A comparison between zinc polycarboxylate and glass ionomer cement in the orthodontic band cementation

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Fixed orthodontic appliances have been held responsible for demineralization and caries since the time they were first introduced. Zinc polycarboxylate and glass ionomer cements are the primary materials used in band cementing. In this study, we evaluated the re-cementing frequencies, enamel demineralization and the degree of cement remains of the bands cemented with glass ionomer and zinc polycarboxylate cements. We have concluded that given the retentive properties and enamel decalcification degree, the glass ionomer cements are to be preferred by the orthodontist.
J Clin Pediatr Dent 26(3): 285-288, 2002

INTRODUCTION

Although direct bracket bonding is the extensively used system, the role of bands cemented onto the molars, are still important in the treatment. Fixed orthodontic appliances have been found responsible for demineralization and for the formation of dental caries, since the beginning of the application.[1] Researchers declared that the orthodontic band cementation happens at two interfaces: the band-cement interface and the enamel-cement interface. They also emphasized that the enamel-cement interface is the most important surface to prevent decalcification and formation of dental caries. Loss of mineral is a result of the accumulation of food particles and bacteria, which penetrated into the gap created between the band and enamel as result of loss of cement. They added that the cement, which would be used for the orthodontic band cementation, should have the characteristic of preventing the decalcification of the enamel.[1-8]

Zinc polycarboxylate and glass ionomer cements are the principle cements used for the banding process. Zinc polycarboxylate cements were developed by Smith.[9] Polycarboxylate cement is in powder-liquid form. The powder consists of modified zinc oxide. The liquid consists of 40% solution of liquid polyacrylic acid, and includes fluoride, which prevents the formation of tooth decay. It is an agent that adheres to dental enamel and the band material both mechanically and chemically, and it is proper for orthodontic cementation.[9-11]

Glass ionomer cements, introduced by Wilson and Kent in 1971,[12] are composed of silica sand and liquid polyacrylic acid. In addition to be able to adhere chemically to the enamel and to the dentin parts of the tooth with the characteristic of being also able to bond to metal surfaces, glass ionomer cements containing fluoride are convenient for orthodontic cementation.[13] In comparison with other cements, glass ionomer cements have an initially lower tensile strength. However, the rate of gain of strength increases and they become stiff and resistant to pressure.

Wilson and Kent[12] and Smith[14] emphasized that glass ionomer cement is more resistant to pressure than zinc polycarboxylate cement, but it has a similar tensile strength. Mizrahi[5] also reported that glass ionomer cement is more resistant to pressure.

In his study where zinc polycarboxylate was compared with glass ionomer cements, Mizrahi[10,15] determined that the re-cementation rate of zinc polycarboxylate cement is 4.8%, whereas, it is 1.8% for glass ionomer cement.

The aim of this study is to investigate the frequency of re-cementation for the zinc polycarboxylate and the glass ionomer cemented bands and to determine the decalcification of enamel under these bands with both types of cements, and the type of cement remaining on the molars at the time of debanding.

MATERIALS AND METHODS

This research was done with a total of 486 molar bands, which have been properly adapted to 148 patients, who were under active treatment in the Orthodontics Clinic of Faculty of Dentistry at Ege University. Teeth that

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had decalcification, caries or restorations were not included in the study.

A two-day-separation with the plastic separators was applied to the teeth to be banded. All bands were tested by being placed on the teeth before cementation. Before the cementation of the bands, all teeth were cleaned with aqueous slurry of pumice and were rinsed off thoroughly. Teeth were then isolated with cotton rolls on the buccal and lingual aspects of each tooth, and a high-volume saliva evacuating system was used continuously to keep the mouth dry.

According to the instructions of the manufacturer, 282 bands (174 upper jaw, 108 lower jaw) were cemented with zinc polycarboxylate (Poly-F® Plus), and 204 bands (120 upper jaw, 84 lower jaw) with glass ionomer cement (3M RelyX™ Luting).

This study lasted on the average of 2 years and 4 months. During the treatment period the condition of bands were checked at every regular appointment. Patients were instructed to check for loose bands and to inform the clinic of any problems. When bands were re-cemented, the enamel surface was checked for hypocalcific areas and the percentage of cement remaining was recorded according the scale shown in Figure 1.

The remaining cement was evaluated according to the classification of Maijer and Smith.[16] According to this classification:

- Type I: Most of the cement remaining on the enamel surface.
- Type II: 50% remaining cement on the enamel surface.
- Type III: Less than 30% remaining cement on the enamel surface.

