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SCHOOL OF DENTISTRY

Final Report

A CLINICAL EVALUATION OF ZINC OXIDE-EUGENOL CEMENTS

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INTRODUCTION

A progress report was made in August, 1965, of a preliminary study of the clinical behavior of five reinforced zinc oxide-eugenol cements of various crushing strengths. The study was of a double-blind nature. Two cements were of the paste type with compression strengths of 200 psi and 1,000 psi. Three cements were of the powder and liquid type with compressive strengths of 2200 psi, 3500 psi and 5400 psi.

Two of the cements (2200 psi and 3500 psi) proved to be satisfactory for temporary cementation of temporary restorations. Although some differences appeared to exist between these two cements, the data was not adequate in volume for a statistical analysis and it was recommended that further data be collected to determine any clinical differences in regard to taste and retention.

The preliminary data collected in relation to cements 200 psi and 1,000 psi indicated that these cements might be adequate for the temporary cementation of finished restorations and it was recommended that data be collected to evaluate the use of these cements in this procedure.

An analysis of the data collected for cement D-5400 psi showed the cement to be too strong for the temporary cementation of temporary and other restorations. There was some indication that this cement might serve for the final cementation of finished restorations. It was, therefore, recommended that further data be collected for this cement as a final cement for finished restorations.

Conversations regarding results and recommendations in this preliminary report were held and further investigations were undertaken on a 12 month basis, September 1, 1965.

The study can be described conveniently in four sections:

I. Preliminary laboratory investigation to determine the proportions of the new cements which would give optimum handling qualities.

II. Clinical study to observe temporary cementations of various temporary restorations with cements C-2200 and E-3500 with regard to retention and taste.

III. Clinical study to observe temporary cementation of various finished dental restoration with cements of various crushing strengths, with regard to retention, longevity of service, relative ease of removal and cleansing of abutments and retainer after removal.

IV. Clinical study to observe final cementations of finished restorations with cement F-8000 and recementations with F-9200.

I. PRELIMINARY LABORATORY INVESTIGATION

The manufacturer supplied additional materials to be included in the study. One new paste, three new powders and one new liquid were provided. The new liquid was to be used with all powders in the second clinical study. The purpose of the preliminary laboratory investigation was to determine the proportions of the new materials which would give optimum handling qualities.

A. MATERIALS

A new paste catalyzer and paste base material, D1-9, was made available. A new liquid, 166-45, Lot 166-187, and a new liquid dispensing device were furnished. Three new powders became available, 166-181, 166-182 and 166-186. A list of the materials in the laboratory study appears in Table I.

B. METHODS

Trial mixes were made of the new paste cement D1-9 in varying proportions of the base and catalyst. The mixes obtained were examined in regard to ease of mixing, mixing time, working time, setting time and consistency. Ease of mixing and mixing time were evaluated by the criterion of complete dispersion of the catalyst in the base by normal spatulation having been accomplished in 30-45 seconds. Working time was determined by the application of a dental mandrel to the mix at 30 second intervals. The time at which the cement no longer adhered to the mandrel on withdrawal was recorded as the working time. The setting time was recorded when the mandrel would no longer penetrate the cement mass. Consistency was evaluated by observation of the flow qualities of the freshly mixed cement from a spatula.

The new squeeze-dropper bottle was calibrated so that known milliliter quantities could be dispensed by counting drops (Table II). Using this method of liquid proportioning, weighed quantities of the five powders were mixed with the liquid. These mixes were also evaluated with regard to time, working time, setting time and consistency. The values obtained for initial set and final set are shown in Table III.

Film thickness tests were done on the cement selected for final cementation procedures using the method described in the A.D.A. Specification No. 8 for zinc phosphate cements, see Table IV.

C. RESULTS

From the data obtained on these tests, all cements met the following criteria:

1. Easy to mix in 30-45 sec.
2. Consistency creamy but not so freely flowing that it would drip from restorations when filled and inverted as in cementing to place.
3. Working time not less than 2-1/2 min and not more than 8-1/2 min.
4. Film thickness satisfactory for adequate seating of restorations at cementation.
5. By varying proportions only, various crushing strengths were obtainable in cements "G" and "F."

During conversations in October, 1965, it was decided to use neither the original nor the improved cements of 5400 psi compressive strength. Observation of those cementations still in the mouth from the previous preliminary study of the 5400 psi cement was to continue.

It was also decided to continue the investigation of the original 3500 psi cement and not substitute the modified 3500 psi cement.

Proportions were mixed at the conference table and a powder liquid ratio selected for the new F-8000 cement, Table V shows the proportions used in the clinical investigations.

II. TEMPORARY CEMENTATION OF TEMPORARY RESTORATIONS

This section of the clinical study collected data for cement C-2200 and E-3500 when used for the temporary cementation of temporary restorations.

A. MATERIALS

Cement powder C-2200 was dispensed in glass vials, each containing 0.6 gram of powder. This quantity of powder was spatulated into 13 drops (3 ml) of liquid.

Cement E-3500 powder was also dispensed in glass vials, each containing 0.6 gram powder. This quantity of powder was spatulated into 13 drops (3 ml) of liquid.

B. METHODS

1. Assignment of Cements

Either cement C-2200 or E-3500 was selected at random for each patient. When subsequent cementation of temporary restorations was required in the same patient, the alternate cement was assigned.

From the data collected on each patient, a single cementation with each cement was selected for inclusion in the study by a standard pattern. In this way each cementation recorded for the analysis of data represented one cementation of one temporary restoration on one tooth by one operator. No tooth was selected twice in the study. This procedure in selecting data ensured an analysis on the basis of "single use."

An instruction sheet, outlining the assignment procedure and the proportioning and mixing of the cements, was given to each student. A copy of the sheet is shown in Figure 1, page 68.

2. Data Collected at Cementation

A. The investigator observed completed abutment preparations at the chairside. Records were kept of the following factors.

1. Arch location of each preparation.
2. Type of each preparation.

3. Retentive qualities of each preparation.

B. Operators were questioned regarding the following factors:

1. Mixing-easy or difficult.
2. Working time-adequate or inadequate.
3. Removal of excess cement-easy or difficult.
4. Did patient make unsolicited comment of a burning taste?

3. Data Collected at Removal of Temporary Restoration

The investigator questioned the operator and/or patient at the time of removal of the restoration, regarding these factors:

1. Did cementation succeed (remain tight with marginal seals intact)?
How long?
2. Did cementation fail? How long before failure?
3. How was removal done? With ease or with difficulty?
4. How readily was the cut dentin surface cleaned? With ease or with difficulty?
5. How did the restoration clean if required for recementing? With ease or with difficulty?
6. Did the cement change the color of acrylic of temporary restoration when used? Yes or No.

4. Data Collection

Data collection was accomplished and controlled by two forms: a data sheet 8/65 C&E and a work sheet 8/65(2) Cont. C,E which are shown in Figures 2 and 3. The method of using these forms is outlined in the appendix, page 68.

C. RESULTS

Three hundred thirty-five temporary restorations were selected as described above. Cement C-2200 was used for 176 restorations and cement E-3500 for 159 restorations. The data selected is analyzed in Graphs, I, II, III, and IV

(pages 45-48). The data for all types of restorations are shown in Graph I. It can be seen that in the case of cement C-2200 there were 161 successful cementations and 15 failures. With cement E-3500 there were 145 successful cementations and 14 failures.

The data for acrylic restorations is shown in Graph II. With cement C-2200 there were 73 successful cementations and 11 failures. For cement E-3500 there were 78 successful cementations and 10 failures.

The data collected on the cementation of aluminum crowns is shown in Graph III. It can be seen that with cement C-2200 there were 88 successful cementations and 4 failures and that with cement E-3500 there were 68 successful cementations and 4 failures.

The data regarding taste is shown in Graph IV. Cement C-2200 was used for 176 cementations. Local anesthesia had been used in 21 instances. In the remaining 155 cementations a burning sensation was experienced 44 times. Cement E-3500 was used 159 times. In 12 instances local anesthesia had been used. Of the 147 remaining cementations a burning sensation was experienced in 36 instances. Two patients were sensitive to the cements and developed reactions which prohibited the further use of the cement.

An analysis of the acrylic temporary restorations is given in Table VI. The following factors are shown: the type of cement; the type of preparation; number of days in place; retentive value of the preparation; success or failure (i.e., stayed in place for required period). An analysis of the aluminum temporary crowns is given in Table VII in which the same factors listed in the previous table are shown.

An analysis of the data collected at the removal of the acrylic temporary restorations is shown in Table VIII. The following factors are listed: type of cement; ease of removal; ease of cleaning the dentin; ease of cleaning the temporary restoration when required and the type of preparation.

An analysis of the data at the removal of the aluminum temporary crowns is shown in Table IX where the same factors are listed as in the previous table.

D. DISCUSSION

Only differences of statistical insignificance appeared between the two cements, C-2200 and E-3500 when used for temporary cementation of temporary restorations from the standpoints of retention and taste.

Both cements were nearly equally adequate for the cementation of temporary restorations. The operators seemed more enthusiastic about cement E. Delight was expressed on many occasions by the operators in that less eruption of teeth into one of the gummiest materials also used as a temporary cement was experienced

when either C-2200 or E-3500 was used.

At the removal of acrylic restorations only two restorations were ruined, one which had been cemented with each cement. Six came off with difficulty cemented with cement C-2200, while 8 came off with difficulty cemented with cement E-3500. Dentin cleaning was insignificantly different, both cements giving difficulty on three occasions. In all six instances, these problems were the result of excessive desiccation of the dentin prior to cementation of the temporary restoration. Two aluminum crowns were ruined at removal. They had been on with cement C-2200. Ten removed with difficulty, being held by cement C-2200 while only 5 gave trouble held by cement E-3500. The dentin cleaned with difficulty eight times with C-2200 and three times with E-3500. The cleansing of the aluminum crown for reuse appeared more difficult with C-2200, two aluminum crowns having been ruined and four others giving difficulty. E cement gave no difficulty in this regard.

No statistically significant difference was apparent between cements C-2200 and E-3500 in regard to retention or taste. Temporary restorations cemented with either cement were held in place for the required period with equal frequency.

From the recorded comments of the operators, it would appear that cement E-3500 was the subject of more favorable comments in regard to general handling qualities than cement C-2200.

Only two acrylic restorations were ruined during removal, one restoration with each of the cements. Six acrylic restorations were removed with difficulty after cementation with C-2200; eight were removed with difficulty after cementation with E-3500. No significant difference was recorded of the ease of cleaning the dentin.

Two aluminum crowns cemented with C-2200 were ruined at removal. Ten crowns cemented with C-2200 were removed with difficulty. Five crowns cemented with E-3500 were removed with difficulty. Difficulty in cleaning the dentin was experienced eight times with C-2200 and three times with E-3500. Two aluminum crowns were ruined in cleaning the restoration for reuse following cementation with C-2200 and four crowns gave difficulty in cleaning. No difficulty was experienced with E cement in this regard.

E. CONCLUSIONS

1. No statistically significant difference was evident between cement C-2200 and cement E-3500 when used for temporary cementation of temporary restorations.

2. Both cements proved adequate for the temporary cementation of temporary restorations.

3. More favorable comments were received from the operators in regard to cement E-3500 than cement C-2200.

III. TEMPORARY CEMENTATION OF FINISHED RESTORATIONS

This section of the clinical investigation collected data on the use of zinc oxide-eugenol cements of various crushing strengths for the temporary cementation of finished restorations.

Each of these several cements was studied in regard to:

1. Retentive capabilities, i.e., would it hold the restoration.
2. Facility of removal of cemented restoration when required.
3. Facility of cleansing the dentin prior to final cementation.
4. Facility of cleansing the restoration for recementation.

A. MATERIALS

The cements used in this section of the study are shown in Table V and numbered 2, 4, 5, 6, 7, 8, and 9. The proportions used are indicated in the table.

B. METHODS

1. Assignments of Cements

The cements were assigned in relation to the following factors:

1. Type, location and number of retainers.
2. Retentive qualities of retainers.
3. Length of and number of spans.
4. Amount of occlusal stress anticipated.
5. Time temporary cementation was expected to remain in place.

2. Data Collection at Cementation

The investigators graded the retention of the preparations and finished restoration at the chairside when the cement assignment was made. Records were

kept on data sheet 8/65 (see Fig. 5, page 72). The mechanics of this data collection appears in the appendix, page 71, and examples are shown, pages 57-59.

