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Aim and Scope

Operative Dentistry publishes articles that advance the practice of operative dentistry. The scope of the journal includes conservation and restoration of teeth; the scientific foundation of operative dental therapy; dental materials; dental education; and the social, political, and economic aspects of dental practice. Review papers and letters also are published.

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EDITORIAL

Craftsmanship Is Important

In a discussion of the need for an increased supply of engineers that are truly inventive and creative, Thring (1965) describes the educational qualifications that he believes such engineers should acquire. Building on the two cultures of C P Snow, that is, literacy and numeracy, Thring adds a third—trained skill with the hands, or craftsmanship. He asserts that properly trained engineers should be able to understand and use the concepts of pure science and mathematics, understand the emotional aspects of human relations including verbal and written communication of difficult ideas to laymen, and should possess the manual skill of the craftsman and experimentalist. Thring goes on to say that the happy man is the man who has attained the highest development in all three cultures. The idea that the man who works purely with his intellect is better than the man who works with both his head and his hands is dangerous nonsense, Thring claims, because the imbalance can lead to nervous breakdowns and other unfortunate consequences.

How like the situation of the engineer is that of the dentist. He too must develop a scientific and humanistic background along with manual dexterity of high precision. Recent concepts of dental education tend to minimize the importance of manual skills and as a result the curriculum now allows less time for the development of craftsmanship.

Those who practice dentistry are aware of the essential part that fine craftsmanship plays in the restoration of teeth afflicted with dental disease. The longevity and success of the treatment depends greatly on the seal of the joint between the restorative material and the cavity walls and on the proper contour of the restoration. Neither of these requirements is easy to fulfill and both require of the dentist manual skill of high quality. Most of us know the frustration of finding recurrent caries around margins that were not adequately sealed and of making crowns that were not quite the right shade, to name only two possible disappointments. For unskilled operators the trauma must be substantial and as Professor Thring has suggested may lead to nervous breakdown. The suicide rate of dentists is extraordinarily high. Better training in craftsmanship to provide a balanced education might have a salutary effect on the health of the dentist; it would surely benefit the patient.

A. IAN HAMILTON

THRING, M W (1965) Mankind and machines. *Nature,* **205,** 1149-1153.

 OPERATIVE DENTISTRY, 1977, 2, 90-96.

ORIGINAL ARTICLES

Root Fracture as a Complication of Post Design and Insertion: A Laboratory Study

Threaded posts that screw into the root canal provide retentive foundations for crowns and if used with care where indicated are not likely to fracture roots unless unnecessarily excessive torque is applied

EDUARDO CALDERON DURNEY • HARRY ROSEN

Summary

The torque required to insert Dentatus posts ranged from 4 to 6 ozf in (0.028–0.042 N m). The torque required to cut threads with Kurer taps ranged from 10 to 12 ozf in (0.07–0.84 N m) if the tap was not cleaned periodically during tapping and from 4 to 8 ozf in (0.028–0.056 N m) if it was. The least torque required to fracture a root with a Dentatus post was 22 ozf in (0.154 N m) and at a torque of 30 ozf in (0.21 N m) only 8.33% of the roots fractured. Before this torque was reached some of the posts fractured or stripped threads. No roots were fractured when the torque on the Kurer tap was raised to 30 ozf in (0.21 N m) though some taps were broken and some threads stripped before this torque was reached. Thus the torque required to fracture roots with either technique was substantially greater than that required to seat posts or to tap threads.

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Reprint requests to Dr Rosen

From a thesis for an MSc degree. Further details may be obtained from the author.

INTRODUCTION

Traditional teaching dictates that an endodontically treated tooth with a mutilated crown must be reinforced with either an intracoronal crutch or extracoronal brace, or both, to become a useful member of the masticatory system. The crutch is a post that extends into the prepared root canal and is continuous with the coronal portion or core. The major function of the post is to enhance retention. The base is a crown that grips the perimeter of the root and thereby protects it from fracture. Traditionally the ideal reinforcement has been a cast gold post and core that is designed with the proper length and shape to prevent fracture of the root (Rosen, 1961).

An alternate method of constructing foundations for mutilated teeth that have been treated endodontically is to use a core of amalgam or composite resin that is retained by a prefabricated endodontic post (Baraban, 1972), rather than by pins as used in vital teeth (Markley, 1958). Prefabricated posts can be used in more conservatively prepared root canals than can cast gold posts and are more retentive (Moffa, Razzano & Doyle, 1969); prefabricated posts also require less time and cost less.

One system of prefabricated post is a threaded post that obtains its retention by being screwed into the root. There is some controversy about the use of these posts because of the alleged danger of inducing root fracture, a danger that has never been substantiated experimentally.

The aim of this project was to determine the torque required to insert threaded posts and compare it with that required to fracture the root.

MATERIALS

Two systems of threaded post are available.

1. Self-threading posts
   Dentatus (Weil Dental Supplies, Toronto, Canada)
   F.K.G. (Union Broach Co., Long Island City, NY 11101, USA)
   Anthogyr (Mo-Dent Ltd., Montreal, Canada)
2. Posts requiring a tap for the threads
   Kurer Crown Saver (39 Dearsgate, Manchester, England)

Selection of Posts

• DENTATUS system of posts is versatile. The posts are made of flexible brass-like alloy and are supplied in six diameters (1.05–1.80 mm) and four lengths (7.8–14.2 mm), providing a total of 20 different sizes. To facilitate final fit, the root canal may be reamed to the exact size of the appropriate post with a corresponding reamer (Fig. 1). Two keys for insertion of the posts are provided, one in the form of a wrench and the other in the form of a cross screwdriver that is used for cavities with narrow access.

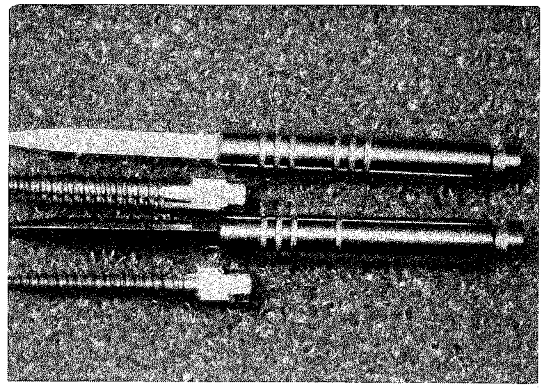

FIG. 1. Dentatus posts Nos. 13 and 15 with corresponding reamers.

• F.K.G. SCREW POST system is very similar to the Dentatus system. The two basic differences between them are:

1. F.K.G. posts are made of stainless steel and therefore are much harder and possess greater tensile and shear strength.
2. F.K.G. posts are supplied in ten different lengths (6.5–15 mm), but in only one diameter.