RESULTS

The distribution of the 282 bands cemented with zinc polycarboxylate was: 174 were placed on the upper jaw and 108 on the lower jaw (Table 1). They were evaluated as follows: 47 bands (27%) placed on the upper jaw and 31 bands (28.7%) placed on the lower jaw had to be re-cemented (Table 2).

Decalcification lesions were found as follows: 17 re-cemented teeth (36.1%) on the upper jaw and 8 re-cemented teeth (25.8%) on the lower jaw. (Table 3).

The remaining cement on the enamel according to the classification was Type III on 21 teeth (44.6%) of the upper jaw, whereas, there was not any remaining cement on 26 teeth (55.4%) (Table 4). The remaining cement on the enamel according to the classification was Type III on 6 teeth (19.3%) of the lower jaw, whereas, there was not any remaining cement on 25 teeth (80.7%) (Table 5).

The distribution of the 204 bands cemented with glass ionomer was as follows: 120 were placed on the upper jaw and 84 on the lower jaw (Table 1). When they were evaluated for re-cementation, 12 bands (10%) were re-cemented on the upper jaw and 9 bands (10.7%) placed on the lower jaw. (Table 2). No decalcification lesions were observed on these teeth (Table 3).

The remaining cement on the enamel was according to the classification, Type I on 1 tooth (8.3%) of the upper jaw, and according to the classification Type II on 11 teeth (91.7%) (Table 4). The remaining cement on the enamel was according to the classification Type I on 2 teeth (22.2%) of the lower jaw, and according to the classification Type II on 11 teeth (77.8%) (Table 5).

Table 1. Band distribution.

	UPPER	LOWER	TOTAL BANDS
Zinc polycarboxylate cement	174	108	282
Glass ionomer cement	120	84	204

Table 2. Distribution of re-cemented bands (N: Total bands, R: Re-cemented bands, %: Percentage of re-cemented bands)

	UPPER			LOWER			TOTAL BANDS		
	N	R	%	N	R	%	N	R	%
Zinc polycarboxylate cement	124	47	27	108	31	28.7	282	78	27.6
Glass ionomer cement	120	12	10	84	9	10.7	204	21	10.2

Table 3. Distribution of decalcification lesions after band removal (N: Total bands, D: Decalcification, %: Percentage of decalcification)

	UPPER			LOWER			TOTAL BANDS		
	N	D	%	N	D	%	N	D	%
Zinc polycarboxylate cement	124	17	36.1	108	8	25.8	282	25	32
Glass ionomer cement	120	-	-	84	-	-	204	-	-

DISCUSSION

In this *in vivo* study, the frequency of re-cementation for zinc polycarboxylate and glass ionomer cemented bands, the decalcification of enamel under these bands with both types of cement, and the degree of remaining cement on the molars that occurred at the time of de-banding were investigated.

Glass ionomer cement has significantly better retentive properties to the enamel than to the band materials. Besides the mechanical retentive properties, there are also molecular properties that provide a better pro-

Table 4. Evaluation of cement layer remaining on the upper teeth after band removal (N: Number of bands of which have a cement layer remaining, %: Percentage of cement layer remaining)

	CEMENT REMAINING							
	Type I		Type II		Type III		No cement remains	
	N	%	N	%	N	%	N	%
Zinc polycarboxylate cement	-	-	-	-	21	44.6	26	55.4
Glass ionomer cement	1	8.3	11	91.7	-	-	-	-

Table 5. Evaluation of cement layer remaining on the lower teeth after band removal (N: Number of bands of which have a cement layer remaining, %: Percentage of cement layer remaining)

	CEMENT REMAINING							
	Type I		Type II		Type III		No cement remains	
	N	%	N	%	N	%	N	%
Zinc polycarboxylate cement	-	-	-	-	6	19.3	25	80.7
Glass ionomer cement	2	22.2	7	77.8	-	-	-	-

tection of the underlying enamel surface.[16] Mount[17] showed that correct dispensing and mixing of glass ionomer cements are important to proper setting and optimum properties. In our study, during the cementation process, particular importance was given to these details.

Mizrahi and Smith[18] noted that a dried salivary film or liquid paraffin reduced the retention of polycarboxylate cemented bands on the enamel. For this reason, in our study particular importance was given for complete cleaning and dryness of the teeth on which the bands would be cemented.

In our study, it was determined that the glass ionomer cement group has significantly better retentive properties. Whereas it is necessary to re-cement 78 of 282 zinc polycarboxylate cemented bands, it is only necessary to re-cement 21 of 204 glass ionomer cemented bands.