Student comments in sections 9 (working time) and patient comments in section 10 (taste) were recorded only when volunteered.

3. Data Collection at Recall Examination

Two methods were used: (a) For short term temporary cementations (under 45 days), and (b) Long term temporary cementations (at the time of this writing up to 18 months).

a. Short Term Temporary Cementations—Patient comments and operator comments when questioned regarding the cementation furnished the information for this data. Factors in questioning were as follows:

1. Did restoration stay in place? How long?
2. Were marginal seals intact with no cement wash-out at margins? (Cavosurfaces of abutments and retainers were examined by operators following removal of cemented restoration).
3. Was removal done with ease or with difficulty?
4. Was cleansing of cut dentin of abutments done with ease or with difficulty?
5. Was cleansing of restoration for re-cementation done with ease or with difficulty?

b. Long Term Temporary Cementations—Periodic recall examination by investigator furnished data on these cases. The patients were advised at the time of cementation to contact the investigators if any of the following signs appeared between recalls:

1. Sensitivity of abutments to temperature changes, fruit acids or sweets.
2. Unusual taste around abutments.
3. Feeling of "looseness" or movement of the restoration.

On recall examination of the long-term cementations, the restorations were examined for loose retainers by one of the investigators. The following procedure was used: excess saliva was cleaned from the environment of the restoration by an air syringe. Each retainer was in turn subjected to traction and pressure in the line of draw of the restoration. A loose retainer was readily detected by the movement of residual saliva across the gold-tooth interface.

Traction was applied to the restoration with a 5S burnisher or an S.S.W. B scaler with a force of approximately 8 lb. Pressure was applied by having the patient bite firmly on a 1/4-inch diameter orangewood stick.

The patient was questioned regarding comfort, sensitivity of teeth, unusual taste, and any other symptoms.

Twenty-one of the long term temporary cementations remain cemented. The restorations are removed and finally cemented only when failure of the temporary cementation is suspected and removal is thought advisable by the examiner. Two of these 21 no longer can be followed, however.

C. RESULTS

Two hundred and twenty-three inlays, bridges and crowns were temporarily cemented representing six hundred and fourteen units of inlay, crown and/or bridge work on three hundred and seventy four retainers. Two hundred and two inlays, bridges or crowns have been removed or have failed and twenty-one remain in place. The data regarding these restorations in Tables X, XI, XII, XIII, XIV, and XV.

The cements used in the study are listed in the first column in Table X. The next three columns show the types of restorations cemented: singles (individual inlays or crowns), bridges and splints. Column 5 gives total cementations, columns 6 and 7 successes and failures. The percentage failures indicated in the column to the far right of this page are gross calculations. Since these disregard the type of each restoration, the retentive qualities, the occlusal environment and the time expectancy of the temporary cementation, the percentages serve mainly as a measure of the level of subjective judgment in the selective assignment of the several cements and not as an index of their relative efficiency, per se.

Table XI further analyzes these data on successes and failures, breaking them down into types of restorations temporarily cemented. No time period is shown for the successes, since the restoration remained in place for the required time. The time interval between cementation and failure is shown in the last two columns.

Table XII shows further analysis of the data on the failures, indicating if the restoration dislodged into the mouth, how many retainers loosened and whether the patient or the examiner discovered the failure.

Table XIII gives the results of ease or difficulty of removal of successful temporary cementations, the dentinal cleansing and cleansing of the restoration in fractional form. Easy appears as numerator and difficulty appears as the denominator.

Table XIV gives details of restorations still temporarily cemented. Time

is indicated in the column at the far right.

Table XV breaks down all temporarily cemented bridges into fixation types, for interest only.

4. Data Processing

The data was transferred to IBM cards via a system which is described in detail in the appendix, pages xiv to xxi. As will be seen in this description, the follow-up recall examination information is added to the original IBM card containing the original information at cementation.

Duplicates of IBM cards have been mailed to the sponsor: (1) When cementations were placed, and (2) when additional information procured at recall examinations was obtained and added.

D. DISCUSSION

The number of times each of the cements was utilized can be seen in Table X (total cementations). Cement A-1000 was selected most frequently (61 times) with the other cements in the following order: G-400 (35 times), B-200 (34-times), C-2200 (31 times), G-600 (21-times), E-3500 (11 times), F-8000 (7 times), D-5400 (2 times). Care was required to select a cement which would allow easy removal of the restoration when required. Selection of too weak a cement, however, would invite loosening of the restoration. The investigators endeavored to select the strongest cement for each case which in the light of previous experience with similar situations could be removed easily. An examination of the data collected at the time the restorations were removed (Table XIII) gives some indication of the success of this judgment. In the 47 successful cementations with cement A-1000 difficulty in removal was experienced on only two occasions. In the various cementations with cements B-200, G-400, G-600, D-5400, and F-8000, no difficulty was experienced in any removals.

In the case of cement C-2200, 9 of the 26 removals presented difficulties, however, this cement was used three times without assignment by an investigator and this data is included. Three out of seven cementations with cement E-3500 were difficult to remove. One of these, however, was not assigned by an investigator.

In the few cases in which the two strongest cements (D-5400 and F-8000) were employed no difficulty in removal was experienced. It might be thought that the highest incidence of difficulty might be found here, but these cements were only resorted to in cases which had very poor retentive quality, some of which were to be modified and remade.

When too weak a cement was selected the cement lute was broken and an examination of Table X reveals the incidence of failure with each cement. The incidence of failure varied from 0% with the case cemented with D-5400 to 36% with cement E-3500. Many of the failures were successfully recemented with the next stronger cement.

A detailed analysis of all cases is given in Table XI where the type of restoration and time periods involved are listed.

None of the cements presented significant difficulties in cleaning either the dentin or the restoration (Table XIII). Where difficulty in cleaning the dentin was experienced it was noted that excessive drying of the dentin had occurred.

E. CONCLUSIONS

1. Cement A-1000 most frequently met the requirements of the cases in this study.

2. Cements B-200, G-400, G-600, C-2200, and E-3500 were selected with sufficient frequency to indicate the need for cements over this range of compressive strengths to be available if all clinical needs are to be met.

3. Cements D-5400 and F-8000 should not be regarded as required for the temporary cementation of normal clinical cases.

4. Selection of a cement for the temporary cementation of a restoration can be made on an evaluation of the retentive quality of the restoration and the occlusal stresses to which it will be subjected. The clinician is required to develop his own judgment in this regard, utilizing the accepted criteria by which the retention of restorations is evaluated. The nature and extent of occlusal stresses are perhaps more difficult to assess and suitable criteria are not yet available.

5. None of the cements presented difficulties in handling nor in removal from dentin or restoration when required.

IV. FINAL CEMENTATION OF FINISHED RESTORATIONS

In this section of the clinical investigation data was collected on the use of zinc oxide-eugenol cements for the final cementation of finished restorations. These cements were studied for their retentive qualities and note was taken of any symptoms which arose at the time of cementation or thereafter.

A. MATERIALS

One cement powder and one liquid were used. By altering the powder liquid ratio, the following two crushing strengths were obtained (see Table V, page 25).

F-8000 -- 0.9 gram powder/3.7 ml (16 drops) liquid gave a cement of 8000 psi (approx.)

F-9200 -- 0.9 gram powder/3.0 ml (13 drops) liquid gave a cement of 9200 psi.

B. METHODS

1. Patient Selection

Patients were selected who would be available for recall examination for a minimum period of 2 years. No other criteria were used and all types of inlays, crowns, and bridges were accepted in the study.

2. Assignment of Cements

Cement F-8000--This cement was given to undergraduate students for the cementation of inlays, crowns and bridges.

Cement F-9200--The higher powder liquid ratio of this cement produced a more viscous material which was assigned only to graduate students and staff in selected cases. The cement was not assigned in the following situations:

- A. Thin procelain jacket crowns.
- B. Pinledge restorations with parallel sided pins.

3. Mixing the Cement

One vial of cement powder (0.9 gram) was incorporated into 16 drops of liquid (3.7 ml) using a parchment pad and a Kerr spatula. All the powder was

brought into the liquid and compressed repeatedly until moistened and the moist mass was spatulated rapidly. The mix was completed in 30-45 sec.

4. Mouth Preparation

The area involved was isolated with cotton rolls and a saliva ejector placed. The teeth and adjacent tissues were thoroughly dried with cotton. The abutment teeth were further dried with cotton and a sterilizing agent applied where required. No varnish was applied to the abutments. Local anesthesia was not used routinely.

5. Data Collection at Cementation

The preparations were graded at the chairside prior to final cementation. Records were made on a data sheet, Figure 5. The mechanics of this data collection appears in the appendix, page 71, and an example is shown on page 58.

6. Data Collection at Follow-up Examination

The patients are being systematically recalled for examination of the cemented restorations. On recall examination of the cementations, the restorations were examined for loose retainers. The following procedure was used: excess saliva was cleaned from the environment of the restoration by an air syringe. Each retainer was in turn subjected to traction and pressure in the line of draw of the restoration. A loose retainer was readily detected by the movement of residual saliva across the gold-tooth interface.

Traction was applied to the restoration with a 5S burnisher or an S.S.W. B scaler with a force of approximately 8 lb. Pressure was applied by having the patient bite firmly on a 1/4-inch diameter orangewood stick.

The patient was questioned regarding comfort, sensitivity of teeth, unusual taste, and any other symptoms.

7. Data Processing

The data collected at the time of cementation was transferred to IBM cards, using a system which is described in the appendix, page 60. The follow-up examination findings are added to the original IBM card containing the information recorded at cementation of the restoration.

Duplicates of the IBM cards were mailed to the sponsor following cementation and after additional information, procured at recall examinations, was added.

C. RESULTS

By December 16, 1966, 246 restorations had been finally cemented. This figure includes two restorations which were finally cemented with D-5400 during the preliminary study and were being followed by recall examination. The 246 cementations involved placement of 790 units of inlay, crown and/or bridge work on 490 retainers for 186 patients.

The time, which has elapsed since cementation, varies from 13 months with the earliest restorations cemented in the study to 2 days for the most recent restorations cemented.

It can be seen that a wide variety of restorations, both single and multiple, are included in the study. The many factors which can be identified and examined are set out in Tables XVI to XXIV.

Tables XVI and XVII show the cement used, the number of restorations cemented with each cement, the number of units in each restoration and the total number of retainers cemented for each type of restoration.

Tables XVIII through XXIV show a further analysis of the data on the restorations cemented. Table XVIII gives the number of spans in each bridge. Table XIX shows the number of pontics in the longest span. Table XX shows the type of fixation. Table XXI shows the retention grades of the restorations. Table XXII shows the location in the arch of the restorations. Table XXIII shows the occlusal function grades and Table XXIV gives the student and/or patient reaction to the cement.

All restorations were completely seated without difficulty. It is well to bear in mind, however, that the heavier bodied F-9200 cement was employed only by experienced dentists.

A remarkable absence of pain at cementation was noted. Numerous cementations were made on hypersensitive abutment teeth and no discomfort was experienced by the patients.

Many patients commented on the feeling of comfort which they experienced immediately the restoration had been cemented.

Local anesthesia was not routinely used even in the more extensive restorations. Although some discomfort was occasionally experienced during the period prior to cementation when a number of abutments were isolated, immediate relief was experienced when the restoration was cemented to place.

Three exceptions, all related to cementation of pinledge restorations, occurred. In two cases transient pain was experienced which subsided rapidly once the restoration was completely seated. It is thought that hydraulic pressure on the pulp through the dentin was produced as the pins went to place. In

the third case acute pain occurred at the time of cementation and persisted for some time. The final effect was not determined as the patient failed to attend for subsequent appointments.

By December 16, 1966, 101 patients have been seen for follow-up examinations. Of the 490 retainers cemented, 255 have been tested for adequacy of the cements from the standpoint of retention. By adding the entries in Table XXVI it can be found that 92 bridges have been examined at recall and 31 single restorations have been examined. The cement successfully luted 83 or 90.2% of the bridges. None of the single restorations had loosened or showed signs or symptoms of marginal leakage.

Of the 255 cemented retainers, 13 or 5% involving 9 bridges, failed. Of the 9 bridges, 2 were dislodged into the mouth and were brought in by the patients. The failure of the other 7 was detected at the recall examination. Eight of the 9 bridges have been recemented with F-9200 cement and are presently being followed by recall examination.