Peeso reamers (Union Broach Co., Long Island City, NY 11101, USA) are used to prepare the root canals for the posts, the No. 3 Peeso reamer providing the exact diameter (Fig. 2). Like the Dentatus, the F.K.G. system has two keys for inserting the posts, a cross screwdriver, and a wrench.

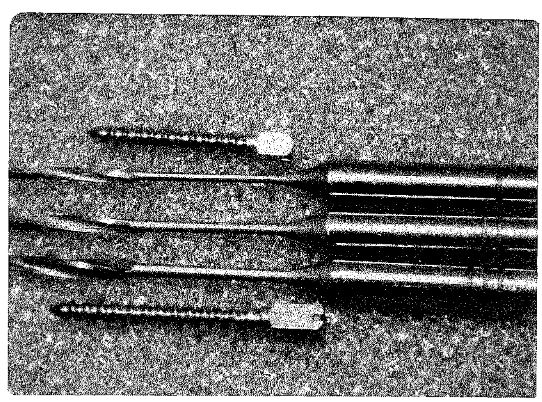

FIG. 2. FKG posts and Peeso reamers. No. 3 reamer matches the diameter of the post.

• ANTHOGYR SCREW POST system is made of stainless steel and is similar to the two previously mentioned systems. The posts are supplied in four diameters (0.9–1.5 mm) and nine lengths (6–13 mm). The inconvenience of this system is that no matched reamer is provided and thus the preparation of the root canal for the post is uncertain (Fig. 3).

• KURER CROWN SAVER system is similar to the Kurer anchorage system but no head is provided. It is suitable for use with composite resins or any other core material.

The following instruments are included in the kit:

1. An engine reamer used to finalize the preparation of the root canal.
2. A tap, matching the reamer, used to cut the threads in the prepared root canal.
3. A driver used to screw the posts to place.

Crown Savers are available in two sizes only, small (diameter 1.45 mm) and universal (diameter 1.65 mm). However, if other sizes are required, the brass head can be removed from the conventional Kurer anchorage posts to provide the screw post alone (Fig. 4).

Preliminary experiments showed that the Dentatus and the Kurer were the only systems that demonstrated consistency in diameter, therefore they were selected for this study and the others eliminated.

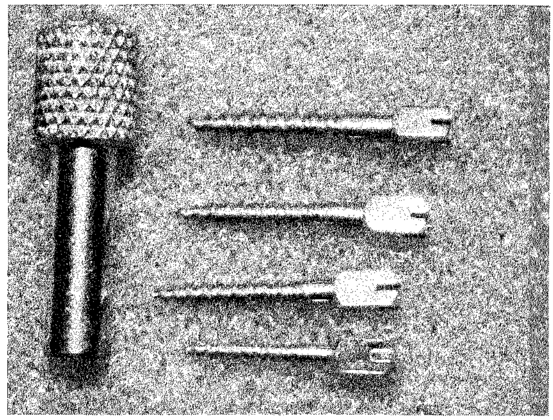

FIG. 3. Anthogyr post and wrench

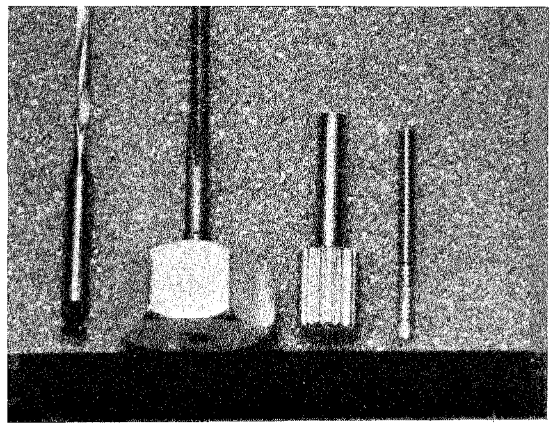

FIG. 4. Kurer crown-saver system including reamer, tap, wrench, and post

METHODS

The study was divided into three sections: (1) measuring the torque required to seat Dentatus posts, (2) measuring the torque required to tap threads into a root canal to receive the Kurer post, (3) determining, for each system, the torque required to crack the tooth.

Measuring Torque Required to Seat Dentatus Posts

A sample of 60 extracted teeth, which had been stored in saline solution from the time of extraction until the beginning of the experiment, was used. The teeth comprised lower central incisors, lower lateral incisors, and upper lateral incisors. Narrow teeth were deliberately selected as they are more prone to fracture. The crowns were severed and the pulps removed. The teeth were then dried with gauze and a gentle blast of air. A thin layer of silicone impression material, Xantopren Blue (Unitek Corp., Monrovia, CA 91016, USA), was applied to each root with a brush while the tooth was held with a reamer inserted in the root canal. The purpose of this coating was to simulate the elasticity of the periodontal ligament when the teeth were subsequently embedded in a stone puck (Fig. 5). Four samples of nine teeth, and two samples of 12 teeth were prepared in this manner. Each tooth, except for 1.5 mm, was immersed in stone. The stone was permitted to set in a humidor, and later stored in a plastic container with water. Three posts of each size were used in the experiment.

With the pucks retained in a vise, the root canals of the teeth first were enlarged with Gates Gliden drills (Union Broach Co., Long Island City, NY 11101, USA) and then ultimately prepared with the corresponding reamers to receive the respective posts.

A torque wrench (Torque Control, Inc., Orangeburg, SC 29115, USA) ranging in force from 0 to 100 ounce inches (ozf in) = 0 to 0.7 Newton meters (N m) was used to measure the torque needed to seat each screw post (Fig. 6). This wrench is capable of increasing the torque in increments of 2 ozf in (0.014 N m). The wrench was set at 2 ozf in (0.014 N m) initially for screwing each post into its corresponding preparation in the root canal. The torque was increased by increments of 2 ozf in (0.014 N m) as necessary until each post was fully seated.

Measuring Torque Required to Tap Threads into Root Canals

The 20 teeth used in this experiment were prepared in the same fashion as described in part 1. Two methods of tapping were employed, each with a sample of 10 teeth.

1. The tap was inserted into the root canal with a drop of water as lubricant. The torque wrench was set at 2 ozf in (0.014 N m) to begin and given two turns forward and one backward. Each time more torque was needed it was increased in amounts of 2 ozf in (0.014 N m). The procedure was repeated until the thread was cut into the whole length of the prepared root canal. The torque needed was recorded for each tooth.

2. The threads were cut into the root canals of the prepared teeth as before except that after two turns forward the tap was removed and the debris of dentine cleaned from the tap flutes. The root canals were also cleaned with a spray of water before continuing the tapping of the thread. The torque needed to cut the threads into the total length of the root canal was recorded for each tooth.