The reason for cement failure in retention may be related to poorly fitting bands or unusual tooth morphology. On the other hand, extraoral appliances may also affect the retention of the band.[13,14] In our study, there were also patients using extraoral appliances attached to the upper jaws. Of the bands (48) where the extraoral appliances would be placed were cemented with zinc polycarboxylate, and 24 of them had to be re-cemented. Of the bands (28) cemented with glass ionomer, and only 3 of them had to be re-cemented. The retention of glass ionomer cement was better in this situation.

Mizrahi and Cleaton-Jones[19] found that there was an increase in the frequency and intensity of enamel demineralization, especially of upper and lower molars after the orthodontic treatment. They also added that despite the adequate retention, the reason maybe the inadequate cleaning of the teeth before the cementation.

It is observed that glass ionomer cements, which are more effective to prevent the decalcification and to protect the teeth against the decalcification release fluoride for a long time.[12,20,21] Researchers also mentioned that glass ionomer cements have the feature of renewing the fluoride in the enamel.[22,23] However, they also noted that the fluoride content of glass ionomer cement may have an anticariogenic effect.[6]

Norris *et al*.[6] mentioned that zinc polycarboxylate cement is not so successful as glass ionomer cement in releasing fluoride. Moreover, it was also emphasized that the characteristic of zinc polycarboxylate cement of being dissolved under the mouth conditions increases the possible risk of demineralization under the band.[5,19]

The glass ionomer cement, introduced by Wilson and Kent[12] takes place as the ideal cement for the orthodontic bands in the literature because of its retention and insolubility.

In our study the observed formation of decalcification on teeth after de-banding was higher in the zinc polycarboxylate cement group than the glass ionomer cement group. The protective feature of glass ionomer cement was determined with its difference in this situation.

In the *in vitro* studies, Norris *et al*.[6] reported that, as an orthodontic luting agent, the glass ionomer cement is more practical in the clinic than zinc polycarboxylate and zinc phosphate cement, and that it has a protective effect on the enamel surface.

The mechanism of inhibiting the lesions by the fluoride released from glass ionomer cement is not fully determined yet. It may be explained as the fluoride release into the enamel and covering the enamel crystals. At the formation of the lesion, on the other hand, the situation that there is not a full fluoride protection under the orthodontic bands may also be explained, as the fluoride released from the cement could not cover the enamel crystals.[24]

Mizrahi[25] mentioned in his *in vitro* study on the factors affecting the retention of cements, that zinc polycarboxylate cement shows a significantly higher retention to the band, whereas, the adherence of cements to the teeth is not of the same degree. Therefore, at the debanding, the remaining cement would not be more than

expected. Because, according to the researcher, the polycarboxylate cement has not only chemical, but also mechanical retention to the both surfaces (band-cement and enamel-cement surfaces) at the cementation of bands. We had similar results. We also observed that the remaining cements of the zinc polycarboxylate cement group are relatively less than the remaining cements of the glass ionomer cement group.

In our study we recorded relatively more remaining cement on the teeth at de-banding of the glass ionomer cemented bands than at de-banding of the zinc polycarboxylate cemented bands. Thus we are of the opinion that chemical retention has an active role on the retention of the glass ionomer cement to the enamel and dentin of the tooth.

Norris *et al*.[6] and Copenhaver[26] mentioned that the remaining cement on the tooth surface could be preferred to cement on the band material in order to protect the surface of the enamel.

With the concordance of the results of our studies, Clark *et al*.[27] Fricker and McLachlam,[28] Kvam *et al*.[29] Maijer and Smith,[16] Mizrahi *et al*.[25] Mizrahi[30] and Ölmez *et al*.[31] also determined that glass ionomer cement is the best cement for orthodontic cementation.

CONCLUSION

In this study, the frequency of re-cementation for the zinc polycarboxylate and glass ionomer cemented bands, the decalcification of enamel under these bands with both types of cement, and the degree of remaining cement that occurred at the time of de-banding were investigated comparatively.

It is natural that the orthodontists would prefer the cement type with reliable retention during orthodontic and extraoral force application, and the cement type which strengthens and supports the enamel with the chemical agents it contains in order not to cause decalcification areas on the enamel. Glass ionomer cement has these qualifications, and this is why it is preferred.