No dental caries was found beneath the retainers which failed. The details of the 9 bridges which failed are shown in Table XXV.

The bridge listed in lines 1 and 2 of Table XXV failed following cementation with D-5400. Failure occurred after recementation with F-8000. Following this second failure the bridge was recemented with F-9200 and is still in place awaiting recall.

Bridge number 3 was retained by two pinledge restorations on the maxillary cuspids. The retention of the pinledges was grade 4, short, parallel, with ample surface to grasp. The occlusion grade was 5 (holds less than half the occlusion) and the patient bruxes on the restoration.

Bridge number 4 was a 5-unit mandibular posterior restoration, with two splinted bicuspid abutments at the mesial end and a crown on the third molar at the distal end. A molar and a bicuspid pontic section was attached with rigid connectors. The two bicupsid retainers loosened, the molar crown remaining in place. This bridge is presently recemented with F-9200 cement.

Bridge number 5 dislodged into the patient's mouth during a meal. The occlusion had not been properly balanced at the time of cementation.

Bridge number 6 stayed in place 10 months before dislodging into the mouth. Retentive factors were of the lowest grade. The restoration is presently in place having been recemented with F-9200 cement.

Bridge number 7 remained in place 91 days before it was dislodged by the investigator during a follow-up examination. It has been recemented with F-9200 cement and is under observation.

Bridge number 8 had the less retentive of two dissimilar retainers loosen in 6 months, while bridge 9, a similar restoration, remained secure for 9 months before the less retentive retainer loosened.

Table XXVI gives a break down of the examinations of the successes for the two cements used. The fractional expressions in the first column indicate the number of units over the number of retainers in the restoration. Those fractions in the 2nd and 3rd columns indicate the number of months following cementation over the number of restorations examined.

Table XXVII shows the number of restorations and retainers examined at varying time intervals after cementation.

D. DISCUSSION

It can be seen from Tables XVI and XVII that a wide variety of restorations were cemented varying from single restorations to multiple span bridges with as many as 14 units. As might be expected in an undergraduate clinic the highest number of restorations were three-unit bridges, with single restorations second in number.

Table XVIII shows that 69 of the bridges were single span bridges, 12 involved 2 spans and 4 involved 3 spans.

Table XIX shows that 135 bridges had one pontic span, 31 had 2 pontic spans, 5 had 3 pontic spans, and 14 had 4 pontic spans.

Table XX shows that 167 bridges had rigid connectors, 7 had a semi-rigid connector, and several other relations between retainer and pontic were represented in the sample.

Table XXI shows the distribution of retention grades among the various cases and it can be seen that all conditions are reported in the cases studied.

Table XXII shows the location of the bridges in the arch and it is interesting to notice that the majority of the bridges are in the posterior section of the arch (8). Bridges next in frequency are located in the anterior section of the arch (6) while 34 bridges located posteriorly include the cuspid as an abutment. The bridge retainers utilized include three-quarter crowns, complete crowns, veneer crowns and inlays. Single restorations include all of these and in addition porcelain jacket crowns. It can be seen that a wide range of all types of restorations, both bridges and single units were included in the study.

From the results already presented it was noted that the cement was remarkably bland to tooth tissue and pain at cementation was absent in the majority of cases. In addition post-cementation pain was similarly reduced to virtual nonoccurrence.

Of the 255 cemented inlays, crowns and bridge retainers in patients who have been recalled and examined 13 or 5% failed. All 13 failures were bridge retainers. None of the 27 single restorations had failed.

It is interesting to examine the nature of the bridges which failed (Table XXV). The bridge listed in lines 1 and 2 extended from the right maxillary cuspid to the left second bicuspid with the left cuspid as an intermediate abutment. Because of the other missing teeth all function was on the left side. It is possible that functional forces exerted displacing forces on the single abutment on the right side. The retainers on the left side remained secure.

Bridge number 3 is a six-unit anterior maxillary bridge replacing the four incisors. Although the retention grade was next to the highest, the occlusion on the bridge was heavy and the patient bruxed.

In bridge number 4 the retention grade for the retainer was 4 and the occlusion was grade 2 with a crossbite.

In bridge number 5 the retention grade for the retainers was 4 and the occlusion was grade 1 but the pontic was left high.

In bridge number 6 the retention grade of the retainers was 9 and occlusion grade 1.

In bridge 7 the retainer retention grade was 4 occlusion grade was 4.

In bridge number 8 the retention of the restoration was grade 4, occlusion was on a denture, grade 4.

It can be seen that among the retainers on the bridges which failed none had a retention grade higher than 4 and in two cases the retention grade was lower than 4. In four of the bridges there was other than normal occlusal conditions. All except one of the failing bridges were recemented with F-9200 and are still in position.

E. CONCLUSIONS

1. The cements tested were nonirritating to freshly cut dentin.
2. The cements showed a sedative effect on sensitive abutments.
3. The cements securely luted 90.2% of the 92 bridges which have been recalled to date.
4. Thirty-one (100%) of the single restorations were successfully luted.
5. No signs or symptoms of marginal leakage were evident in any case other

than those which failed.

6. No caries was found in any of the bridges which had failed.

TABLE I

CEMENTS IN LABORATORY STUDY

I.	<u>Paste Catalyser</u>	<u>Paste Base</u>
	D1-9	(New "G")
II.	<u>Powders</u>	
	166-186	(New "F")
	166-181	(Altered "D" → sent back)
	166-182	(Altered "E" → sent back)
	166-44-2	(Lot, 166-120-A) old "C" used
	166-43-2	(Lot, 166-123-A) old "E" used
III.	<u>Liquids</u>	
	166-45	(Lot, 166-187) new liquid to be used with all powders

TABLE II

DROPPER CALIBRATION

A 5 cc graduate cylinder was obtained to calibrate the droppers. The trial measurements were made as follows:

	Trial	Drops	Milliliters
Dropper No. 1	1	45	1.1
	2	45	1.2
	3	42	1.0
	4	39	0.9
	5	39	0.9
	6	39	0.9
Dropper No. 2	1	39	0.90
	2	39	0.90
	3	39	0.90
Dropper No. 3	1	16	0.37
	2	16	0.38
	3	16	0.37
	4	13	0.30
	5	13	0.29
	6	13	0.31
	7	13	0.30

TABLE III

LABORATORY MIXES

Paste Cements					
Cement	Base	Catalyst		Minutes Initial Set	Minutes Final Set
D 1-9	1 part	1 part		4.5- 6.5	7.5- 9.0
(G)	2 parts	1 part		7.5-10.5	9.0-12.0
	1-1/2 parts	1 part		5.5- 6.5	8.0-12.0
Powder/Liquid Cements					
Cement	Powder	Liquid	Proportions	Minutes Initial Set	Minutes Final Set
Altered "E"	166-182 or 166-43-4 (166-123-B)	166-45 (166-187)	0.6 gram/3ml	2.75-3.0	5.0
Old "E"	166-43-2 (166-123-A)	166-45 (166-187)	0.6 gram/3 ml	2.0	2.5
"C"	166-44-2 (166-120-A)	166-45 (166-187)	0.6 gram/3 ml	3.0	3.5
Altered "D"	166-181 or 166-43-4 (166-123-B)	166-45 (166-187)	0.6 gram/3 ml	2.5	3.0
F-9200	166-186	166-45 (166-187)	0.9 gram/3 ml	4.5-5.5 6.5-7.0	5.0-5.5 7.0-7.5
F-8000	166-186	166-45	0.6 gram/3 ml	6.5-7.0	7.0-7.5

TABLE IV

FILM THICKNESS, CEMENT F

(Room temperature, 76°F, 44% rel. humidity, load 2 kg (33 lb)
on 2 cm² applied 3 min after mix)

Test	0.9 Gram Powder With 13 Drops Liquid (3 ml), Thickness (mm)		0.9 Gram Powder With 19 Drops Liquid (4.4 ml), Thickness (mm)	
	With Cement	Without Cement	With Cement	Without Cement
1	1.930	1.955	2.040	2.060
2	1.930	1.955	2.040	2.060
3	1.930	1.955	2.040	2.055
4	1.930	1.950	2.040	2.055
5	1.930	1.955	2.035	2.055

Film thickness = 24 microns

Film thickness = 18 microns

Note: A.D.A. specification no. 8 test procedure for film thickness.

TABLE V

CEMENTS SELECTED FOR THE CLINICAL STUDIES

IBM No.	Code	Paste	Powder	Liquid	Proportions
1	F-9200		166-186 Lot D-1-4	166-45 Lot 166-187	0.9 gram powder 3.0 ml liquid (13 drops)
2	F-8000		166-186 Lot D-1-4	166-45 Lot 166-187	0.9 gram powder 3.7 ml liquid (16 drops)
3	D-5400		166-43-4 Lot 166-123-B	166-45-2 Lot 166-120-D	0.6 gram powder 0.3 ml liquid (dropper change) Observation of existing cementations only
4	E-3500		166-43-2 Lot 166-123-A	166-45 Lot 166-187	0.6 gram powder 3 ml liquid (13 drops)
5	C-2200		166-44-2 Lot 166-120-A	166-45 Lot 166-187	0.6 gram powder 3 ml liquid (13 drops)
6	A-1000	166-117			Equal lengths base and catalyst
7	G-600	D-1-9			1-1/2 lengths base to 1 length catalyst
8	G-400	D-1-9			Equal lengths base and catalyst
9	B-200	166-121			Equal lengths base and catalyst

TABLE VI

ACRYLIC TEMPORARY RESTORATIONS

Type of Preparation	Days	Cement C-2200								Cement E-3500							
		Retention of Preparation								Retention of Preparation							
		A		B		C		D		A		B		C		D	
		S*	F**	S	F	S	F	S	F	S	F	S	F	S	F		
Complete Crown	0-3			1	4								5	0	1	3	
	4-7	3	0	8	0	5	1	1	0	2	0	4	0	4	2		
	8-14	2	0	3	0	4	0			1	0	4	1	2	0		
	> 14			3	0					1	0	5	0	2	0	1	0
	Totals	5	0	15	4	9	1	1	0	4	0	18	1	9	5	1	0
Three Quarter Crown	0-3	4	0	4	1	1	0			2	0	2	0				
	4-7	2	0	1	0	1	0			2	0	3	1	5	0		
	8-14	1	0	1	0	2	0			2	0	6	0				
	> 14	3	0	2	0	1	0			2	0	4	1				
	Totals	10	0	8	1	5	0			8	0	15	2	5	0		
M.O.D. Inlay Protected Cusp	0-3	1	0	3	0					2	0	3	2				
	4-7	2	1	1	1					2	0	2	0				
	8-14			2	0	1	0					4	0				
	> 14			0	1												
	Totals	3	1	6	2	1	0			4	0	9	2				
Pinledge	0-3	2	0	2	1	1	0	0	1								
	4-7											2	0				
	8-14	2	0	2	0					1	0	1	0				
	> 14			1	0												
	Totals	4	0	5	1	1	0	0	1	1	0	3	0				

*Successful cementations.

**Failure of cementations.

TABLE VII

ALUMINUM TEMPORARY RESTORATIONS

Type of Preparation	Days	Cement C-2200								Cement E-3500							
		Retention of Preparation								Retention of Preparation							
		A		B		C		D		A		B		C		D	
		S*	S**	S	F	S	F	S	F	S	F	S	F	S	F	S	F
Crown	0-3			4	1	1	0	1	0	1	0	4	0	1	1		
	4-7	3	0	13	0	6	0			2	0	9	1	4	0		
	8-14			7	0	2	0	1	0	1	0			1	0	1	0
	> 14			3	0	2	0			1	0	2	0			1	0
	Totals	3	0	27	1	11	0	2	0	5	0	15	1	6	1	2	0
Three Quarter Crown	0-3	2	0	5	0					1	0	4	0				
	4-7	3	0	7	0	2	0			6	0	7	0			0	1
	8-14	2	0	5	1	1	0			1	0	4	0	1	0		
	> 14	1	0	3	1							4	0				
	Totals	8	0	20	2	3	0			8	0	19	0	1	0	0	1
M.O.D. Inlay Protected Cusp	0-3	1	1	4	0					2	0	2	0	1	0		
	4-7	2	0	6	0					2	0	4	0	0	1		
	8-14	1	0									1	0				
	> 14																
	Totals	4	1	10	0					4	0	7	0	1	1		

*Successful cementations.

