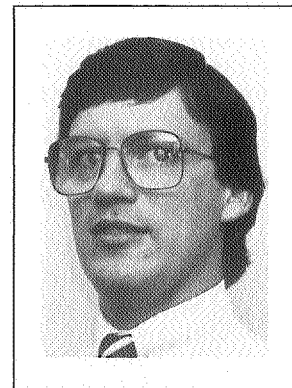


Clinical studies on glass ionomer cements

Part 2 - A two year clinical study comparing glass ionomer cement with zinc phosphate cement

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Abstract: A clinical trial has been carried out on 198 patients with fixed appliances to compare the relative performance of a glass ionomer cement with a zinc phosphate cement as an orthodontic luting agent. It was found that 13.2% of zinc phosphate cemented bands became loose over 24 months compared with 2.3% of bands cemented with glass ionomer. Furthermore, glass ionomer cement appeared to protect the enamel against demineralisation beneath the bands.

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INTRODUCTION

The relatively new glass ionomer cements require evaluation as an alternative to zinc phosphate cement for the cementation of orthodontic bands.

This paper reports the second part of a clinical study to determine the failure rates of glass ionomer cement compared with zinc phosphate cement for orthodontic molar bands.

Glass ionomer cements have been also assessed to determine the protection given to enamel beneath the bands via the leaching of fluoride.

MATERIALS AND METHODS

Cements

Glass ionomer cements were formulated by Wilson and Kent (1971) and further developed as luting agents by Wilson et al. (1977). They are chemically adhesive to enamel, dentine, base metals and leach fluoride. Fuji 1 (G.C. Dental Japan) glass ionomer cement is a powder/liquid cement. The powder is 100% fluoro-aluminium-silicate glass and the liquid is 45% copolymer and 55% distilled water. (The copolymer component comprises 95% acrylic acid and 5% maleic acid.) The manufacturer states the particle size to be 15 μ while the film thickness is 23 μ .

Zinc phosphate cement was used for comparison because of its widespread acceptance as a luting agent for dental use (Wilson and Prosser 1983). Orthostan (Stratford Cookson) zinc phosphate is also a powder/liquid cement. The liquid is an aqueous solution of phosphoric acid and the powder is a mixture of zinc oxide (90-98%) and magnesium oxide (2-10%).

Sample

A sample of 198 patients were banded over a two year period using fixed maxillary and mandibular appliances.

Two cements were used in each patient with zinc phosphate (Orthostan) on one side and glass ionomer (Fuji 1) on the other. A sample of 171 patients were banded with zinc phosphate on the upper and lower right molars (342 bands) and glass ionomer on the upper and lower left molars (342 bands). Conversely, in a sample of 27 patients (54 bands) glass ionomer was used on the right side and zinc phosphate on the left side.

Method

Separating elastics (Dentaurum Blue Alastik) were placed mesially and distally to the four first permanent molars and left in situ for one week prior to the placement of bands.

Some separators fell out within the week and were not replaced as separation was considered adequate.

The band cementation was completed in a single visit one week after the separation appointment. Begg light wire attachments were used in all cases with bonded brackets to the maxillary and mandibular anterior teeth. All first permanent molars were fitted with Rocky Mountain bands, individually fitted for right and left. The brackets were bonded to the mandibular and maxillary anterior teeth using the acid etch technique. Molar bands were then fitted, removed, rinsed in alcohol and dried. Tubes were welded to the buccal surfaces and the bands set aside for cementation. Molar bands were not shimmed at any stage.

Cementation was carried out in two stages, commencing with the maxillary and mandibular left molars and followed by the maxillary and mandibular right molars. No premolars were banded at the initial appointment but were normally fitted after six months.

The molars were isolated with cotton rolls and dried with an air syringe while each cement was mixed on a glass slab according to manufacturer's specifications.

Zinc phosphate cement was allowed to set and the excess was removed from the occlusal surfaces and gingival margins using hand scalers.

The glass ionomer cement was wiped clean from the occlusal surfaces and gingival margins with cotton rolls immediately after seating the band. The teeth were then covered with a generous layer of petroleum jelly and the cotton roll isolation removed.

Arch-wires were shaped for each patient and these were fitted, pinned and ligated approximately 20 to 30 minutes after cementation of the last band.

The date of banding and the type of cement used for each side was recorded against the patient's name.

Cementations were recorded as failures either when the patient presented between appointments with a loose band, or when the band was found to be loose by the orthodontist at the regular appointment. Failures were recorded with the date and tooth against the date of banding. Loose bands were placed in an ultra-sonic cleaner, dried and recemented with Fuji 1 glass ionomer.

Cement failures were inspected with the naked eye to assess the site of failure of each luting agent. Enamel surfaces were inspected for any untoward effects, such as staining or demineralisation. Those patients debanded during the period of the study were also checked for enamel demineralisation prior to cleaning.

All procedures were standardised with the two authors being the only operators in the same practice.

RESULTS

Over 12 months the sample of 171 patients with zinc phosphate on the right showed a failure rate of 9.9% or 34 out of 342 bands and with glass ionomer on the left a failure rate of 1.5% or 5 out of 342. (Table 1) A t test of statistical significance showed a significant difference between these failure rates. $t = 4.8$ $p < 0.01$. The same sample over a period of 24 months showed a failure rate of 2.3% for the glass ionomer cement with a failure rate of 13.2% for zinc phosphate. (Table 1). The increases from 12 to 24 months in failure rates were not significant with $t = 0.8$ $p > 0.05$ for glass ionomer and $t = 1.4$ $p > 0.05$ for zinc phosphate.

