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THE STRENGTHS OF SOME ORTHODONTIC CEMENTS*

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To test the strength of orthodontic cements in resisting band loosening and displacement, a chrome-cobalt casting of similar dimensions to an upper incisor band was cemented to an upper central incisor tooth. The force required to rupture the cement bond in a series of tests was measured by means of a Hounsfield tensometer, the rupturing force being in the opposite direction to the path of band seating.

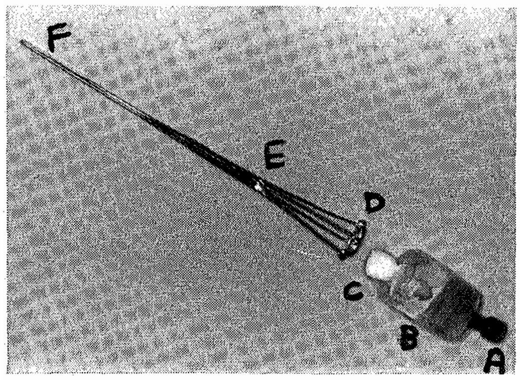

Fig. 1

In Figure 1, the incisor tooth (C) and a metal test piece (A) which inserts into a Hounsfield tensometer chuck are both embedded into clear acrylic (B). The chrome-cobalt band (D) has four gauge 22 wires (E) soldered to it. These wires are extensively incorporated in solder between E and F. At F the wire and solder have been ground flat on two sides to ensure a constant angle of insertion into a friction grip chuck.

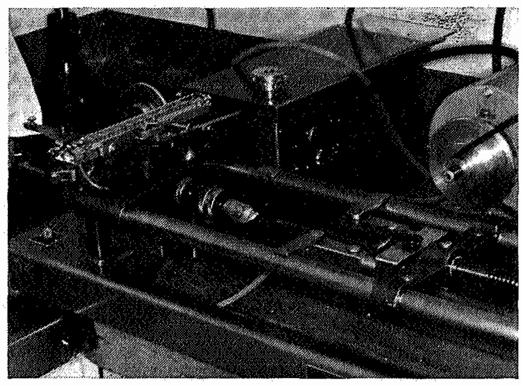

Fig. 2

Figure 2 shows the mounted test pieces in the Hounsfield tensometer. A 62.5 lb. tensometer beam was used and an electric motor used to apply a constant rate of load for each test.

The cements tested were:—(a) Dalton's Zinc-phosphate Cement, (b) Durelon Carboxylate Cement (c) Ames' Black Copper Cement, (d) Dalton's Copper Cement.

Three series of tests were done for each cement (see Table 1):—

(a) the cemented band was left in air for 60 minutes prior to testing.

(b) the cemented band was left in air for 5 minutes, and then immersed completely in water for 55 minutes prior to testing. This series allowed for a dry initial set and was the most closely parallel to the clinical condition.

Table 1

Dalton's Zinc Phosphate			Durelon Carboxylate			
Air 60 mins	Air 5 Water 55	Air 0 Water 60	Air 60 mins	Air 5 Water 55	Air 0 Water 60	
20.0	16.5	17.0	28.0	38.5	49.0	
25.5	20.0	18.0	35.0	37.5	42.5	
23.0	18.5	17.5	31.5	43.5	45.0	
23.0	19.0	17.0	32.5	40.0	44.0	
25.7	18.5	17.7	31.7	39.9	45.1	Average Results

(c) the cemented band was immersed immediately into water and left for 60 minutes prior to testing.

*Based on a lecture delivered to the A.S.O. (W.A. Branch) on 2nd Novvember 1971 and being part of the Material Science Project section of the M.D.Sc (W.A.) Preliminary requirements carried out during 1969.

Table 2

Ames Black Copper			Dalton's Copper Cement			
Air 60 mins	Air 5 Water 55	Air 0 Water 60	Air 60 mins	Air 5 Water 55	Air 0 Water 60	
3.5	14.5	20.0	14.5	17.5	13.5	
8.0	12.0	13.5	15.0	15.5	19.0	
11.0	21.0	11.5	15.0	16.0	18.5	
10.5	11.5	16.0	15.5	16.0	15.5	
8.3	14.8	15.3	15.0	16.3	16.6	Average Results

All figures in lbs.

All tests were conducted using new and previously unopened bottles of cement liquid and powder. All articles used in the tests were kept in an air-conditioned environment at all times thus ensuring constant temperature and humidity, two important factors when dealing with cements.

A constant liquid-powder ratio (by weight) was used for each cement as follows:—

Dalton's zinc phosphate cement	2 powder to 1 liquid
Dalton's copper cement	3 powder to 1 liquid
Ames' black copper cement	4 powder to 1 liquid
Durelon carboxylate cement	1½ powder to 1 liquid.

These ratios are all within the limits set by the manufacturers and were selected as giving ideal consistencies for orthodontic band cementation. Weight ratios for each test done were measured on an electric balance to an accuracy of four decimal points of a gram. Durelon was mixed on the special paper pad provided by the manufacturer, while the other cements were mixed on glass. All were mixed to manufacturers directions, the mixing time being 60 seconds except for Durelon which was mixed for 30 seconds. 20 seconds were allowed for seating the band.

Discussion

From Table 1 it can be seen that the carboxyate cement gave the best results under each of the three sets of conditions.

Especially in considering that it had the highest powder/liquid ratio, the comparative results for Ames black copper cement are remarkably low. Clinically this cement is found to have a greater cementing power than zinc phosphate cement, its disadvantages being excess acidity and it is rather messy to handle. This discrepancy between clinical and laboratory findings points out the necessity for clinical trials in any critical evaluation of cements.

The Ames black copper cement readings, although low in relation to the other cements do substantiate the clinically noted fact that this cement performs well under conditions of moisture. It is interesting to note that the manufacturer claims "However, the properties of the cement are such that it will give satisfactory service when applied under very adverse conditions of moisture".

In this series of tests, zinc phosphate cement deteriorated with moisture contamination and all the others show increased cementing power, to varying extents, with moisture contamination. Carboxylate cement was 50% stronger when in moisture for the whole 60 minutes than it was when left dry in air for this time, while zinc phosphate cement was 50% stronger in the 60 minute air environment than when setting under water. These results suggest that while moisture contamination is critical when cementing with zinc phosphate cements, it is not critical to the same degree when using carboxylate cement, a factor which has been noticed clinically by the author.

Dalton's copper cement gave the most uniform results over the range of conditions tested.

Summary

In retaining a band on a tooth under the laboratory conditions described, Durelon carboxylate cement has been found to be the superior material of those tested.

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