**Failure of cementations.

TABLE VIII

DATA AT REMOVAL ACRYLIC TEMPORARY RESTORATIONS

Type of Preparation	Cement C-2200									
	Removal			Dentin Cleaned			Restoration Cleaned			No Restoration Cln.
	Easy	Difficult	Ruin Restoration	Easy	Difficult	Restoration	Easy	Difficult	Ruin Restoration	
Crown	28	2	0	29	1	1	29	0	0	1
3/4 Crown	21	1	1	22	1	1	21	0	0	2
PC M.O.D.	8	2	0	9	1	1	8	1	0	1
Pinledge	<u>9</u>	<u>1</u>	<u>0</u>	<u>9</u>	<u>1</u>	<u>1</u>	<u>8</u>	<u>1</u>	<u>0</u>	<u>1</u>
Total	66	6	1	69	4	4	66	2	0	5
<u>Cement E-3500</u>										
Crown	28	4	0	31	1	1	30	0	0	2
3/4 Crown	25	2	1	27	1	1	27	0	0	1
PC M.O.D.	11	2	0	12	1	1	10	1	0	2
Pinledge	<u>4</u>	<u>0</u>	<u>0</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	68	8	1	74	3	3	71	1	0	5

TABLE IX

DATA AT REMOVAL ALUMINUM TEMPORARY RESTORATIONS

Type of Preparation	Cement C-2200									
	Removal			Dentin Cleaned			Restoration Cleaned			
	Easy	Difficult	Ruin Restoration	Easy	Difficult	Ruin Restoration	Easy	Difficult	Ruin Restoration	No Cln.
Crown	34	7	2	39	4	34	3	2	4	4
3/4 Crown	28	3	0	27	4	26	1	0	4	4
PC M.O.D.	<u>14</u>	<u>0</u>	<u>0</u>	<u>14</u>	<u>0</u>	<u>14</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	76	10	2	80	8	74	4	2	8	8
<u>Cement E-3500</u>										
Crown	26	2	0	27	7	26	0	0	2	2
3/4 Crown	26	2	0	27	1	24	0	0	4	4
PC M.O.D.	<u>11</u>	<u>1</u>	<u>0</u>	<u>11</u>	<u>1</u>	<u>11</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>
Total	63	5	0	65	3	61	0	0	7	7

TABLE X

COMPLETED TEMPORARY CEMENTATIONS OF FINISHED RESTORATIONS,
SUCSESSES AND FAILURES

Cement	Restorations Cemented			Total Cementations	Successes	Failures
	Singles	Bridges	Splints			
B-200	7	25	2	34	25	9 = 25%
G-400	15	18	2	35	28	7 = 20%
G-600	12	9	0	21	17	4 = 19%
A-1000	20	38	3	61	47	14 = 20%
C-2200	12	17	2	31	26	5 = 16%
E-3500	2	9	0	11	7	4 = 36%
D-5400	1	1	0	2	2	0 = 0%
F-8000	<u>0</u>	<u>7</u>	<u>0</u>	<u>7</u>	<u>5</u>	<u>2 = 30%</u>
Total	69	124	9	202	157	45

TABLE XI

COMPLETED TEMPORARY CEMENTATIONS OF FINISHED RESTORATIONS,
ANALYSIS OF SUCCESSES AND FAILURES

Cement	Successes (1 day to 18 months)		Failures		Time of Failure	
	No. of Restorations	Type of Restorations	No. of Restorations	Type of Restorations	Days	Months
B-200	6	Single tooth restoration	1	Single tooth restoration	1	
	2	2-unit bridges				
	8	3-unit bridges	2	3-unit bridges	1	
			2	4-unit bridges	1	
	4	5-unit bridges	1	4-unit bridges		3-1/2
	1	6-unit bridges	1	7-unit bridge		3
	3	8-unit bridges	1	10-unit bridge		4
	1	11-unit bridge	1	13-unit bridge	4	
Total, 34						
G-400	14	Single tooth restorations	1	Single tooth restorations	21	
	2	2-unit bridges				
	4	3-unit bridges	2	3-unit bridges	1,4	
	4	4-unit bridges	2	4-unit bridges	1,7	
	4	5-unit bridges	1	5-unit bridges	10	
			1	13-unit bridge	4	
Total, 35						
G-600	10	Single tooth restoration	2	Single tooth restoration	2,3	
	4	3-unit bridges				
	2	4-unit bridges	1	4-unit bridge	90	
	1	5-unit bridges	1	11-unit bridge		11
Total, 21						
A-1000	19	Single tooth restoration	2	Single tooth restoration	54,55	
	2	2-unit splints	1	single	1	
			1	2-unit bridge	1	
	19	3-unit bridges	7	3-unit bridges	1-95	
	5	4-unit bridges	1	4-unit bridges	10	
	2	5-unit bridges	1	5-unit bridge	24	
	1	6-unit bridge				
	1	11-unit bridges	1	13-unit bridge	11	
Total, 61						
C-2200	12	Single tooth restoration				
	2	2-unit bridges				
	8	3-unit bridges	3	3-unit bridges	2,12,14	
			2	4-unit bridges	35,59	
	4	5-unit bridges				
Total, 31						

TABLE XI (Concluded)

Cement	Successes (1 day to 18 months)		Failures		Time of Failures	
	No. of Restorations	Type of Restorations	No. of Restorations	Type of Restorations	Days	Months
E-3500	2	Single tooth restoration				
	2	3-unit bridges	3	3-unit bridges	7,10,72	
	2	4-unit bridges	1	4-unit bridge		4
	1	5-unit bridge				
Total, 7						
D-5400	1	Single tooth restoration		No Failures		
	1	6-unit bridges				
Total, 2						
F-8000	1	2-unit bridge (semirigid)	1	2-unit semi-rigid	64	
	2	3-unit bridge	1	3-unit bridge	35	
	2	4-unit bridges				
Total, 7						

TABLE XII

COMPLETED TEMPORARY CEMENTATIONS OF FINISHED
RESTORATIONS, ANALYSIS OF FAILURES

Cement IBM No. Code	No. of Failures	Restoration fell out in- to patient's mouth	One retainer		More than one		More than one	
			loose patient discovered	loose examiner discovered	retainer patient discovered	retainer loose examiner discovered		
9 B-200	9	4	1	3	1			
8 G-400	7	4		1	1		1	
7 G-600	4	2		2				
6 A-1000	14	7	1	4		2		
5 C-2200	5	2		2				
4 E-3500	4	3					1	
3 D-5400	0							
2 F-8000	2	1					1	

TABLE XIII

COMPLETED TEMPORARY CEMENTATIONS OF FINISHED RESTORATIONS,
DATA AT REMOVAL OF SUCCESSES

Cement IBM No.	Code	No. of Successes	Remove E/D	Dentin Clean E/D	Restoration Clean E/D
9	B-200	25	25/0	25/0	25/0
8	G-400	28	28/0	28/0	28/0
7	G-600	17	17	17	17
6	A-1000	47	45/2	45/2	47
5	C-2200	26	17/9*	19/7	26
4	E-3500	7	4/3**	5/2	6/1
3	D-5400	2	2/0	2/0	2/0
2	F-8000	5	5/0	5/0	5/0

*Used in three cases without assignment: One case recemented with A-1000 and two cases recemented with G-400: All three successful and easily removed later.

**Used in one case without assignment.

TABLE XIV

TEMPORARY CEMENTATIONS OF FINISHED RESTORATIONS STILL IN PLACE

Cement	No. of Restorations	No. of Units	No. of Retainers	Months In
B-200	1	10	7	3
G-400	1	3	2	8
	1	4	3	12
A-1000	1	1	1	8
	1	3	2	8
	2	4	4	12,12
	1	12	7	18
C-2200	3	1	3	8,8,6
	3	3	6	11,11,20*
	1	5	3	12
	1	4	2	8
E-3500	1	1	1	8
	1	3	2	8
	1	4	3	12
F-8000	2	1	2	10,10

*Patient overseas in armed forces

TABLE XV

TEMPORARY CEMENTATIONS OF FINISHED RESTORATIONS
ANALYSIS OF BRIDGES BY TYPE OF FIXATION

Cement	Rigid	Semi-Rigid	Cantilever
B-200	26	1	0
G-400	20	0	0
G-600	9	0	0
A-1000	35	2	0
C-2200	17	2	0
E-3500	9	0	0
D-5400	1	0	0
F-8000	3	2	1

TABLE XVI

FINAL CEMENTATIONS OF FINISHED RESTORATIONS LISTED BY NUMBER OF UNITS IN ASCENDING ORDER; CEMENTS D-5400, F-8000, AND F-9200

Cement	No. of Units/Restoration	No. of Restorations Cemented	Total Units Cemented
D-5400	3	1	3
*	8	1	8
Subtotal	—	2	11
F-8000	1	59	59
	2	3	6
	3	102	306
	4	34	136
	5	12	60
	6	7	42
	8	4	32
	9	1	9
	11	1	11
	14	1	14
Subtotal	—	224	675
F-9200	1	2	2
	3	8	24
	4	1	4
	5	3	15
	6	2	12
	8	1	8
	12	1	12
	13	1	13
	14	1	14
Subtotal	—	20	104
Totals	—	246	790

*Cemented during preliminary study and being followed by recall examinations.

TABLE XVII

FINAL CEMENTATIONS OF FINISHED RESTORATIONS LISTED BY NUMBER
OF RETAINERS IN ASCENDING ORDER; CEMENTS D-5400, F-8000, AND F-9200

Cement	No. of Retainers/Restoration	No. of Restorations Placed	Total Retainers Cemented
D-5400	2	1	2
*	3	1	3
Subtotal	—	2	5
F-8000	1	62	62
	2	128	256
	3	26	78
	4	5	20
	5	3	15
Subtotal	—	224	431
F-9200	1	3	3
	2	11	22
	3	3	9
	6	1	6
	7	2	14
Subtotal	—	20	54
Total	—	246	490

*Cemented during preliminary study and being followed by recall examination.

TABLE XVIII

NUMBER OF SPANS IN EACH BRIDGE

No. of Spans	Cement Used		
	D-5400	F-8000	F-9200
0	0	59	2
1	1	154	14
2	1	10	1
3	0	1	3

TABLE XIX

NUMBER OF PONTICS IN LONGEST SPAN OF BRIDGE

No. of Pontics	Cement Used		
	D-5400	F-8000	F-9200
0	0	59	2
1	1	126	8
2	0	26	5
3	0	5	0
4	1	8	5

TABLE XX

TYPE OF FIXATION

No. of Type*	Cement Used		
	D-5400	F-8000	F-9200
0	0	58	2
11	2	153	12
2	0	7	0
3	0	2	3
4	0	1	0
5	0	2	3
6	0	1	0

*See page 63 of appendix for key to type.

TABLE XXI

RETENTION GRADES

Grade*	Cement Used		
	D-5400	F-8000	F-9200
2	1	28	4
3	0	48	2
4	0	57	6
5	1	43	4
6	0	4	1
7	0	37	2
8	0	0	0
9	0	7	1

*See page 65 of appendix for key to grade.

TABLE XXII

ARCH LOCATION

Location Number*	Cement Used		
	D-5400	F-8000	F-9200
1	0	5	3
2	1	1	1
3	0	0	0
4	0	1	0
5	0	2	0
6	0	52	1
7	0	1	0
8	1	130	13
9	0	32	2

*See page 65 in appendix.

TABLE XXIII

OCCLUSAL FUNCTION GRADE

Grade*	Cement Used		
	D-5400	F-8000	F-9200
0	0	17	0
1	1	43	2
2	0	24	1
3	0	1	0
4	0	103	7
5	0	31	3
6	1	5	7

*See page 66 in appendix.