The sample of 27 patients showed a failure rate of 1.9% or 1 out of 54 for glass ionomer on the right side and 7.4% or 4 out of 54 for zinc phosphate on the left side. (Table 2).

Table 1. Failures for zinc phosphate and glass ionomer cement over 12 months and 24 months

Cement	No. of bands	12 months		24 months	
		No. of fails	% fails	No. of fails	% fails
ZnPO ₄	342	34	9.9%	45	13.2%
Fuji 1	342	5	1.5%	8	2.3%

Table 2. Failures for zinc phosphate and glass ionomer cements over 12 months for left and right sides of the mouth

Cement	No. of bands	Left % fails	Right % fails
ZnPO ₄	396	7.4%	9.9%
Fuji 1	396	1.5%	1.9%

There was no significant difference in respective failure rates for either glass ionomer or zinc phosphate for molar bands on the left or right sides of the mouth. i.e. when the samples were reversed. For zinc phosphate $t = 0.6$ $p > 0.05$. For glass ionomer $t = 0.1$ $p > 0.05$.

Failure rates for the two samples combined over 12 months were 1.5% or 6 out of 396 for glass ionomer and 9.6% or 38 out of 396 for zinc phosphate. (Table 3). This is a significant difference, $t = 5.2$ $p < 0.01$.

Table 3. Total failures for zinc phosphate and glass ionomer cement after 12 months

Cement	No of bands	No of fails	% of fails
ZnPO ₄	396	38	9.6%
Fuji 1	396	6	1.5%
Total	792	44	5.6%

Inspection of the enamel at band removal, showed that zinc phosphate cement failure occurred invariably at the enamel cement interface. The site of failure of the glass ionomer cement was at the metal cement interface leaving a deposit of cement on the enamel surface. This supports a laboratory observation by Norris et al. (1986).

Enamel demineralisation occurred in 19 patients out of the sample of 198. All cases of demineralisation were on molar teeth cemented with zinc phosphate cement. There were no cases of demineralisation on molars cemented with glass ionomer.

DISCUSSION

The results show the superiority of glass ionomer cement over the zinc phosphate cement for the cementation of orthodontic molar bands. After 24 months the failure rate for glass ionomer was 2.3% while that for zinc phosphate was 13.2%.

Wilson et al. (1977) recommend that all glass ionomer cements be isolated from saliva during the initial

set. Earl et al (1985) tested various varnishes for isolating these cements and concluded that a thick layer of petroleum jelly was satisfactory.

McLean et al. (1984) state that glass ionomer cements adhere to dry gingiva and are difficult to remove from teeth if allowed to dry too long. However removal of excess glass ionomer with a cotton roll while the cement was still viscous, then isolating with petroleum jelly, avoids this.

Meryon and Smith (1984) indicated that glass ionomer cements should be as effective as silicate cements in protection against secondary caries. Swartz et al. (1984) showed that glass ionomer luting agents released fluoride in approximately the same amounts as silicate cement. Reteif et al. (1984) showed enamel and cementum to take up substantial amounts of fluoride from glass ionomer cements. Wilson et al. (1985) showed fluoride release to continue for at least 598 days.

The glass ionomer cements protect tooth enamel against demineralisation beneath bands and this is recommendation enough for their routine use in orthodontics. *Figure 1 and 2.*



Figure 1. Mandibular left molar at band removal prior to cleaning. Glass ionomer used leaving deposits on enamel surface

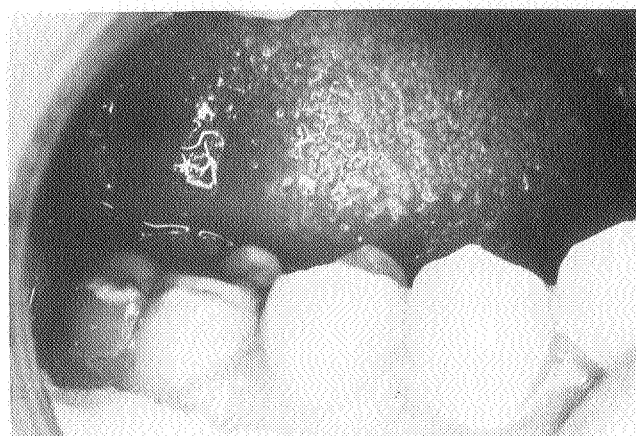


Figure 2. Mandibular right molar at band removal prior to cleaning. Zinc phosphate used, no cement remaining and areas of demineralisation at the margin of the band

The use of zinc phosphate cement has now been discontinued by the authors and further clinical trials are being carried out on different glass ionomer cements, selected at random for each side of the mouth. Clinical trials need only be conducted over 12 months as no significant difference was found in the results between the 12 month and 24 month periods.

Since there is no significant difference between left and right, the researcher may pool all results for any cement on either side of the mouth to provide a total failure rate for each cement.

CONCLUSION

A clinical study comparing zinc phosphate with a glass

ionomer cement for the cementation of orthodontic molar bands is described. The failure rate for zinc phosphate was 13.2% while that for glass ionomer was 2.3% over a period of 24 months. A *t* test showed this to be significantly different with no difference between left and right.

All cases of demineralisation (19 out of 198 patients) occurred in molars cemented with zinc phosphate.

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