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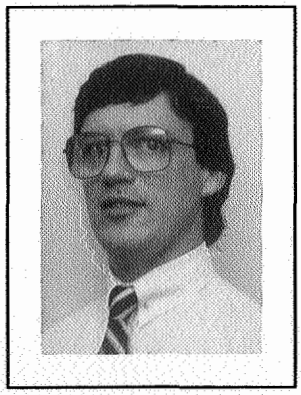

A clinical comparison of different powder:liquid ratios of two glass ionomer cements on the retention of orthodontic molar bands

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ABSTRACT: The clinical significance of adding 50 percent more powder to a standard mix of two glass ionomer luting cements was assessed.

Failure rates (loose bands) were recorded over a 12 month period and removal of cement was subjectively assessed at the time of band removal. There was no significant difference between Fuji I standard and heavy mix or between Ketac Cem standard and heavy mix.

Cement deposits at band removal were always on enamel surfaces. The heavier mix of each cement was far more difficult to remove, and may have significance in restorative dentistry. There were no cases of enamel demineralisation around the margins of bands at the time of band removal.

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Key words: Glass ionomer cements, orthodontic luting cements, enamel demineralisation, powder:liquid ratios

INTRODUCTION

Glass ionomer cements have been shown to be effective luting agents for orthodontic molar bands with a greater retention rate than zinc phosphate, ((Fricker and McLachlan 1987), Majier and Smith (1988), Mizrahi (1988)). Fluoride leach of Glass Ionomer Cement protects surrounding enamel such that demineralisation at band margins is no longer a significant problem, making these cements ideal orthodontic luting agents.

Observations by clinical orthodontists show that incorporating additional powder into the cement appeared to provide a greater bond strength (Mollenhauer 1987).

This paper reports a controlled clinical study on the retention/failure rates of glass ionomer cement at different liquid powder ratios and observations on debanding are also reported.

MATERIALS AND METHOD

Cements

Two glass ionomer luting cements were selected, representing a water based liquid with freeze dried powder (Ketac Cem, Espe W. Germany) and a conventional cement with a liquid co-polymer of polyacrylic and itaconic acid and alumina silica glass powder (Fuji GIC Dental Co Japan).

Sample

Forty-four consecutive banding cases in the one practice were monitored over a twelve month period following banding for loose molar bands.

Two samples for each cement were compiled. One using a mix according to manufacturers recommendations and a second using 50 percent more powder incorporated into the mix. The powder for each cement was stored in the refrigerator and removed just prior to mixing. Four samples were thus generated as follows:

Fuji I standard mix 44 bands
Fuji I heavy mix 44 bands
Ketac Cem standard mix 44 bands
Ketac Cem heavy mix 44 bands

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 during this period but were not replaced as separation was considered adequate.

Band cementation was completed at a single visit and was preceded by a thorough prophylaxis using plaque disclosing solutions. Begg Light Wire attachments were used in all cases with bonded brackets to the maxillary and mandibular anterior teeth. The brackets were bonded using the acid etch technique and the first permanent molars were banded with Rocky Mountain molar bands, individually fitted for left and right. These were sized by the orthodontist, removed, rinsed in alcohol and dried. Tubes were then welded to the buccal surfaces of these bands and no shimming was carried out at any stage.

Each patient had a single brand of cement, with one side having the standard mix of cement and the other, the mix with 50 percent more powder added. Left and right sides were alternated for each consecutive patient, with equal numbers of each mix for each side of the mouth.

Cementation was carried in two stages commencing with the maxillary and mandibular left molars using one cement followed by the maxillary and mandibular right molars using a second cement. No premolars were banded at the initial appointment but were normally fitted after approximately six months.

The molars were isolated with cotton rolls and dried with an air syringe while each cement was mixed on a chilled glass slab in the proportions specified by the sample. Once the bands were seated, the excess cement

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was wiped from the margins of the band, before a generous layer of petroleum jelly (Vaseline) was placed to completely cover the band and the cotton roll isolation removed.

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

The date of banding, the brand and mix of cement used for each side were recorded against the patient's name. Cementations were recorded as failures either when the patient presented between appointments with a loose band or at the routine appointment. Failures were recorded with the date and particular tooth against the date of banding. Loose bands were placed in an ultra sonic cleaner, dried and recemented with Fuji I cement.

All procedures were standardised with a single operator placing the appliances on all patients sampled.

The patients were then monitored at band removal at the completion of active treatment, to clinically

Table 1.

	Ketac Cem		Fuji I	
Mix	HEAVY	STANDARD	HEAVY	STANDARD
Sample	44	44	44	44
Failures	2	2	1	2
%	4.5	4.5	2.3	4.5

Table 2.