TABLE XXIV

STUDENT/PATIENT REACTION

Grade	Cement Used		
	D-5400	F-8000	F-9200
0 (No Comment)	1	95	4
1 (Liked Cement)	1	109	16

TABLE XXV

ANALYSIS OF THE NINE BRIDGES WHICH CAME LOOSE

Br. No.	Cement	Time of Failure	Units	Retainers Cemented	Retainers Failed	Retainers Holding	Type of Restoration
1	D-5400	7 mo	8	3	1	2	Max. canine to opposite 2nd bicuspid
2	F-8000	7 mo	8	3	1	2	Max. canine to opposite 2nd bicuspid
3	F-8000	6 mo	6	2	1	1	Max. canine to canine
4	F-8000	8 mo	5	3	2	1	Mand. posterior, molar to bicuspids
5	F-8000	9 days	3	2	2	0	Mand. posterior
6	F-8000	10 mo	3	2	2	0	Mand. posterior
7	F-8000	91 days	3	2	2	0	Mand. posterior
8	F-8000	6 mo	3	2	1	1	Mand. posterior
9	F-8000	8 mo	<u>3</u>	<u>2</u>	<u>1</u>	<u>1</u>	Mand. posterior
	Totals		43	21	13	8	

TABLE XXVI

EXAMINATIONS OF SUCCESSES

Restoration Type Units/Retainers	Cement F-8000		Cement F-9200	
	Months After Cementation	No. of Restorations Examined	Months After Cementation	No. of Restorations Examined
1/1	2/1,3/2,4/1,5/9,6/1,7/1, 8/12,9/3,12/1			
3/2	1/1,2/1,3/1,4/5,5/7,6/12, 7/11,8/9,9/3,10/2		10/1	
4/2	4/1,7/3,8/1,9/1,10/1			
4/3	5/1,6/3,7/2,8/2			
5/2	7/1,8/2			
5/3	4/1,6/1,7/2,8/1			
8/4	4/1,8/1			
8/5	6/1			
12/6			9/1	
13/7			3/1	
14/5*	5/1			
14/7			13/1	

*8-unit, 3-span mandibular fixed bridge holding a symmetrical, distal extension, removable, Chayes attachment restoration, supplying 6-units, 2 molars and 1 bicuspid on each side.

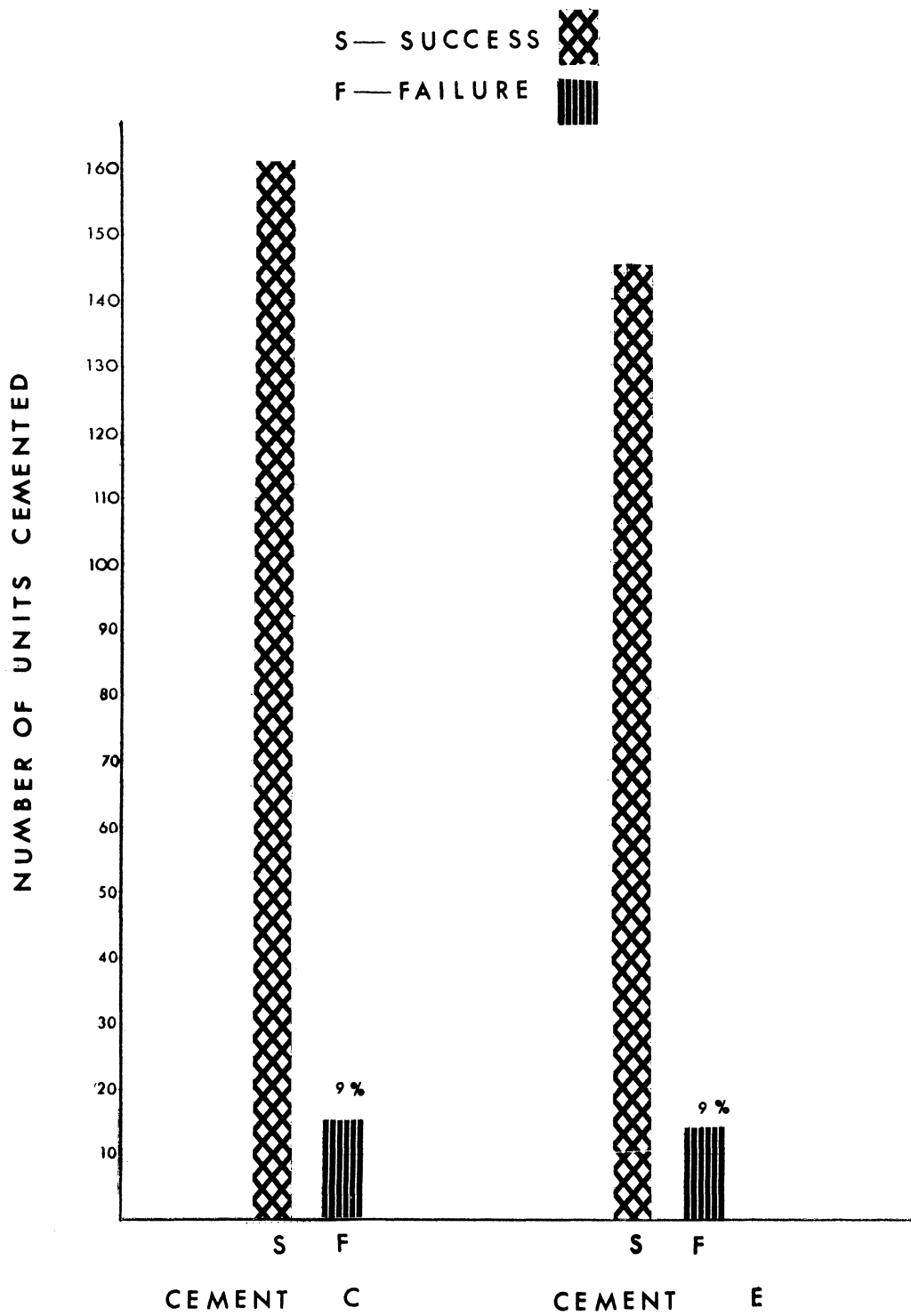
TABLE XXVII

NUMBER OF RESTORATIONS AND RETAINERS
EXAMINED AT VARYING TIME INTERVALS

Months Following Cementation	No. of Examined Restorations	No. of Retainers
1	1	2
2	2	3
3	4	11
4	9	20
5	18	31
6	18	42
7	20	43
8	28	49
9	8	17
10	4	8
12	1	1
13	<u>1</u>	<u>7</u>
Totals	114	234

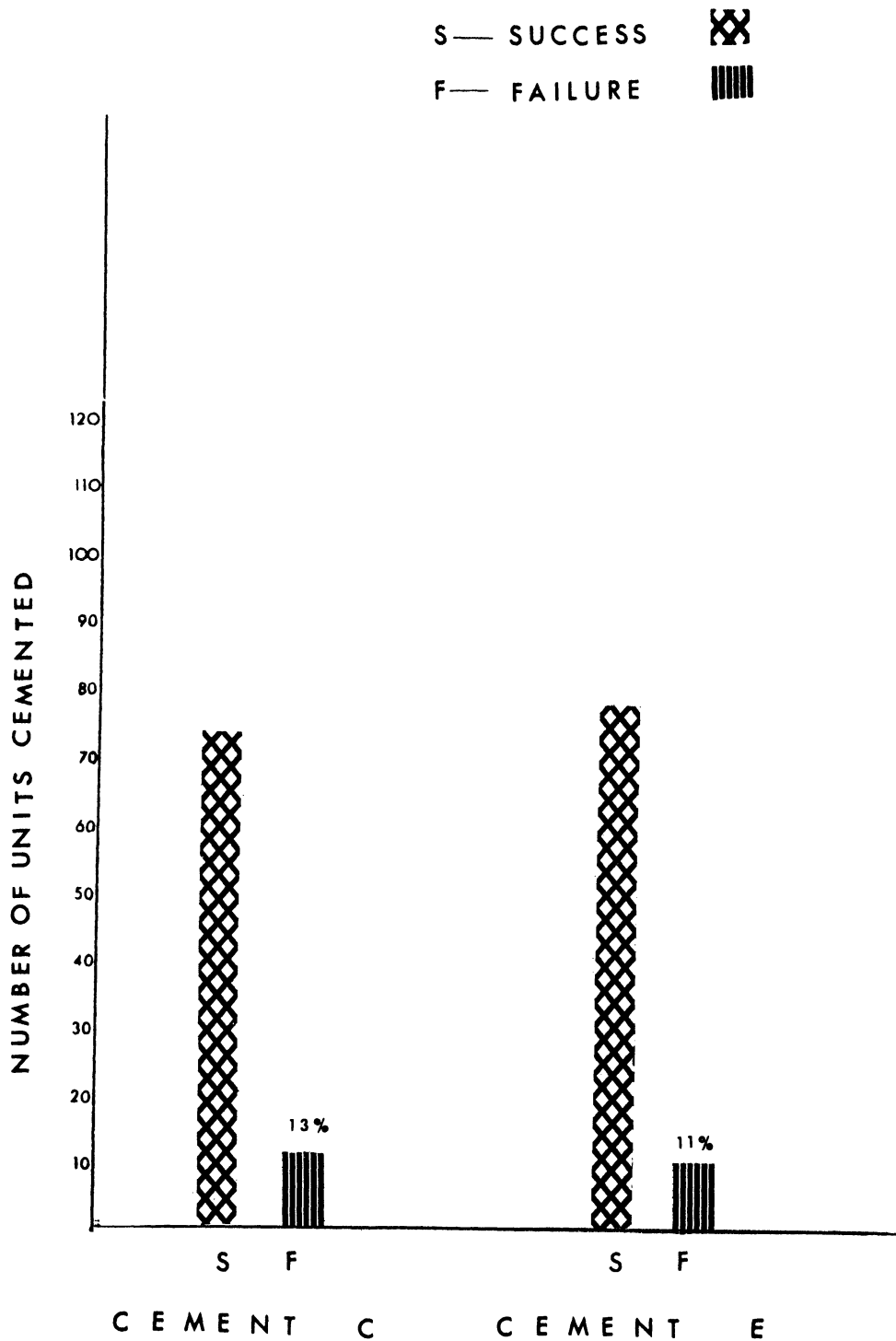
ALL TEMPORARY RESTORATIONS

SINGLE USE DATA



Graph I Retention of all restorations -- single use data.

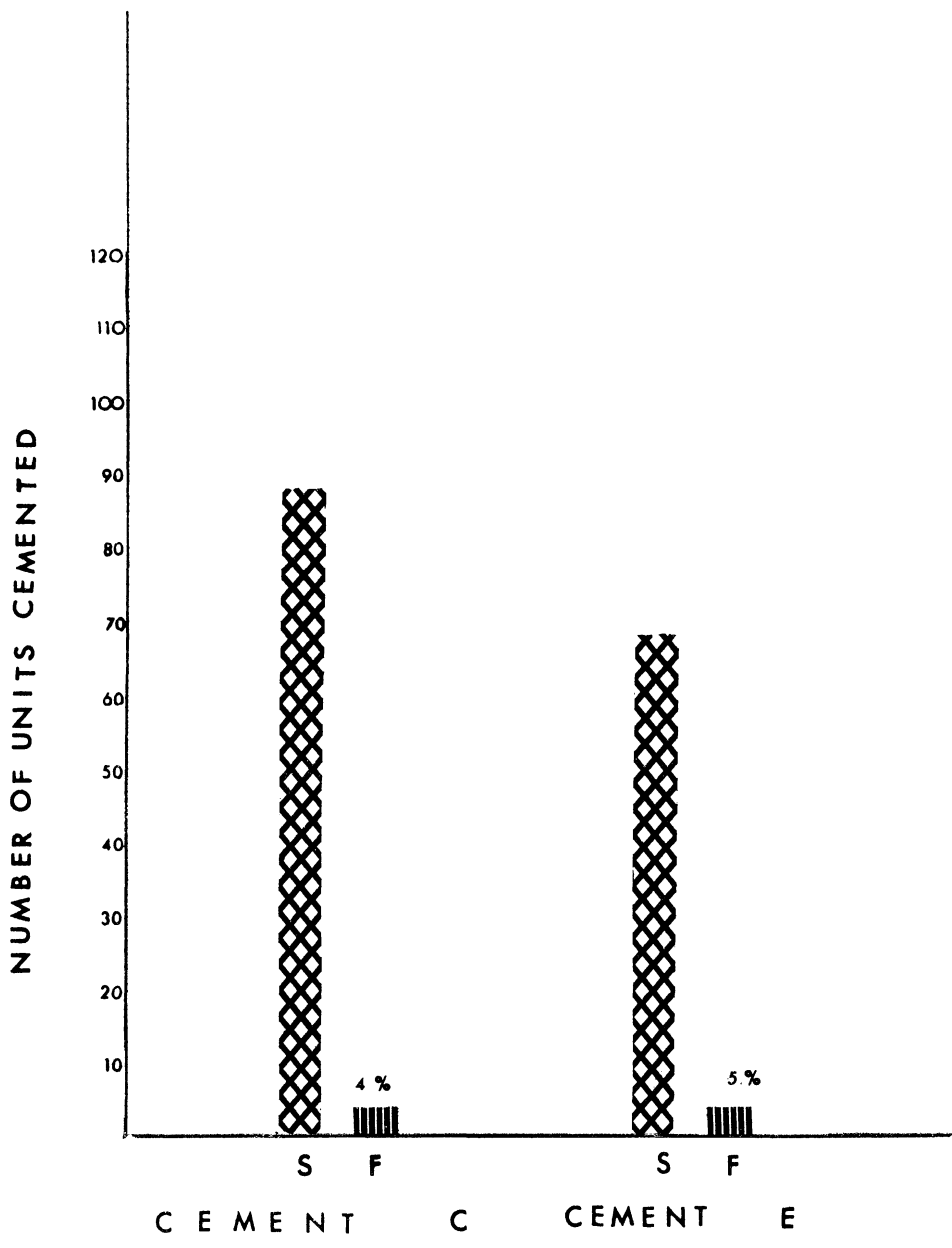
ALL ACRYLIC RESTORATIONS
SINGLE USE DATA



Graph II Retention of acrylic restorations -- single use data.