FIG. 5. Stone puck with ten teeth ready for torque tests

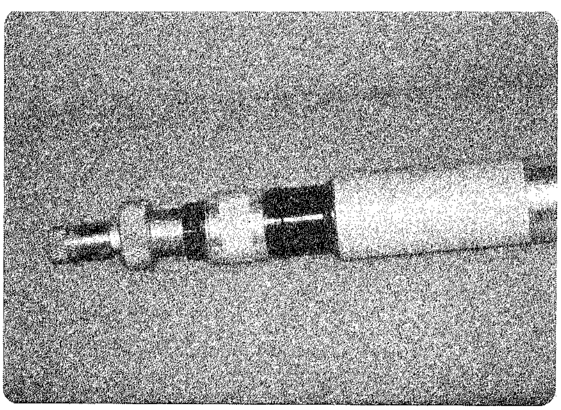

FIG. 6. Precision torque wrench used in experiments

Measuring Torque Required to Fracture Root

Extra long Dentatus posts (No. 15) were selected for this study as they approximated the size of the smaller Kurer Crown Saver post. Both are suitable for upper lateral incisors and 60 such teeth were used for each type of post. The samples were prepared as in the two experiments previously described. After the Dentatus post and the Kurer tap had been fully seated, the torque was increased by increments of 2 ozf in (0.014 N m) until a torque of 30 ozf in (0.21 N m) was reached in an attempt to provoke a fracture of the root.

RESULTS

Torque Required to Seat Dentatus Posts

The results of the experiment to determine the torque required to seat Dentatus posts are summarized in Table 1.

As expected, the torque required to seat the Dentatus posts increased as the diameter of the posts increased. On the other hand, the length of the posts had no influence on the torque.

Torque Required to Tap Threads into Root Canals

The results of the tests to measure the torque required to cut threads in root canals with the Kurer tap are summarized in Table 2.

The method of tapping had a definite influence on the torque required to cut threads in

Table 1. *Torque Required to Seat Dentatus Posts*

Size of Posts No.	Number of teeth	Torque ozf in Mean	Torque ozf in SD	Torque N m Mean	Torque N m SD
18	9	2	0	0.014	0
17	9	2.44	0.88	0.018	0.006
16	9	3.33	1	0.02	0.007
15	12	3.83	0.577	0.03	0.004
14	9	3.78	0.667	0.03	0.005
13	12	3.83	1.337	0.03	0.009

Table 2. *Torque Required to Cut Threads in Lower Canines with Kurer Tap*
(Large Diameter = 1.85 mm)

Method of Tapping	Number of teeth	Length of tap	Torque ozf in Mean	Torque ozf in SD	Torque N m Mean	Torque N m SD
Without Cleaning	10	10	11.2	1.033	0.078	0.007
With Cleaning	10	10	6.2	1.135	0.043	0.008

Table 3. *Torque Required to Fracture Roots with Dentatus Posts*

Type of Failure	Proportion N = 60 %	Torque ozf in Mean	Torque ozf in SD	Torque N m Mean	Torque N m SD
Fracture of root	8.33	26.0	3.049	0.182	0.021
Fracture of post	60.00	26.0	2.309	0.182	0.016
Stripped Threads	16.67	20.8	6.546	0.146	0.046
Removal of tooth	5.00	24.6	1.157	0.172	0.008
No failure	10.00	30.0	0	0.21	0

the root canal. When the tap was removed to clean the dentine debris from the tap flutes, less torque was required to cut the threads, 6.2 ozf in (0.043 N m) compared with 11.2 ozf in (0.078 N m) when the tap was not removed for cleaning. This confirms the findings of Standlee & *others* (1972) who, using the photoelastic method of analyzing stress, observed high stresses, cracking of the specimens, and fracture of the taps if they were not removed and cleaned after two turns.

Torque Required to Fracture Root

The results of the test to determine the torque required to fracture roots when inserting Dentatus posts are summarized in Table 3.

Five roots fractured at slightly under the maximum torque, 10 roots withstood the maximum torque, and the remainder failed because the post fractured, the threads were stripped, or the root was dislodged from the stone. The torque required to fracture the roots was almost seven times that required to seat the posts and the torque required to strip the threads was five times greater.

Torque Required to Fracture Roots with Kurer Tap

The results of the experiment to determine the torque required to fracture roots when cutting threads in the root canals with the Kurer tap are summarized in Table 4.

No roots were fractured up to a torque of 30 ozf in (0.21 N m) despite the lack of precautions to avoid fracture; however, the tap failed in four instances by either fracture or twisting and eight roots were dislodged from the stone before the maximum torque was reached. This contradicts the results of Standlee & *others* (1972) who found high stresses and cracking of the specimens as well as fracture of the tap if it was not withdrawn for cleaning, but their specimens may not have had the physical properties of dentine.

DISCUSSION

Failures with the Dentatus posts are due to overmanipulation. To avoid such overmanipulation in clinical use the manufacturer should provide a suitable torque wrench with a maximum torque of 5 ozf in (0.035 N m) to insert the posts. Dentists should also be instructed to turn posts slowly and delicately without leverage and when they bind to enlarge the post hole by reintroducing the reamer or drill.

The torque required to insert a post results from the reaction of the tooth to the bearing pressures induced by insertion of the post. Part of this reaction is caused by friction.

The basic difference between the two systems in the manner of engaging the walls of the root canal is that the Kurer involves cutting a thread with a tap, which removes dentine debris. The technique of thread tapping is regarded technologically as a safe method. The Dentatus post is tapered and consequently it forces the tooth to expand as the post moves apically.

Table 4. *Torque Required to Fracture Roots with Kurer Tap*

Type of Failure	Proportion N = 60 %	Torque ozf in Mean	Torque ozf in SD	Torque N m Mean	Torque N m SD
Removal of tooth	13.33	27.0	1.069	0.189	0.008
Failure of tap	6.67	27.5	3	0.193	0.021
No failure	80.00	30	0	0.21	0

The amount of expansion will depend on:

- the shape of the post
- the shape of the thread
- the difference between the diameter of the reamed canal and the maximum and minimum diameter of the threads
- the depth of engagement of the post and the torque applied
- the physical characteristics of dentine

The Kurer method uses a tap, designed to cut threads efficiently. With this method, the accumulation of debris is minimal, most of it escaping through the two grooves of the tap, resulting in relatively little expansion after the thread is formed.

In the Kurer system, the tapping procedure is critical in minimizing the hazards of root fracture. The tap should be withdrawn and cleaned as soon as resistance to further tapping is encountered.

Relatively few roots fractured during this experiment. However, it could be argued that endodontically treated teeth might be more brittle than the extracted teeth used for this study. The literature does not support this view (Stanford & *others,* 1960), but the literature on the subject is sparse.

Further studies of the stresses developed in roots by the insertion of screw posts is required. It is especially important to learn if microfractures are formed in the dentin.