REFERENCES

1. Sadowsky PL, Retief DH. A comparative study of some dental cements used in orthodontics. The Angle Orthod 46: 171-8, 1976.
2. Balenseifen JW, Modonia JV. Study of dental plaque in orthodontic patients. J Dent Res 49: 320-24, 1970.
3. Kocadereli I. Ortodontik simanlardaki gelişmeler. Türk Ortodonti Dergisi 7: 254-258, 1994.
4. Kocadereli I., Ciğer S. Retention of orthodontic bands with three different cements. J Clin Pediatr Dent 19: 127-130, 1995.
5. Mizrahi E. Glass ionomer cements in orthodontics-An update. Am J Orthod Dentofac Orthop 93: 505-7, 1988.
6. Norris DS, Ledoux PM, Schawaninger B, Weinberg R. Retention of orthodontic bands with new flouride-release cements. Am J Orthod 89: 206-11, 1986.
7. Mizrahi E. Surface distribution of enamel opacities following orthodontic treatment. Am J Orthod 84: 323-31, 1983.
8. Mizrahi E. Enamel demineralization following orthodontic treatment Am J Orthod 82: 62-7, 1982.
9. Smith DC. A new dental cement. Br Dent J 125: 381, 1968.
10. Mizrahi E. The re-cementation of orthodontic bands using different cements. Angle Orthod 49: 239-46, 1979.
11. Rich JM, Leinfelder KF, Hershey HG: An in vitro study of cement retention as related to orthodontics. Angle Orthod 45: 219-25, 1975.
12. Wilson AD, Kent BE. A new translucent cement for dentistry. The glass ionomer cement. Br Dent J 132: 133-5, 1972.
13. Negm MM, Beech DR, Grant AA. An evaluation of mechanical and adhesive properties of polycarboxylate and glass ionomer cements. J Oral Rehabil 9: 161-7, 1982.
14. Smith DC. Dental cements-current status and future prospects. Dent Clin North Am 6: 763-92, 1983.
15. Mizrahi E. Success and failure of bonding and banding. A clinical study. Angle Orthod 52: 113-7, 1982.
16. Maijer R, Smith DC. A comparison between zinc phosphate and glass ionomer cement in orthodontics. Am J Orthod Dentofac Orthop 93: 273-9, 1988.
17. Mount G. Maximizing glass ionomer cement usage. Aust Orthod J 9: 246, 1985.
18. Mizrahi E, Smith DC. The bond strength of a zinc polycarboxylate cement: Investigations into the behaviour under varying conditions. Br Dent J 127: 410-14, 1969.
19. Mizrahi E, Cleaton-Jones PE. Decalcification following orthodontic treatment. J Dent Res 59B: 935, 1980. (Abstract no: 191)
20. De Freitas JR. The long term solubility of a stannous fluoride zinc-phosphate cement. Aus Dent J 18: 167, 1973.
21. Swartz MC, Phillips RW, Clark HE, Norman RD, Potter R. Fluoride distribution in teeth using a silicate model. J Dent Res 59: 1596-1603, 1980.
22. Retief DH, Bradley EL, Denton JC, Switzer P. Enamel and cementum flouride uptake from a glass ionomer cements. Caries Res 18: 250-57, 1984.
23. Swartz MC, Phillips RW, Clark HE. Long term fluoride release from glass ionomer cements. J Dent Res 63: 158-60, 1984.
24. Arends J, Christoffersen J. Nature and role of loosely bound fluoride in dental caries. J Dental Res 69: 601-5, 1990.
25. Mizrahi E, Cleaton-Jones PE, Austin JC. Effects of surface contamination on band retention. Am J Orthod 79: 390-8, 1981.
26. Copenhaver DJ. In vitro comparison of glass ionomer cement ability to inhibit decalcification under orthodontic bands (Abstract) Am J Orthod 99: 528, 1986.
27. Clark JR, Phillips RW, Norman RD. An evaluation of silica phosphate as orthodontic cement. Am J Orthod 75: 190-6, 1977.
28. Fricker JP, McLachlam MD. Clinical studies of glass ionomer cements. Aus Orthod J 9: 179-180, 1985.
29. Kvam E, Broch J, Nissen-Meyer I. Comparison between a zinc phosphate and a glass ionomer cement for cementation of orthodontic bands. Eur J Orthod 5: 307-13, 1988.
30. Mizrahi E. Orthodontic band failure rate with glass ionomer cements. J Dent Res 65: (Abstract 62), 624, 1986.
31. Ölmez H, Korunmus F, Ölmez S. Farklı simanların baglanma kuvvetlerinin in vitro olarak incelenmesi. Türk Ortodonti Dergisi 7: 119-122, 1994.