ALUMINUM CROWN FORMS
SINGLE USE DATA

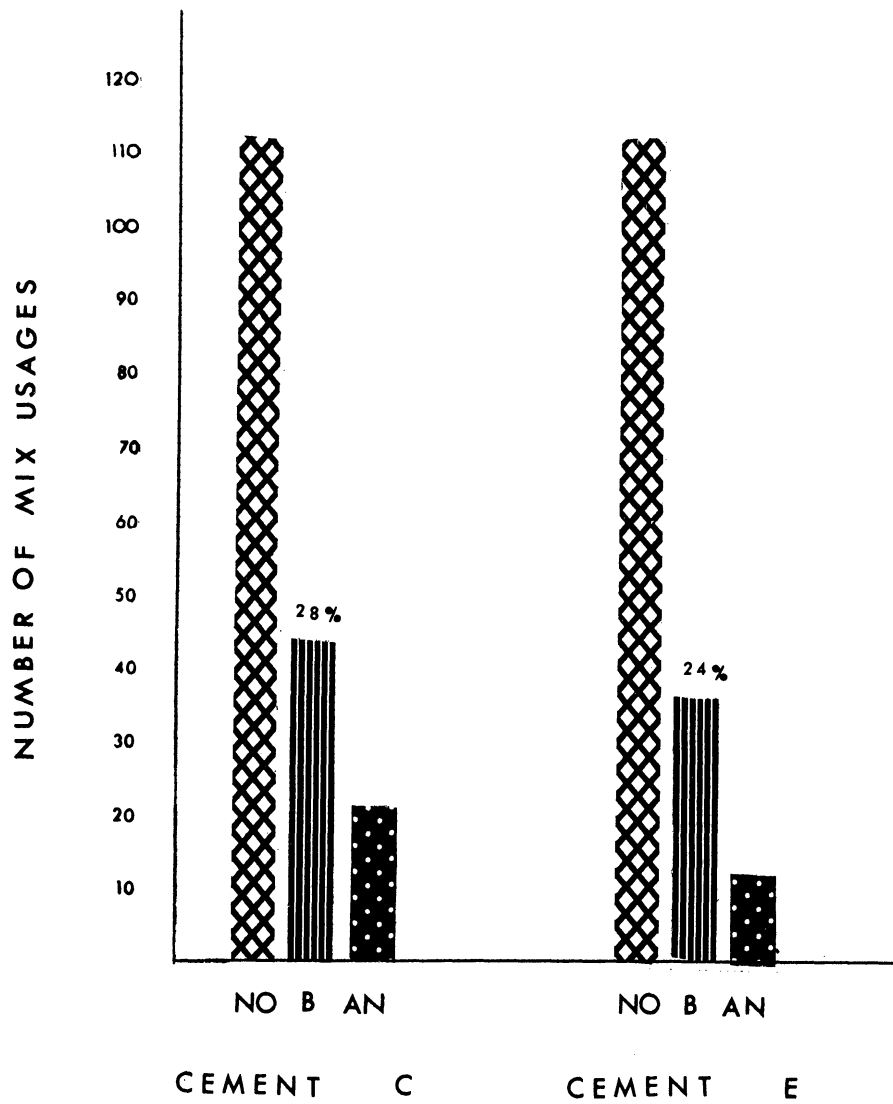
S — SUCCESS 
F — FAILURE 



Graph III Retention of aluminum crowns -- single use data.

SINGLE USE DATA

NO— DID NOT BURN 
 B — BURNED 
 AN — ANESTHETIZED 



Graph IV Burn or no burn -- single use data.

APPENDIX

METHODS OF DATA COLLECTION

Objective 1—Temporary Cementation of Temporary Restorations

Two forms were used to collect data in this portion of the study. The first was a data sheet, labelled in upper left corner 8/65 C&E, Fig. 2. One data sheet was used for each patient-operator combination. These data sheets were personally completed by the investigator obtaining the information from the patient and/or student operator.

Most items are self-explanatory on this data sheet, however, section 9 and 10 require some comment.

Section 9.—The retentive qualities of each preparation were assessed at the chairside by the investigator on the following characteristics: long or short (i.e., occluso-gingivally), parallel or tapered (i.e., with relation to axial walls), presence or absence of boxes, grooves or pins. Positive retention characteristics were recorded as checks above the horizontal line while negative retention characteristics were recorded below the line. The appropriate boxes were checked for each preparation. Four grades of retention were recognized: Grade A, all scores in upper boxes; Grade B, two scores in upper boxes; Grade C, one score in upper boxes; Grade D, no scores in upper boxes.

Section 10.—This section is divided into two halves, one labelled C for cement C-2200 and one labelled E for cement E-3500. The dates of cementation and which teeth were randomly selected for the single use data collection were notated in these sections.

The second form used was a work sheet, labelled in upper left corner 8/65(2) Cont. C,E (Fig. 3). The purpose of this work sheet was for ease of checking off factors at cementation and removal and also indicating the days the cementation was successful or how long the cementation was successful before failure.

Each wide horizontal line served as the identification of a single patient-operator combination. The first columns indicated the data sheet number to which this series of entries referred. The second column gave case assignment date, column 3 indicated the instructor on the case, column 4 the student's name and column 5 the patient's registration number.

Proceeding to the right and commencing with column 6 the wide horizontal line was divided horizontally for dichotomous data scoring. Information for cement C-2200 was scored on the upper line and for cement E-3500 on the lower. Column 6 labelled these lines.

Two main headings at the top of sections to the right of column 6 contained information regarding operator and patient reactions at cementation and at removal of the temporary restorations. The former contained four double columns and one single block. Each of the four double columns required a check mark in one or the other of the two horizontal spaces in each. These were labelled in abbreviated form as follows:

Mix

E.D. This referred to ease-E or difficulty-D of mixing the powder and liquid.

Wk.T.

In

Ad:ad Working time comments were scored here.

In

Ad-adequate or ad-inadequate working time to get the temporary restorations filled and seated to place.

Xcs

rem

E.D Removal of excess cement E-easy or D-difficult

Ts'te

No Here the unsolicited comments from the patient were scored.

Bn:bn

No

Bn-patient complained of burning. bn-patient did not voluntarily comment about burning sensation during cementation.

The block labelled "sheet fill-in" was for the investigator's convenience to assure completion of the data sheet (Fig. 2); i.e., a check on himself. Five likewise double columns appear in the At Removals section to the right. Their abbreviated headings indicated as follows:

Stayed

days

In:Out Arabic numerals were entered in one or the other of these columns. If the temporary cementation had been successful, the number of days it had succeeded were entered in the "In" space. If the cementation had failed, the number of days prior to failure were entered in the "Out" space.

Proceeding to the right, the next three double entry columns were used to indicate either E-, easy or D-, difficulty in (1) removal of the temporarily cemented temporary restorations (Tke off); (2) cleansing of dentin of the preparation, (Den Cln); and (3) cleaning the restoration for re-use if necessary (Apl Cln). The last double column indicated color change acrylic temporary restorations, either Ys=yes color change occurred or No-color change did not occur.

Objectives 2 and 3--Temporary and Final Cementation of Finished Restorations

One additional data sheet (Fig. 5), was used for the collection of information concerning both objective no. 2, the temporary cementation of finished restorations and objective no. 3, the final cementation of finished restorations. The investigator personally filled out this data sheet using the following directions as a guide.

1. Two series of chronologic numberings of data sheets were used: series 5000's for final cementations and series 3000's for temporary cementations of finished restorative dentistry: crowns, bridges and attachment-removable restorations.

2-7. Self-explanatory.

8. Space for cross-indexing of model boxes.

9. and 10. Self-explanatory, except that 10 was a record of unsolicited comment by patient.

11. The numbering of all teeth was standard clinic procedure as if facing the patient. Immediately adjoining the thirty-two, numbered $3/8" \times 3/8"$, above teeth 1 through 16, and below teeth 17 through 32, are six divided spaces, three above the horizontal line and three below it. Their purpose was to provide labeled spaces for the observer to use check marks regarding his evaluation of the retention of the cavity preparation of the abutment of this particular tooth. He checked the space either above the line or below it in all three spaces, for each prepared abutment, the key for use of which is as follows:

<u>L - Long</u>	<u>P-Parallel</u>	<u>A - Ample cavo-surface for cement available</u>
<u>S - Short</u>	<u>T- Tapered</u>	<u>M - Minimal cavo-surface for cement available</u>

Thus, diametrically opposed observations of the three situations was forced. The use of this data for retention scoring will be treated later in 12.

A. Use of the $3/8" \times 3/8"$ squares

1. If that tooth (teeth) were missing and were prosthetic members (Not abutments):

(a) Upper portion of square nearest the abutment was used to indicate the type of union with that abutment. Letters were used for this, keyed thus:

S--Soldered union, or rigid fixation to abutment or pontic

L--Loose joint, or semi-rigid union with abutment or pontic

A--Attachment, removable (Chayes-type) union with abutment or pontic.

(b) Indications of fractional space(s) of pontic(es) due to "drifting" of teeth, if having occurred, was noted in this (these) space(s). Thus reduced span lengths were apparent.

Arabic numerals for pontic mesio-distal length were used: 6-1/2 incisor or bicuspid; 7-bicuspid or incisor or 1/2 molar; 8-molar length.

(c) Other observer comments regarding unusual conditions encountered regarding the restoration were written in other, unused squares, on the arch opposing the one on which the restoration was being charted.

(2) If the tooth had been prepared as an abutment for the restoration:

(a) Upper left corner received the appropriate Roman numeral, indicating the type of preparation cut on the abutment, the key for which follows:

- I. Complete coverage restoration. Add letter J, Vc, or P to indicate Jacket, Veneer Crown, or Post Crown respectively, otherwise a cast crown is inferred.
- II. Protected cusp 3/4 crown. If cusp 3/4 crown. If cusp protection was not used, the investigator circled the Roman numeral.
- III. Protected cusp MOD restoration. If cusp protection was not used, he circled the numeral.
- IV. Pinledge (-lay) restoration. If cusp protection was not used, he circled the numeral.
- V. Two surface inlay.

(b) Lower left corner received the appropriate Arabic numeral, indicating the number of any intra-coronal pins in the preparation.

(c) Entire right half of the square was used to indicate the location of any pins used in the preparation. Each pin's location shown by a two digit Arabic numeral, the key for whose use was as follows:

1--Mesial	4--Lingual (palatal)
2--Distal	5--Occlusal (incisal)
3--Buccal (labial)	6--Cervical

Thus a two dimensional location of each pin was achieved. The first digit of the numeral was used for positions 1, 2, 3, and 4, while the second digit was used for positions 4, 5 and 6.

12. Each abutment tooth's retentive grade was arrived at thus: three checks above horizontal line gave "A" grade, i.e., Long, parallel preparation with abundant surface of cement between preparation and metal and/or porcelain; two above "B", that is, any two with one below. Only one above gave "C", and all three below gave "D". In this latter, a short, tapered abutment with minimal surface available for cement was the situation.