CONCLUSIONS

- Both types of screw post are relatively safe. Root fracture with the Dentatus post occurred only after overmanipulation by applying excessive torque (26 ozf in or 0.182 N m). The torque required to seat the post averaged 3.26 ozf in (0.023 N m). A probability of stripping threads occurred at 15 ozf in (0.105 N m).
- The Kurer system appears to be the safer method, because no root fracture occurred in an experiment that was designed to create root fracture. However, more torque was required initially with the Kurer system than with the Dentatus.
- The Dentatus post may be improved by changing the material of the post to, for example, stainless steel. This will reduce the probability of the threads failing. However, failure of the threads may decrease the incidence of root fracture.
- Tapping the threads for the Kurer post may be improved by withdrawing the tap every second turn to remove the debris.
- The dentist must determine for each case whether the additional retention justifies the risk.

The results of this study suggest that screw posts have a place in the restoration of endodontically treated teeth. The techniques are simple and relatively safe as long as they are understood and correctly performed.

These conclusions are drawn from a laboratory study, thus caution is recommended in the choice of screw posts for situations where they are least likely to result in a failure. They should be used only for canals that are narrow and not too tapering. Such canals should be round or almost round in cross section. The remaining root dentin should be thick and a well-designed crown restoration should brace the root.

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Proportioning and Mixing of Cements: A Comparison of Working Times

Powder/liquid ratios and mixing times of cements should be measured and standardized to ensure adequate working time and acceptable film thickness

WILMER B EAMES • SCOTT D MONROE • JOHN D ROAN, JR • SANDRA JEAN O'NEAL

Summary

Several commercially available cements were investigated to determine their clinical working times based on a correlation with film thickness. A modified technique of ADA Specification No. 8 for film thickness (25 μm) of Type I fine grain cements was used as the criterion.

Both zinc phosphate cements and one polycarboxylate cement had working times of 4 minutes when mixed at clinically determined powder/liquid ratios; but when some manufacturers' ratios were used, they were not acceptable.

For all cements tested, higher powder/liquid ratios resulted in shorter working times.

Zinc phosphate cements mixed for 3 minutes resulted in shorter working times, and it is suggested that 1.5-minute mixing times are more acceptable.

At mouth temperature (37 °C) Fleck's zinc phosphate and Durelon cements both exhibited maximum working times only one minute less than at room temperature (23 °C).

A simple method of reliably proportioning optimum ratios of powders and liquids is described.

Suggestions are made for mixing times, and their importance in obtaining the best results is shown.

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INTRODUCTION

Adequate working time of cement is necessary, clinically, to ensure complete seating of a dental casting. However, the proportioning and mixing of zinc phosphate cement is almost universally an empirical technique. Lengthening or shortening the working time of cement has been arbitrarily governed by altering the powder/liquid ratio or the mixing time and cooling the mixing slab (Friend, 1969; Phillips, 1973). It has been commonly believed, and taught by some, that longer mixing times, of three minutes or more, result in longer working times and that higher strengths are obtained because, in theory, more powder can be incorporated by dissipating the heat.

This study attempts to determine the safe clinical time that the dentist has to mix the cement, load the casting, and seat it in the mouth. The study deals with the determination of an exact powder/liquid ratio, based on optimum film thickness, that will be acceptable to the dentist. A clinical assessment of the variables that affect the working times of several cements is also provided.

MATERIALS

The cements used in this study are listed in Table 1. They are all commercially available. The EBA zinc oxide and eugenol cements, which generally exhibit longer working times, were not included in this study because working time is not critical with these cements.

METHODS

Powder/liquid ratios and mixing times were the considered variables. Manufacturers' recommended ratios of powder to liquid for cementation were employed as well as arbitrary ratios in subjectively acceptable mixes made by dentists, assistants, and dental faculty. These arbitrary ratios are called 'clinical' ratios.

Clinical Aspects

In the first phase of the study, only zinc phosphate cements were included, because this cement has been used by most dentists for the longest time; and because of their long experience with zinc phosphate cement, most dentists are comfortable using it.

Table 1. *Cements Tested*

Cement	Manufacturer
1. ZINC PHOSPHATE	
Fleck's Extraordinary	Mizzy Inc., Clifton Forge, VA 24422, USA
S S White Zinc Cement Improved	S S White Dental Products Philadelphia, PA 19102, USA
2. POLYCARBOXYLATE	
Durelon	Premier Dental Products Co. Norristown, PA 19401, USA
Zopac	The Lorvic Corp. St Louis, MO 63134, USA
PCA	S S White Dental Products Philadelphia, PA 19102, USA
Poly-C	Claudius Ash, Inc. Niagara Falls, NY 14304, USA
3. SILICO-PHOSPHATE	
Fluoro-Thin	S S White Dental Products Philadelphia, PA 19102, USA

Table 2. *Average Values for Arbitrary Mixes of Zinc Phosphate Cement*

	Powder/liquid ratio g/ml	Mixing time s	Film thickness μm
Practicing Dentists (8)	2.57 ± 0.29	82 ± 19.0	27 ± 2.6
Dental Assistants (10)	2.70 ± 0.52	68 ± 25.0	33 ± 10.2
Dental Instructors (14)	2.11 ± 0.31	95 ± 16.0	22 ± 1.7

Preweighed packets of powder were given to 14 faculty members, 8 practicing dentists, and 10 dental assistants. The participants were asked to mix the cement to their normal luting consistency, using whatever proportions of powder and liquid they chose. The remaining unused powder was collected and weighed, this weight being used to calculate their preferred powder/liquid ratio.

Laboratory Comparison of Clinical and Recommended Techniques

Several empirical mixing times have been suggested for zinc phosphate cements and polycarboxylates; therefore, powder/liquid ratios and mixing times were both varied. These are shown in Table 2.

When polycarboxylates were first introduced, manufacturers tended to recommend powder/liquid ratios that were too high, and many dentists found the consistency unsatisfactory. The 'clinical' ratios shown in Table 2 are those we found in our laboratory tests repeatedly to produce acceptable film thicknesses in a mixing time of 30 seconds. One manufacturer apparently erred in recommending a 3:1 powder to liquid ratio, but even reducing the powder by 33% did not provide cement thin enough for clinical use.

It was felt that the mixing time of polycarboxylate cements could not be varied appreciably, and in this experiment, powder/liquid ratios were the only variables.

Laboratory Film Thickness Test

A modification of the standard ADA Specification No. 8 test for film thickness was used as the experimental technique (American Dental Association, 1973). The modification consisted of adapting a base of cast stone to the platform of a Chatillon testing machine (Fig. 1) to direct the load evenly over the entire glass plate and thus assure repeated precision to a tolerance of less than 0.5 micrometers (μm). Constant rechecking of our techniques gave the values credibility.

Cements were mixed according to both the manufacturers' ratios and the clinicians' ratios.

One series of experiments was conducted at room temperature (23 °C) and another at mouth temperature (37 °C).