Chi Square Test 2x2

Attribute Heavy

	Ketac Cement			Fuji I			Total		
	O	E	Chi	O	E	Chi	O	E	Chi
Success	42	42.5	0.01	43	42.5	0.01	85	85	0.01
Failure	2	1.5	0.17	1	1.5	0.17	3	3	0.33
Total	44	44.0	0.17	44	44.0	0.17	88	88.0	0.35

df = 1 Chi = 0.35
Significance p = >0.80

Chi Square Test 2x2

Attribute Ordinary

	Ketac Cement			Fuji I			Total		
	O	E	Chi	O	E	Chi	O	E	Chi
Success	42	42.0	0.00	43	43.0	0.00	85	85	0.00
Failure	2	2.0	0.00	2	2.0	0.00	4	4	0.00
Total	44	44.0	0.00	45	45.0	0.00	89	89.0	0.00

df = 1 Chi = 0.00
Significance p = >0.90

Chi Square Test 2x2

Attribute Heavy + Ordinary

	Ketac Cement			Fuji I			Total		
	O	E	Chi	O	E	Chi	O	E	Chi
Success	84	84.5	0.00	85	84.5	0.00	169	169	0.01
Failure	4	3.5	0.07	3	3.5	0.07	7	7	0.14
Total	88	88.0	0.07	88	88.0	0.07	176	176.0	0.15

df = 1 Chi = 0.15
Significance p = 0.09

Similar Table and Result for both cements

	Ordinary	Heavy	
	84	85	169
	4	3	7
Total	88	88	176

Chi = 0.15

Data - Results are similar for the different combinations of material or mix. No statistically significant differences observed or likely to be observed.

assess the difficulty of cement removal. The average time for active treatment was 21 months.

RESULTS

Failures of each cement whether heavy or standard mixes were recorded over a twelve month period following banding. Left and right results were pooled *Table 1.*

For Fuji I cement, there were two failures (4·5%) for a mix as per manufacturer's instructions with one failure (2·3%) for a mix with 50 percent more powder incorporated.

For Ketac Cem, there were 2 failures (4·5%) for a mix as per manufacturer's instructions with 2 failures (4·5%) for a mix with 50 percent more powder incorporated.

Statistical tests showed no significant difference between each respective cement or each respective mix. *Table 2.*

Observations at debanding showed little difference in the removal of the bands with pliers. The weakest bond in both cements and for each mix, was between the adhesive and the metal. Bond strength for each mix to the metal showed undetectable differences in the clinical situation of physically removing the band. Bond strength for each mix of adhesive to enamel were significantly different clinically.

Removal of cement from the enamel using an ultra sonic scaler was far more difficult with both Fuji I and Ketac Cem where heavy mixes of glass ionomer cements were used, compared with the standard mix of the respective cements.

DISCUSSION

Variations in powder:liquid ratios have a significant effect on physical properties, with thinner mixes giving a decrease in bond strength (Wong and Bryant 1985). Observations by Mollenhauer (1987) have suggested that incorporating additional powder into the mix provides a clinically significant increase in bond strength of cement to enamel.

Loose bands always failed at the cement metal interface for both heavy and ordinary mixes and at band removal, deposits of glass ionomer cement were always left on enamel. This is in agreement with previous studies (Fricker 1989, Norris et al. 1986, Majier and Smith 1988). Clean up of cement deposits was with ultra sonic scalers. Ordinary mixes of cement were relatively straight forward to remove, however, heavy mixes of cement for both Fuji I and Ketac Cem were significantly more difficult to remove.

Although the sample is comparatively small the Chi square analysis clearly indicates there is no difference, either in mix or material for the very low failure rates. There is no indication from these figures that any increase in sample size will show a more definite trend.

These observations would suggest that for orthodontic purposes, incorporating additional powder into the mix is not clinically significant. However, for restorative purposes and fissure sealants, this may be a significant factor and further research is indicated to test this.

A study by Muzynski et al. (1988) examined the fluoride release from Ketac Cem and Fuji I cement. They showed that greater release was from the cements with a lower powder and liquid ratio and this is directly related to its solubility in oral fluids.

Ketac Cem has a higher powder:liquid ratio than Fuji I. Fuji I cement releases approximately twice as much fluoride to surrounding hard tissues as Ketac Cem, as the cement slowly dissolves. The adjacent enamel is rendered less soluble and therefore more resistant to caries attack.

One may conclude from this that incorporation of additional powder into the mix may reduce the amount of fluoride released from the set cement. Ogaard et al. (1988) have shown that enamel demineralisation in vivo is a rapid process in the absence of fluoride with visible white spot lesions developing within four weeks. Maintenance of the fluoride leach from glass ionomer cements is desirable to prevent enamel demineralisation (Copenhaver 1986).

Powis et al. (1988), have shown that glass ionomer cement provides 'almost perfect and reliable seals' and prevent microleakage to enamel. This property, combined with the fluoride leach makes an ideal orthodontic luting agent.

CONCLUSION

Two different glass ionomer cements were clinically evaluated at different powder:liquid ratios. It was found that increasing the powder by 50 percent per mix had no significant effect on failure rate of orthodontic molar bands.

However, at debanding, cement with 50 percent more powder per mix was considerably more difficult to remove than the standard mix of cement. This would suggest that the bond strength of glass ionomer cements to enamel may have increased but the bond to base metal is little changed.

This may have clinical significance for the restorative and preventive dentists and demands further study. From this study, for orthodontic purposes there seems no advantage in incorporating additional powder to the cement mix. However, shimming of molar bands may improve the retentive strength of the cement to bands and warrants further investigation.

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