, especially for the cementation of orthodontic bands.

Glass Ionomer Cements

The glass ionomer cements were formulated by Wilson and Kent (1971) and introduced into Australia by McLean and Wilson (1977). A version for luting was developed by Wilson et al.(1977). These cements are truly adhesive to enamel and dentine and are amongst the least irritant of all cements since they contain preformed polymers rather than monomers. (Wilson and Prosser 1982).

The glass ionomer cement system consists of the following (Crisp et al, 1975) :

1. Poly alkenoic acid, commonly a homo- or co-polymer of acrylic acid.

2. An ion leachable alumina silicate glass to provide ions to cross link the chains.
3. Water as a reaction medium.
4. Tartaric acid to improve working and setting characteristics.

According to Wilson and Prosser (1982), the glass ionomer cements have the following characteristics;

1. Rapid set. (4-5mins.)
2. Low temperature rise during setting.
3. High compressive strength. (140-200 Mpa after 24 hours)
4. Translucency similar to tooth enamel.
5. Adhesion to enamel, dentine and base metals.
6. Resistance to acid erosion.
7. Fluoride release.
8. Slight plasticity after initial 12 hours which disappears on aging.
9. Blandness, i.e. bio-compatibility.

The purpose of this study was to evaluate glass ionomer cement for clinical performance using zinc phosphate as a yardstick.

MATERIALS AND METHODS

A sample of 181 patients was banded with fixed upper and lower appliances over a period of 12 months. Begg light wire brackets were bonded to all anterior teeth and Rocky Mountain molar bands were fitted to the upper and lower left and right first permanent molars. Two operators were used, each using the same technique, and the total numbers pooled.

In each patient, the upper and lower right first permanent molars were cemented with zinc phosphate (Orthostan) while the upper and lower left first permanent molars were cemented with glass ionomer (Fuji type 1). Each side was isolated with cotton rolls during cementation and the cements mixed on a glass slab according to manufacturer's instructions. No varnish was used for the glass ionomer cements although petroleum jelly was applied in an attempt to exclude water during the initial set. Thus there were 362 bands cemented with glass ionomer and 362 bands cemented with zinc phosphate.

The failures were to be inspected to determine where the luting agents remained, and the tooth surfaces were to be checked for untowards effects, such as stains or demineralisation.

RESULTS

Tables 1 & 2

At the end of 12 months, 34 bands had become loose and each was recemented with glass ionomer (Fuji type 1) Of the 34 failures, 32 (94.1%) were cemented with zinc phosphate, with only two failures (5.9%) cemented with glass ionomer.

The total failure rate for zinc phosphate cement was 32 from a sample of 362 (8.8%) while that of glass ionomer with 2 out of 362 (0.6%).

As per Table 2, the majority of failures occurred in the first three months with 18 loose bands (52.9%). All of these were zinc phosphate. The total failure rate for all bands was 34 out of a sample 724 or 4.7%.

Inspection of the failures with the naked eye showed that the two failures of the glass ionomer cement were between the metal and the adhesive. The 32 failures with zinc phosphate showed failure both at the metal adhesive interface and the enamel interface.

Table 1. Numbers of loose bands for each cement taken over 12 months.

Cement sample	3 mnth	6 mnth	9 mnth	12 mnth	TOTAL	RATE
ZnPO ₄ 362	18	9	4	1	32	8.8%
G.I.C. 362	0	2	0	0	2	0.6%

Table 2. Total numbers of loose bands in each three monthly interval

No of loose bands	3 mnth	6 mnth	9mnth	12mnth	TOTAL	RATE
	18	11	4	1	34	34/724
% of total	52.9	32.4	11.8	2.9	100.0	4.7%

DISCUSSION

The results clearly show greater clinical performance of the glass ionomer cement over zinc phosphate for the cementation of orthodontic molar bands. This is in agreement with McComb (1982) who evaluated glass ionomer cements for the retention of cast inlays.

As stated above, inspection of the failures with the naked eye showed that the two failures of the glass ionomer cement were between the metal and the adhesive. In each case there was a substantial deposit of adhesive over the surface of the enamel which was hand scaled prior to re-cementing. The surface of the enamel was very clean with no visible sign of demineralisation. McComb (1982) noted that there was a slight tendency for the retention of the glass ionomer cements to improve on second cementation while that of zinc phosphate was less.

Comparative studies of fluoride release from glass ionomer cements and silicate cements suggest that the glass ionomer cements should be as effective as the silicate cements in protection against secondary caries. (Meryon and Smith 1984).

The failures with zinc phosphate showed failure both at the metal adhesive interface and the enamel interface. The remaining deposits on each surface were easily removed with hand scalers, sometimes to the point of being able to be washed off with a water jet.

The development of the glass ionomer cements led the authors to anticipate a slightly better performance of the glass ionomer cement over zinc phosphate but the results far exceeded expectations.

The particle size and film thickness of the Fuji type 1 glass ionomer cement are both 40µm. and exceeds the British standard specification of 25µm. (Prosser et al. 1984). Further research is needed to determine whether

the smaller particle size of other glass ionomer luting agents is an advantage for the cementation of orthodontic molar bands.

CONCLUSION

Loose orthodontic bands are a serious problem in orthodontic treatment. They not only consume a considerable amount of chairside time in re-cementation, but may also slow treatment progress. If the failure is not detected soon after it occurs there is a danger of enamel decalcification around the margins of the bands.

The results of this study show a clear clinical advantage of Fuji type 1 glass ionomer cement over Orthostan zinc phosphate, for the cementation of orthodontic molar bands.

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