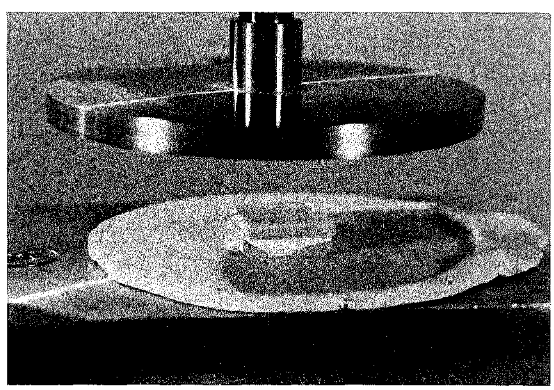

FIG. 1. Chatillon testing machine head in position to provide force against plates and cement

Three specimens were made for each cement at each powder/liquid ratio. Two glass plates 2 cm x 2 cm with cement between were used to determine film thickness. The glass plates were thoroughly cleaned in an ultrasonic cleaner (L & R Manufacturing Company, Kearney, NJ 07032, USA) and rinsed with water. They were dried and checked for dust. Small index marks were etched on the glass plates so that alignment of the plates could be assured. The plates were placed together (Fig. 2) and positioned without cement under the Mikrokator head (Aktiebolaget, C E Johansson, Eskelstuna, Sweden). The instrument was repeatedly set on zero until consistent readings were recorded. Each cement was mixed for the appropriate length of time in the appropriate powder/liquid ratio and placed on the glass plates (Fig. 1).

Three minutes from the beginning of spatulation, the glass plates with cement were forced together on the Chatillon testing machine (John Chatillon & Sons, New York, NY 11415, USA) under 33 pounds (15 kg) of force

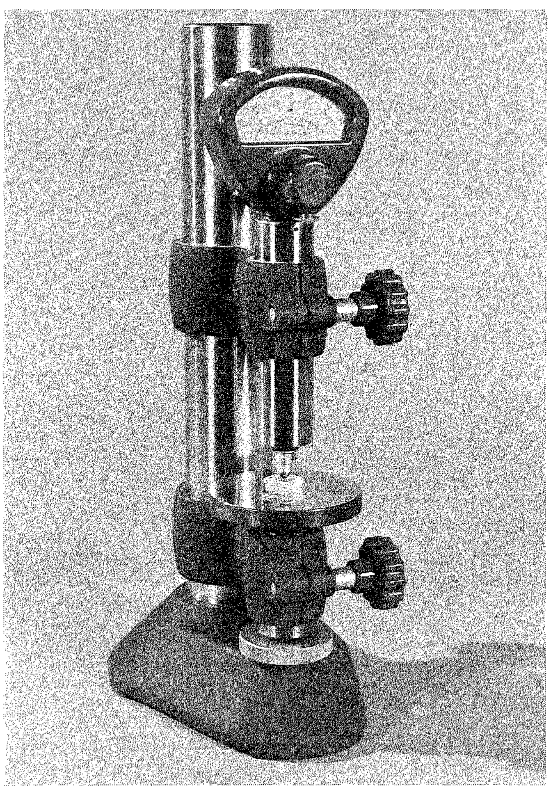

FIG. 2. Glass plates positioned on Mikrokator

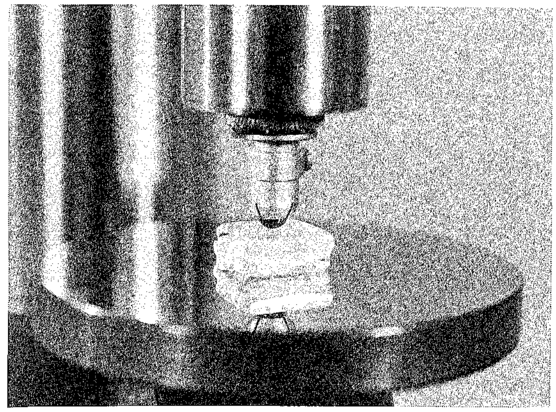

FIG. 3. Cemented plates returned to Mikrokator measuring film thickness

at the appropriate time intervals. Ten minutes from the beginning of spatulation the pressure was released and the glass plates were removed and then replaced on the zeroed Mikrokator where the film thickness in µm was read and recorded (Fig. 3).

The Chatillon testing machine was also used in a 37 °C oven in one phase of the experiment. One glass plate 2 cm x 2 cm was placed in the oven prior to each test to simulate the prepared tooth at mouth temperature. Cements were mixed and placed on the 23 °C glass plate (representing a gold casting), then taken to the Chatillon testing machine. The plate at mouth temperature was placed atop the plate at room temperature and a 15 kg load applied after 3 minutes.

The method of mixing zinc phosphate cement in this study was similar to that suggested by the manufacturer. The increments, however, were mixed for different periods, 1.0, 1.5, and 3 minutes, to accommodate the conditions of the experiment.

RESULTS

Arbitrary Mixing of Zinc Phosphate Cement

The powder/liquid ratios, the mixing times, and the resulting film thickness of the arbitrary mixes are shown in Table 2.

The 14 dental faculty took approximately 1.5 minutes and used slightly lower powder/liquid ratios resulting in the thinnest mixes of 22 µm.

We cannot say that the techniques of the practicing dentists were incorrect as the film thicknesses of their mixes only slightly exceeded those of the faculty. The thicker film may correlate directly with the somewhat higher powder/liquid ratio and the shorter time used in mixing.

Most dentists rely on their assistants to mix cement. The 10 who were tested tended to mix too much powder in somewhat less time, resulting in unacceptable film thicknesses.

Earlier studies of our own have shown that a powder/liquid ratio of 2 g/ml for zinc phosphate cement lies well within ADA specifications for both strength and solubility.

Comparison of Powder/Liquid Ratios and Mixing Times As They Affect Film Thickness and Working Time

The working times obtained after varying powder/liquid ratios and mixing times are shown in Table 3. The working time recorded in Table 3 is the amount of time after spatulation at which the film thickness exceeds 25 μm.

Both S S White and Fleck's zinc phosphate cements at a clinical powder/liquid ratio of 2 g/ml (an optimal ratio) showed similar results. Mixing for 1 minute resulted in a maximum working time of only 2 minutes.

Higher powder/liquid ratios of both zinc phosphate cements significantly reduced the working time. Mixing Fleck's cement for 1.5 minutes, at the manufacturer's recommended higher powder/liquid ratio, resulted in film thicknesses that were not acceptable. Mixing S S White cement for 1.5 minutes, at the manufacturer's ratio, resulted in a working time of only 1 minute.

Mixing times of polycarboxylate cements were the same in each instance, and only the ratios were varied. These cements are much easier to mix and can be mixed in less time than zinc phosphate cements. Thicker mixes resulted in shorter working times for all polycarboxylate cements. Durelon at a clinical powder/liquid ratio provided more working time than the other two polycarboxylate cements. Durelon also equaled the working time of 4 minutes of zinc phosphate cement at clinical powder/liquid ratios.