Further discussions of the treatment of these grades in a numerical coding follows later, page 61 at B, through B(1).

13. This same above principle applied in the grading of the occlusion, or occlusal demands on the restoration, the key for use of which boxes follows. Numerical coding of these grades appears later, page 66.

<u>HL</u>	<u>Holds Least</u>	<u>NG</u>	<u>No guidance</u>	<u>NX</u>	<u>No signs of bruxism</u>
HM	Holds most	DG	Does guide	BX	Has signs of bruxism

14. and 15. Are blank spaces for the grading of auxiliary situations. Later these were found superfluous and were unused.

The horizontal lines occupying the lower portion of the data sheet were used to date and record information on recall examination.

Data Transfer to IBM Cards

Standard, 80 column, 30 line IBM sheets were used to score each individual cementation. Thus, each piece of restorative dentistry cemented required a card. The directions for use of these columns appear in the appendix, pages 60-67.

ZINC OXIDE-EUGENOL CEMENTS
(Directions for 8/65 data sheet)

1. Two series of chronologic numberings of data sheets will be used: series 5000's for final cementations and series 3000's for temporary cementations of finished restorative dentistry: crowns, bridges and attachment-removable restorations.

2.7 Self-explanatory.

8. Space for cross-indexing of model boxes.

9. and 10. Self-explanatory, except that 10 is record of unsolicited comment by patient.

11. The numbering of all teeth is standard clinci procedure. Immediately adjoining the thirty two, numbered $3/8''$ x $3/8''$ squares, above teeth 1 through 16, and below teeth 17 through 32, are six divided spaces, three above the horizontal line and three below it. Their purpose is to provide labelled spaces for the observer to use check marks regarding his evaluation of the retention of the cavity preparation of the abutment on this particular tooth. He checks the space either above the line or below it in all three spaces, for each prepared abutment, the key for use of which is as follows:

<u>L-Long</u>	<u>P-Parallel</u>	<u>A-Ample cavo-surface for cement available</u>
S-Short	T-Tapered	M-Minimal cavo-surface for cement available

Thus, diametrically opposed observations of the three situations is forced. The use of this data for retention scoring will be treated later in 12.

A. Use of the $3/8''$ x $3/8''$ squares

1. (If that tooth (teeth) are missing and are prosthetic members (not abutments):

(a) Upper portion of square nearest the abutment is used to indicate the type of union with that abutment. Letters are used for this, keyed thus:

S--Soldered union, or rigid fixation to abutment
L--Loose joint, or semi-rigid union with abutment
A--Attachment, removable (Chayes-type) union with abutment

(b) Indications of fractional space(s) of pontic(es) due to "drifting" of teeth, if having occurred, is noted in this (these) space(s). Thus reduced span lengths will be apparent.

(c) Other observer comments regarding unusual conditions encountered regarding the restoration are to be written in other, unused squares, on the arch opposing the on which the restoration is being charted.

(d) Wavy line indicates span of fixed replacement(s). Double wavy lines indicates removable portion(s) of attachment restorations.

2. If that tooth has been prepared as an abutment for the restoration:

(a) Upper left corner receives the appropriate Roman numeral, indicating the type of preparation cut on the abutment, the key for which follows:

- I. Complete coverage restoration. Add letter J, Vc, or P to indicate Jacket, Veneer Crown or Post Crown respectively, otherwise a cast crown is inferred.
- II. Protected cusp 3/4 crown. If cusp protection is not used, circle the Roman numeral.
- III. Protected cusp MOD restoration. If cusp protection is not used, circle the numeral.
- IV. Pin-ledge(-lay) restoration.

(b) Lower left corner receives the appropriate Arabic numeral, indicating the number of any intra-coronal pins in the preparation.

(c) Entire right half of the square is used to indicate the location of any pins used in the preparation. Each pin's location shown by a two digit Arabic numeral, the key for whose use is as follows:

- | | |
|---------------------|------------------------|
| 1 - Mesial | 4 - Lingual (palatal) |
| 2 - Distal | 5 - Occlusal (incisal) |
| 3 - Buccal (labial) | 6 - Cervical |

Thus a two dimensional location of each pin is achieved. The first digit of the numeral is used for positions 1, 2, 3 and 4, while the second digit is used for positions 4, 5 and 6. (See examples and their description attached.)

12. Each abutment tooth's retentive grade is arrived at thus: Three checks above horizontal line gives "A" grade, i.e., Long, parallel preparation with abundant surface of cement between preparation and metal and/or porcelain; two above "B", that is, any two with one below. Only one above gives "C", and all three below gives "D". In this latter, a short, tapered abutment with minimal surface available for cement is the situation.

13. This same above principle applies in the grading of the occlusion, or occlusal demands of the restoration, the key for the use of which boxes follows, likewise yielding A, B, C, and D situations, as above described.

<u>HL</u>	<u>Holds Least</u>	<u>NG</u>	<u>No guidance</u>	<u>NX</u>	<u>No signs of bruxism</u>
HM	Holds most	DG	Does guide	BX	Has signs of bruxism

14. and 15. Are blank spaces for the grading of auxiliary situations later to be described.

Example 1.

ZINC OXIDE - EUGENOL CEMENTS

8/65

- 1) Sheet number 3212 2) Rest'n: Single Fixed bridge 3 Att'ch'm'nt rem'v'ble
 (No.) (No. units) (Number of units)
 3) Cement code A-1000 4) Chair number 36j 5) Pat'n's regis. No. 654321
 6) Date cemented _____ 7) Graded by T 8) Model number None
 9) Working time: 9/21/65, 19____ 10) Taste: _____
 Adequate Inadequate _____ Did NOT burn Did BURN _____

L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A			
S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M
¹ Tru pontic used										² Patient										³ very										⁴ "high-strung"											
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17																										
			A	1b	5	7	S	I																																	
			2	2b	Vc																																				
L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A			
S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M

- 12) Retention Grade A- 13) Occlusion Grade 5

V	HL	NG	NX
V	HM	DG	BX
V	V		V

 14) _____ Grade _____ 15) _____ Grade _____

Date _____ FINDINGS _____

This example is of the charting of a temporary cementation of a finished, rigid fixed bridge supplying missing tooth #28 with the use of a Tru pontic. Both ends are soldered, a veneer crown on #27, whose retentive grade is "B", the pontic and a protected cusp 3/4 crown, having mesial and distal cervical pins, on tooth #29, whose retentive grade is "A". The minor dis-similarity of the preparations' retentive grades dictates a "3" grade for the restoration.

Occlusal demands dictate a "5" grade since, while little of the occlusion is held or borne, it is guided and evidence of bruxism is present.

Example 3. ZINC OXIDE - EUGENOL CEMENTS

8/65

- 1) Sheet number 3411 2) Rest'n: Single Fixed bridge ^{Cant. 2-Bi-lat.} 8 Att'ch'm'nt rem'v'ble 6
 (No.) (No. units) (Number of units)
 3) Cement code B-200 4) Chair number 175 5) Pat'n's regis. No. 63978-D
 6) Date cemented JAN. 15, 1966 7) Graded by T 8) Model numbers 866, 867, 868
 9) Working time: Adequate Inadequate _____ Did NOT burn Did BURN _____
 10) Taste: _____
 11) RESTORATION CHART

L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A
S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M
2		3		4		5		6		7		8		9		10		11		12		13		14		15		16				
Full complement of natural teeth on maxilla, involving only minimal extrusion. BARE-ON shown: BK . Case done by GRAD STUDENT USING NEW																																
52	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17																	
B		B		7 A		BK S		I BK S		BK		BK		BK		BK S		I BK S		BK		A 7 B		B		B						
L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A	L	P	A
S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M

- 12) Retention Grade B 13) Occlusion Grade 3
- | | | |
|----|----|----|
| HL | NG | NX |
| HM | DG | BX |
| V | V | |
- 14) _____ Grade _____ 15) _____ Grade _____

Date _____ FINDINGS

articulator. Class II occlusion and slight VD opening produced horizontal and vertical over bites; Horizontal 2mm, Vertical 6mm (approx) ^{see models}
 This occurring in four incisors only; canine stops are present.

The temporary cementation of a complicated fixed and removable combination is here shown, all teeth missing on the mandible except the two canines. They each have been veneered to support a rigid fixation replacing the incisors and the two 1st bicuspids with distal cantilevers from the central span. Attachments have been placed in these two cantilevered pontics, replacing missing teeth #28 and 29, on their distals, to accommodate also a bilateral, extension, attachment-removable prosthesis, supplying teeth numbers 18, 19, 20, 29, 30 and 31.

Grading of the retention and occlusion is as has been described in previous examples.

I.B.M. FORMATI. GENERAL STATEMENT

Cards will be punched at the following stages:

1. Temporary cementation of finished restoration (one card); TF Active
2. After removal of temporary cementations (one card); TF Complete
3. Final cementation of finished restoration (one card); FF Active
4. Recall of cemented restorations (one card); TF and/or FF Active
5. Failure of cementation noticed by patient (one card); TF and/or FF Complete

II. RULES FOR SHEET SCORING

1. Unless numerically significant, zero numeral indicates no entry or information insignificant, except in Sec. M and in follow-up examinations, Sec. X, q.v.
2. Using multiple column spaces for entries, when fewer digits than supplied are needed, as in numerical numbering or dates, units space is on right and, proceeding to left, tens, hundreds and thousands spaces are used.

Note: Zero numeral use is often required.

Example:

3 in three column space is 003; NOT 030 or 300

5 in two column space is 05; NOT 50, etc.

3. ALL 56 columns are required in the original punching for each restoration.
4. Single column grades 1 thru 9 generally follow the pattern indicated below:
 - A. The lower the number the better or more favorable the situation.

The higher the number the worse or less favorable.

Examples:

(1) Section H, cols. 23, 24;

Highest psi gets 01

Lowest psi gets 09

(2) Section QR, col. 35, student and/or patient reactions, if expressed.

B. Significance of even and odd numerals in sections N and X

Four grades have been assigned the retention of individual retainers. Since experience has shown that weakly retentive retainer(s) soldered to strongly retentive retainer(s) invites failure of the cement bond on the weaker, identification of this situation and the relative retention of the restoration can be shown in column 32, (1) below.

In extremely dis-similarly vs moderately dis-similarly retentive grades, the examiner adjusts the odd grade subjectively from practical experience. To separate the findings for a single abutment retainer on the restoration versus findings for more than one abutment retainer, the even and odd principle is used in section X, column 60, (2) below:

(1) Retention grade, col. 32 (section N)

- (a) Even indicates relative acceptable similarity between or among abutment retainers' retention 2, best thru 8, worst;
- (b) Odd indicates relative dis-similarity between or among abutment retainers, 3 best thru 9 worst.

NOTE: Singles get odd numerals 3, 5, 7, 9.

(2) Follow-up findings, cols. 59, 60 et al following (Section X)

- (a) Even indicates findings on more than one abutment retainers of bridge/splint.
- (b) Odd indicates findings on only one abutment of multiple abutment bridge/splint. Also singles.

Exceptions:

- (a) 30, 50, 70 indicate best for whole restoration.
- (b) 19, 39, 79 indicate worst for whole restoration.