Fluoro-Thin (silico-phosphate cement) was mixed at the recommended time only. Both of the powder/liquid ratios recommended by the manufacturer slightly exceeded the 25 μm criterion of film thickness and measured 30 μm in 2 minutes. Fluoro-Thin can be regarded as a fast-setting cement.

At mouth temperature the maximum working time for Fleck's zinc phosphate was 3 minutes, only 1 minute less than that of cement at room temperature.

Durelon, at mouth temperature, resulted in a working time of 3 minutes, also only 1 minute less than that of the cement at room temperature.

DISCUSSION

The experiment was designed to determine how much time a dentist may spend, after mixing a cement, in placing the restoration in the prepared tooth, and at what time the cement becomes unusable. Many of the cements tested were found to set at different rates while reaching the point at which they were no longer usable by the clinician. Empirical observation has largely guided the dentist in making this decision.

Tests of film thickness of the several cements appeared to be reliable and consistent in examining working time. Practical data that can be applied clinically appear to correlate closely with that of mixing cements at the chairside.

AN IMPROVED STANDARDIZED TECHNIQUE FOR PROPORTIONING AND MIXING CEMENTS

Since it has been determined that optimum powder/liquid ratios and mixing times can produce consistent results, it is here proposed that all powder and liquid can be proportioned volumetrically by using simple devices readily available to the dentist.

■ *The Liquid:* An inexpensive plastic insulin or TB syringe (Fig. 4) which will precisely measure the correct amount of liquid required can be purchased in pharmacies. Markings of indelible ink can be made to ensure accuracy. Glass syringes, on which the calibrations will remain more legible, are also available. Eyedroppers are unreliable and do not give calibrated amounts of liquid.

■ *The Powder:* Most dental offices have used, or can obtain, measuring dipsticks or

Table 3. *Mixing Times and Powder/Liquid Ratios for Acceptable Film Thickness (25μm or less) for Cementation*

CEMENT	POWDER/LIQUID RATIO	MIXING TIME Min	WORKING TIME Min 23 °C	WORKING TIME Min 37 °C
Zinc Phosphate	*g/ml*			
Fleck's Extraordinary	2.0/1.0 (Clin.)	1.0	2.0	
		1.5	3.5	2.5
		3.0	2.0	
	3.2/1.0 (Mfr.)	1.0	1.0	
		1.5	NA	NA
S S White Zinc Cement Improved	2.0/1.0 (Clin.)	1.0	2.0	
		1.5	3.5	
		3.0	2.0	
	2.6/1.0 (Mfr.)	1.5	1.0	
Polycarboxylate	*g/g*			
Durelon	1.0/1.0 (Clin.)	0.5	4.0	3.0
	1.5/1.0 (Mfr.)	0.5	2.0	NA
	2.0/1.0 (Mfr.)	0.5	1.0	
	2.5/1.0	0.5	NA	
PCA	1.0/1.0 (Clin.)	0.5	3.0	
	1.5/1.0 (Mfr.)	0.5	2.0	
	2.0/1.0 (Mfr.)	0.5	NA	
Zopac	1.0/1.0 (Clin.)	0.5	2.0	
	1.5/1.0 (Mfr.)	0.5	1.0	
	2.0/1.0 (Mfr.)	0.5	NA	
Poly-C	3.0/1.0 (Mfr.)	0.5	NA	
	2.0/1.0 (Clin.)	0.5	NA	
Silico-Phosphate	*g/ml*			
Fluoro-Thin	2.75/1.0 (Mfr.)	1.0	NA	NA
	3.0/1.0 (Mfr.)	1.0	NA	

Clin. = Clinically acceptable
Mfr. = Ratio suggested by manufacturer
NA = Not acceptable (exceeds 25 μm)

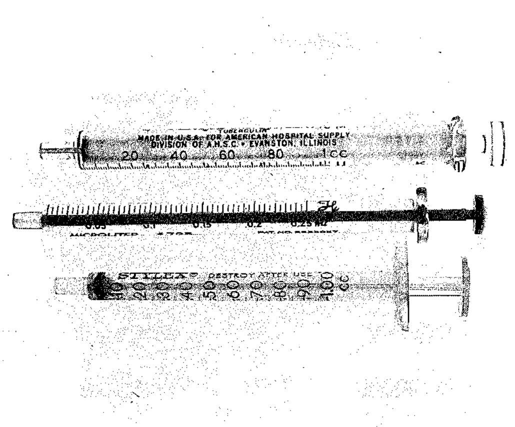

FIG. 4. Plastic or glass syringes are readily available. By removing needle, exact quantities can be delivered, assuring consistently optimum mixes.

scoops (Fig. 5). For our experiments, the **large** end of S S White sticks were used (readily available) and found to be highly reliable (tested on Mettler balances) if the powder is packed heavily by thrusting the stick 4 or 5 times into the powder bottle to compact it. The residual powder can be easily cleaned off with a spatula (Fig. 6). **It is, of course, important that all of the preproportioned powder be incorporated in the mix.**

The powder/liquid ratios for both Fleck's and S S White cements are simple to obtain. (The ratios given in some instruction sheets cannot be dispensed precisely without pharmacy scales and pipettes.)

Table 4 gives the ratios obtainable by using the stick and syringe technique, and the resultant ratios.

■ *How Much to Use:* It is suggested that for single unit castings, 2 scoops of powder and 0.25 ml (¼ cc) of phosphoric acid liquid will give a film thickness of 22 μm. Slightly higher powder/liquid ratios can be used, to as high as 24μm, but thinner mixes are advised.

Multiple castings and bridges with several abutments will need 4 scoops and 0.5 ml (½ cc) of liquid.

■ *How to Mix:* Spread the liquid well over most of the slab. Mix the powder over as large an area as possible to allow the heat to dissipate. An experimental mix, using all the powder at one time, produced a temperature of 82 °C (180 °F).

It is important to use an incremental method of mixing. It is not important whether you use small increments first or last, but mix each increment for the full time as described by the manufacturer to complete the incorporation of all the powder in 90 seconds.

■ *The Variations and Empirical Techniques:* You cannot bring in more powder by mixing for a total of 3 minutes. This will, in fact, give a **shorter** working time—the time needed to seat a casting.

The mixing of an increment the size of a kernel of wheat into the liquid will slow the reaction time, because the acid is buffered, thus allowing more working time; but this will not allow you to use more powder. Mixing as described above, by accurate proportioning, provides more than adequate time to seat a casting.

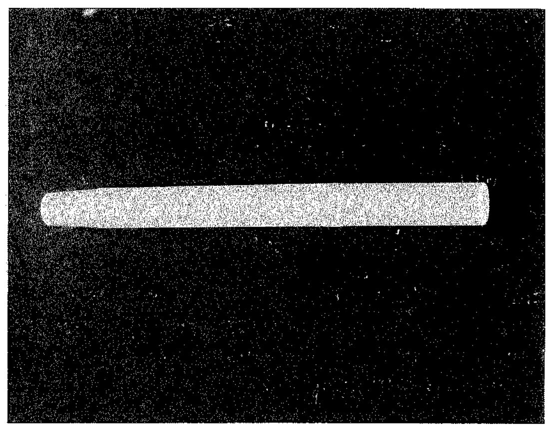

FIG. 5. Plastic dipstick, available from S S White. The large end is used to compact scoops of powder.

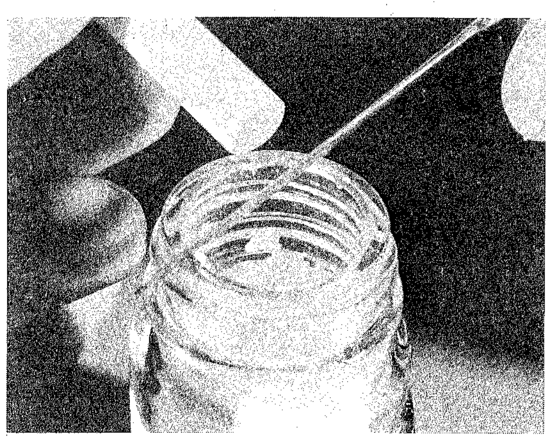

FIG. 6. Leveling the scoop of powder with spatula assures consistently reliable ratios.

Table 4. *Standardized Powder/Liquid Ratios for Mixing Phosphate Cement*

Ratio (g/ml)	Powder	Liquid	Average film thickness
2.00/1	two level scoops*	0.25 ml	21.5 µm
2.25/1	two level scoops	0.23 ml	23.5 µm
2.50/1	two level scoops	0.20 ml	24.2 µm
2.75/1	two level scoops	0.185 ml	26.0 µm
3.00/1	two level scoops	0.170 ml	28.5 µm
3.20/1	two level scoops	0.16 ml	29.0 µm

*2 S S White large scoops, leveled = 0.5 g

Chilling the slab will allow more working time, and you can bring in more powder; but you will reduce the working time in the warmer atmosphere of the room and mouth. Although we were all taught to 'chill the slab' we didn't know we were going to be working in air-conditioned offices. The manufacturers generally don't advise chilling because the slab may collect dew in a humid atmosphere, again reducing the working time.

■ *Further Suggestions:* Use a stopwatch or sweep second hand—the full recommended time for mixing is important.

As you have a full 3 or 4 minutes after mixing to load and seat your castings, there is no need to feel hurried. Insist on thorough mixing—to dissipate the heat. (This dissipation occurs very quickly.)

Empty and flush the syringe after each appointment. It is a simple procedure. Keep the acid in a bottle where it will remain stable; aspirate just the amount you need.

When using a new syringe, pull off the hub and needle. They are not needed and could be a hazard.

■ *What Is Commercially Available?* Durelon liquid has been available in calibrated dispensers for several years. They are highly satisfactory and can be refilled. Some method of standard calibration was suggested by the senior author in the early days because dentists were not familiar with the 'feel' of this type of cement, and the dispenser was developed as a result.

CONCLUSION

The time for properly proportioning luting cements is overdue. Almost every other dental material has some system for measuring ingredients. The wide range and diversity of opinions of many clinicians bear out this statement. Film thickness is probably the most important property for which we should show concern.

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DENTAL PRACTICE

Pulp Conservation

The vitality of the pulp should be maintained whenever possible in preference to pulpectomy and endodontic treatment

ALBERT G VERMEERSCH

Summary

Three methods of conserving pulp—remineralizing dentinogenesis, dentinogenic pulp capping, and anti-inflammatory pulp treatment—have been widely studied in the past decade and have been generally accepted by the dental profession. This account should be of service to those in the profession not yet using these techniques.

INTRODUCTION

Endodontic techniques have improved greatly in the past decade and for endodontic treatment, correctly performed, the prognosis is likely to be good. However, unexplained failure and the fact that pulpless teeth become brittle are reasons enough to avoid unnecessary pulpectomies. Successful pulp therapy is advantageous because the pulp remains vital, there is less trauma and pain for the patient, and the treatment requires less time and costs less than root canal therapy.

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METHODS OF PULP THERAPY

There are, in general, three methods of treating deep carious lesions: (1) remineralizing dentinogenesis; (2) dentinogenic pulp capping; and (3) anti-inflammatory pulp capping.

1. **Remineralizing dentinogenesis:** A treatment whereby the operator, upon approaching the pulp chamber, leaves the deepest layer of carious dentin and treats this tissue to remineralize it. Massler (1967) refers to this treatment as 'vital pulp therapy'.
2. **Dentinogenic pulp capping:** A treatment to maintain pulp vitality upon inadvertent exposure of a healthy pulp during instrumentation of the cavity. The treatment attempts to close the exposure by inducing the formation of reparative dentin.
3. **Anti-inflammatory pulp treatment:** A method of treating reversible pulpitis.

REMINERALIZING DENTINOGENESIS

This method of treatment is commonly known as 'indirect pulp capping'; however, 'remineralizing dentinogenesis' is a more descriptive term. This treatment poses certain questions. Is it really possible to remineralize softened carious dentin? And if it is possible, which part of the softened dentin can eventually be remineralized? And for which pathologic conditions is this treatment indicated?

Is It Possible to Remineralize Softened Carious Dentin?

To answer this question we should review the physiology of the dental pulp and consider the histopathology of the carious process.

The microscopic examination of a carious lesion of dentin will show the following layers from the pulp cavity outwards. These layers are represented schematically in Figure 1.

1. Normal dentin
2. Sclerotic dentin
3. Affected dentin
4. Infected dentin
5. Destroyed dentin

1. NORMAL DENTIN

The structure of normal dentin is well known and the reader can refer to a good textbook on dental histology.

2. SCLEROTIC DENTIN

The second layer is composed of sclerotic dentin. This layer is sometimes called the translucent layer because, in a section of a demineralized preparation, the layer appears much more translucent than adjacent dentin. This layer is hypercalcified through a physiological mechanism of defense activated in the pulp by the advancing carious attack. Sclerotic dentin can be recognized on a radiograph as a white radiopaque layer (Fig. 2). The hypercalcification is brought about by a deposit of minerals inside the dentin tubules which finally are completely blocked by mineral crystals. These crystals are slightly different from the normal apatite crystals and are known as carious crystals, or whitlockite crystals.

The cytoplasmic processes of the odontoblasts gradually degenerate, first by deposition of lipids and further by slight depolymerization of the mucopolysaccharides. We find no microorganisms because they cannot penetrate this layer.