Section	Columns Used	Column Number	P U R P O S E																																				
A	2	1,2	Institution or operator I.D. by company; University of Michigan 01																																				
B	1	3	Examiner I.D.; University of Michigan: Dr. Myers 1, T. Gilson 2																																				
C	6	4,5,6 7,8,9	<p>Patient I.D.; University of Michigan: Patient registration number, if registered.</p> <p>The 4 column, usually containing 0, is used for bizarre situations as follows; digits 90000n and 50000n (n indicating numerical number of cases in these categories)</p> <p>9 - indicates patients with no registration number, i.e. Dr. Myers himself et al, from whom data could be collected.</p> <p>8 - indicates Dental School personnel, whose registration number contains capital letter D following the registration number.</p> <p>7 - indicates construction and cementation by a Restorative Dentistry Graduate Student.</p> <p>6 - indicates a recementation of a Temporary Cementation, either a failure or a removal of a successful cementation; also re-cementation by final cementation.</p> <p>5 - indicates use of Fixable-Removable attachments by the Ash-Scott micro-transmitter research project.</p>																																				
D	5	10,11, 12 13,14	University of Michigan student I.D.; 10, 11, 12 chair number. 13, 14 digits of his year of graduation																																				
E	2	15,16	<p>University of Michigan instructor I.D.:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">01 Dr. Myers</td> <td style="width: 50%;">10 Partial Denture Dept.</td> </tr> <tr> <td>02 Dr. Faust</td> <td>11 Dr. Russell Anderson</td> </tr> <tr> <td>03 Dr. Segat</td> <td>12 Perio. Grad. Students' reconstruction</td> </tr> <tr> <td>04 Dr. Lorey</td> <td>13 Dr. T. Gilson</td> </tr> <tr> <td>05 Dr. Maly</td> <td>14 Op. Dept. instruction</td> </tr> <tr> <td>06 Dr. Schaffer</td> <td>15 Dr. Clayton</td> </tr> <tr> <td>07 Dr. Miller</td> <td></td> </tr> <tr> <td>08 Dr. Johnson</td> <td></td> </tr> <tr> <td>09 Dr. Fusilier</td> <td></td> </tr> </table>	01 Dr. Myers	10 Partial Denture Dept.	02 Dr. Faust	11 Dr. Russell Anderson	03 Dr. Segat	12 Perio. Grad. Students' reconstruction	04 Dr. Lorey	13 Dr. T. Gilson	05 Dr. Maly	14 Op. Dept. instruction	06 Dr. Schaffer	15 Dr. Clayton	07 Dr. Miller		08 Dr. Johnson		09 Dr. Fusilier																			
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F	5	17,18, 19 20, 21	<p>Date of cementation. Numerical number of day of year.</p> <p>Year of the century</p>																																				
G	1	22	Operation I.D.: 1 Final cementation; 2 Temporary cementation																																				
H	2	23,24	<p>Cement used:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 10%;">01</td> <td style="width: 10%;">F</td> <td style="width: 30%;">9200</td> <td style="width: 50%;">99 Possible</td> </tr> <tr> <td>02</td> <td>F</td> <td>8000</td> <td></td> </tr> <tr> <td>03</td> <td>D</td> <td>5000</td> <td></td> </tr> <tr> <td>04</td> <td>E</td> <td>3000</td> <td></td> </tr> <tr> <td>05</td> <td>C</td> <td>2200</td> <td></td> </tr> <tr> <td>06</td> <td>A</td> <td>1000</td> <td></td> </tr> <tr> <td>07</td> <td>G</td> <td>600</td> <td></td> </tr> <tr> <td>08</td> <td>G</td> <td>400</td> <td></td> </tr> <tr> <td>09</td> <td>B</td> <td>200</td> <td></td> </tr> </table>	01	F	9200	99 Possible	02	F	8000		03	D	5000		04	E	3000		05	C	2200		06	A	1000		07	G	600		08	G	400		09	B	200	
01	F	9200	99 Possible																																				
02	F	8000																																					
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06	A	1000																																					
07	G	600																																					
08	G	400																																					
09	B	200																																					
I	2	25,26	Numerical number of units of restoration 01 thru 16																																				

Section	Columns Used	Column Number	P U R P O S E
J	2	27,28	Numerical number of abutment retainers cemented 1 thru 16
K	1	29	Numerical number of spans (separate edentulous areas replaced by the restoration) 0 thru 9
L	1	30	Number of units of pontics in longest span
M	1	31	Type of fixation: 0 Single retainer restoration 1 Rigid restoration of one retainer or more with pontic(es) 2 Semi-rigid restoration 3 Cantilever restoration 4 Removable attachment restoration 5 Fixable-removable att. "
N	1	32	Retention grade (see explanation p. 6)
O	1	33	Arch location index (see explanation p. 6)
P	1	34	Occlusal function grade (see explanation p. 7)
QR	1	35	Student and/or patient reaction, if expressed: 0 No comment 1 Likes 2 Dislikes 3 Resents study
S	2	36,37	<u>Days</u> cement expected to retain restoration (TFs) only <u>Temporary</u> cementation of finished dentistry, <u>Complete</u> .
T	2	38,39	<u>Months</u> cement expected to retain restoration (TFs) only Temporary cementation of finished dentistry, <u>Complete</u> .
S ₁ T ₁	4	36,37, 38,39	Temporary cementations of finished dentistry <u>Active</u> (i.e. still in the mouth for long periods) have data sheets and punch-cards numbered in these columns thus, 3001, 3002, etc. Final cementations of finished dentistry (FFs), i.e. those cases being periodically examined have data sheets and punch-cards numbered in these columns thus, 0001, 0002, etc.
U	1	40	Arch I.D.: 1 Maxillary, 2 Mandibular
V	16	41 thru 56	Individual tooth I.D. 41 Right third molar thru 48 Right central incisor; 49 Left central incisor thru 56 Left third molar (see explanation p. 8).
W	2	57,58	Number of <u>days</u> following cementation that examination of restoration's condition is done
X	2	59,60	Follow-up findings: 59 column 1 Patient discovered 3 Examiner finding in temporary cementations expected to remain in place 5 Ditto for Final cementations 7 Findings at removal of Temporary cementations which are successful (continued next page)

Section	Columns Used	Column Number	P U R P O S E
X	2	59,60	Follow-up findings (continued) Examples: 59 60 columns 30 50 All firm, margins, tight; success 31 51 Examiner suspicious of retainer 32 52 Examiner suspicious of retainers 13 33 53 Retainer tight, marginal leaks 14 34 54 Marginal leaks, plural retainers 15 35 55 Retainer loose (no caries) 16 36 56 Retainers loose (no caries) 17 37 57 Retainer loose, caries beneath 18 38 58 Retainers loose, caries beneath 19 39 59 Restoration dislodged from abutments into mouth 70 Removes easily, cleans easily 71 Removes easily, abutment cleans hard 72 Removes easily, abutments clean hard 73 One retainer off hard, easy clean 74 Plural retainers off hard, easy clean 75 One retainer off hard, cleans hard 76 Plural retainers off hard, clean hard 77 One retainer impossible removal 78 Plural retainers impossible removal 79 Remake of appliance due to ruin in removal attempts
Y	2	61,62	Number of <u>months</u> following cementation that examination findings are recorded
Z	2	63,64	Findings as done columns 59, 60
YZ ₂	4	65-68	Ditto Y, Z
YZ ₃	4	69-72	Ditto Y, Z
YZ ₄	4	73-76	Ditto
YZ ₅	4	77-80	Ditto

Second card to be carried on using 4 column format follow-up allows for five examinations recording commencing with Section Y.

Explanatory Notes

N 1 31

Retenth grade
Use odd numeral if
dis-similarity among
or between abutments
retention.

Similar

Dis-similar

2

3

x	x	x
L	P	A
S	T	M

Use even numeral if
similarity is close
among abutment
retention.

4

5

x	x	
L	P	A
S	T	M

or

x		x
L	P	A
S	T	M

or

	x	x
L	P	A
S	T	M

Key

- L Long
- S Short
- P Parallel
- T Tapered
- A Ample #
- M Minimal #

Surface for
cement to
bond restoration

6

7

x		
L	P	A
S	T	M

or

	x	
L	P	A
S	T	M

or

		x
L	P	A
S	T	M

8

9

L	P	A
S	T	M

0 1 33

Arch location index.

- 1 Bilateral bridge/splint, posterior to posterior
- 2 Bilateral bridge/splint, posterior to canine
- 3 Bilateral bridge/splint, posterior to lateral
- 4 Bilateral bridge/splint, posterior to central
- 5 Unilateral bridge/splint, posterior to central
- 6 Anterior bridge/splint, canine to canine
either unilateral canine to incisor
or bilateral incisor to incisor
single incisor restoration
- 7 Unilateral bridge/splint, posterior to lateral
- 8 Unilateral bridge/splint, posterior to posterior
(no canine involved)
single posterior restoration
- 9 Unilateral bridge/splint, canine to posterior
single canine restoration

Explanatory Notes

P 1 34 Grade of occlusal function

<p><u>Key</u></p> <p>HL restoration <u>holds least</u> of occlusion</p> <p>HM restoration <u>holds most</u> of occlusion</p> <p>NG <u>no occlusal guidance</u> by restoration</p> <p>DG restoration <u>does guide</u> the occlusion</p> <p>NX <u>no clinical evidence</u> of afunctional attrition (<u>bruxism</u>)</p> <p>BX <u>bruxism</u> evident clinically</p>	1	<table border="1"> <tbody> <tr><td>x</td><td>x</td><td>x</td></tr> <tr><td>HL</td><td>NG</td><td>NX</td></tr> <tr><td>HM</td><td>DG</td><td>BX</td></tr> </tbody> </table>	x	x	x	HL	NG	NX	HM	DG	BX			
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HL	NG	NX												
HM	DG	BX												
x	x	x												

Explanatory Notes

V	16	41 thru 56	1 Complete coverage restoration 2 Protected Cusp 3/4 crown 3 Protected Cusp MOD 4 Pinlay 5 Two surface inlay 6 1/2 bicuspid/incisor size pontic 7 Whole bicuspid/incisor size pontic(1/2 molar) 8 Molar size pontic 9 Non-hooded cusp in occlusion inviting push-out by occlusal force
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ZINC OXIDE-EUGENOL CEMENTS
"C" and "E"
TEMPORARY CEMENTATION OF TEMPORARY DENTISTRY

TO: Mr. _____

FROM: Department of Crown and Bridge Prosthesis

Assignment was made on _____, 196____, of a patient, registration number _____, for crown or bridge prosthesis with your instructor, Dr. _____.

1. After the preparation(s) have been checked by your instructor, please cement the temporary restorations at least once with temporary cement "C" and once with temporary cement "E", noting the date and which cement was used on the Treatment Record. If pin-holes have been prepared, grease the pin-holes only with vaseline prior to temporary cementation.
2. The cement powders are located in individually labeled drawers in a dental cabinet outside the south-east corner of the "cage". Take one vial for each temporary restoration to be cemented. Please remove a dropper-bottle of liquid from the top rear compartment of this cabinet to keep in your cubicle thereafter. Always replace the cap on the nozzle of the dropper after use.
3. On one end of a parchment-paper slab, sharply tap out entire contents of particular powder vial(s) to be used. Remove small cap from the dropper nozzle, up-end the liquid bottle vertically and, squeezing the white soft polyethylene section, carefully dispense thirteen (13) drops per vial of the powder and mix as follows:
4. Using a heavy spatula, incorporate all of the powder and liquid together at once, applying pressure, thus forcing complete wetting of the powder before spatulation is commenced. Complete the mix in 30 to 45 seconds (approx.). Quickly fill the restoration(s) and place on tooth (teeth).
5. Please furnish either rubber base impression or working model and opposing model to investigator if available at final cementation.

Figure 1. Directions to students, cements C-2200 and E-3500.

ZINC OXIDE-EUGENOL CEMENTS
Cementation of Finished Restorations

I. TEMPORARY CEMENTATION BY SPECIAL ASSIGNMENT

1. If assignment of any of the following is made:

"A"	1000	These are supplied in two-tube combinations
"B"	200	of pastes, one being the base and the other
"G"	400	the catalyst.

Take a parchment-paper slab to the cabinet outside the south-east corner of the cage. Using a freshly exposed top sheet of the slab, extrude equal lengths of each component of the assigned cement, using roughly 3/4 inch of each for each retainer to be cemented. Spatulate the components together thoroughly for 30 to 45 seconds. Fill the restorations with cement and place on teeth. If pin-holes are present, lubricate them with vaseline prior to cementation.

2. If assignment of the following cement is made:

"G" 600

Dispense pastes from "G" tubes using the following proportions:

1 inch Component C

1 1/2 inch Component B

3. If assignment of "C" cement is made, follow instructions for Temporary Cementation of Temporary Dentistry, 1/66 TT. Remember the working time with this cement is only 2 1/2 to 3 1/2 minutes AND to grease pin-holes with vaseline if pins are part of a retainer.

II. FINAL CEMENTATION BY SPECIAL ASSIGNMENT ONLY

FF

1. Cement "F" 8000 will be assigned in special instances when the patient is available for periodic, follow-up examination through August 1967.
2. Alter procedures for powder-liquid combinations previously described only as follows, working time being 5 to 7 minutes:
Use one vial of powder to sixteen (16) drops of liquid for each retainer to be cemented.
3. Proceed as per instructions for other powder-liquid cements described on 1/66 TT, however, DO NOT GREASE PIN-HOLES.

Figure 4. Directions to students, temporary and final cementations of restorations.

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