3. AFFECTED DENTIN

The third layer is a zone of affected dentin and is characterized by some demineralization of the inorganic substance of the dentin and intense depolymerization of the mucopolysaccharides of the organic substances. The odontoblastic processes, however, are not destroyed. Some microorganisms may appear in the tubules.

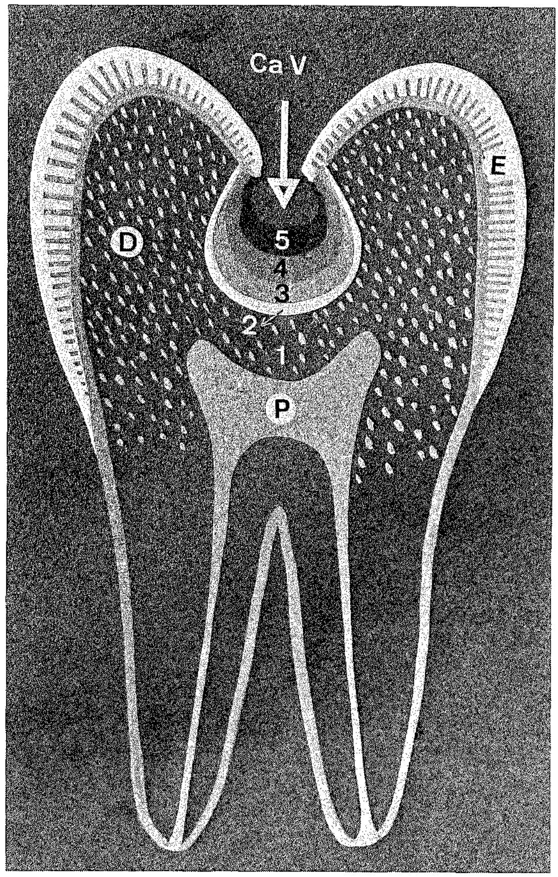


FIG. 1. Layers of a carious lesion of dentin

4. INFECTED DENTIN

The fourth layer is a zone of infected dentin. This layer is characterized by further demineralization of the dentin, complete destruction of the odontoblastic processes, and the presence of a large number of microorganisms.

5. DESTROYED DENTIN

The fifth layer is a zone of intense destruction and is characterized by complete demineralization of the dentin and complete destruction of all organic substances, creating an amorphous structure, which gradually disappears to leave a cavity.

It has been conventional to think that the carious process is irreversible, that is, once caries begins it proceeds to complete destruction of the tooth. Massler (1972) has shown that some carious processes might be arrested when, for instance, the conditions of the mouth change from an infected to a disinfected environment. This type of dentinal caries is characterized clinically by deep pigmentation and a hard leathery surface. Histologically this structure reveals a higher degree of mineralization due to intratubular calcification and sclerosis and also to reprecipitation of previously dissolved crystals, and finally to remineralization by mineral salt deposits originating from the saliva. This could be called a self-induced preventive process.

Which Part of Softened Carious Dentin Can Be Remineralized and Preserved?

It is imperative that the fourth zone of advanced demineralization, characterized by infected dentin, complete destruction of the odontoblastic processes, and heavy microbial invasion be removed. But the third zone of affected dentin which is partly demineralized and contains only a few microorganisms can be preserved. Remineralization of this layer is possible by suitable treatment as long as the odontoblastic processes are not destroyed and, more precisely, as long as sound collagen fibers remain.

Clinically, without having a microscope at the end of the bur, it is difficult to know which zone is infected dentin and which is free of microbial invasion. Clinical judgment would indicate that all dentin easily removed by a slowly revolving bur or a sharp excavator must be eliminated. Fusayama and Terachima (1972) have shown that these two layers can be identified by staining. A 0.5% fuchsin propyleneglycol solution stains the infected dentin but not the affected layer. The staining front corresponds roughly to the bacterial invasion front. This study, however, was done only on sections of extracted teeth. The clinical application of this staining procedure is difficult and needs further improvement.

When Is Remineralizing Treatment Indicated?

If remineralizing treatment is to be used instead of the complete removal of all softened dentin, the first condition is that the tooth be asymptomatic with no pulpitis. Secondly, it is imperative that the treatment be used only when the operator is sure he can remove all carious dentin without exposing the pulp. This condition can be recognized easily on a radiograph (Fig. 2) where the sclerotic zone of

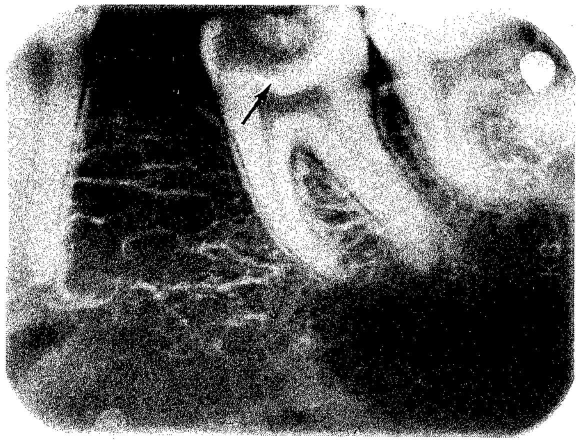


FIG. 2. Sclerotic dentin under carious lesion

hard dentin, which will act as a barrier against overexcavation, can be seen distinctly.

There are two special conditions in which the remineralization treatment is clearly indicated. The first is when one realizes, as in Figure 3, that there is no sclerotic barrier between the cavity and the pulp chamber. The second is in young newly erupted teeth. The pulp horns are large in these teeth and the root apices have not fully closed (Fig. 4). At this stage of development there is a possibility of exposing the pulp horn during instrumentation of the cavity. Further, if conventional root canal therapy is attempted, the blunderbus root canal presents obvious difficulty in filling.

Technique of Remineralizing Dentinogenesis

There are two well-known techniques commonly employed in remineralizing dentinogenesis. The first, recommended by Langeland and Langeland (1969), requires isolation of the tooth and removal of the soft carious dentin from the periphery of the preparation toward the pulp. The pulp is not exposed and the remaining deep layer of carious dentin is covered with a layer of zinc-oxide/eugenol (ZOE) which is further covered with a stronger temporary material. The treatment is left in place for six months, removed, and if remineralization has occurred, a definitive restoration placed. If the pulp is exposed during the excavation of soft dentin, the treatment has failed and the pulp must be removed. This technique is suitable only for patients who are certain to return within six months for completion of the

FIG. 3. At left: *absence of sclerotic dentin under carious lesion.*

FIG. 4. Above: *Tooth with large pulp horns and unclosed apices.*

treatment. Otherwise the temporary filling will be lost and the carious process will begin again.

The second method of remineralizing dentinogenesis can be completed in one appointment. This method uses a disinfectant, chlorhexedine, over the deep caries. Then 8% stannous fluoride is applied for 30 seconds. The cavity is washed with 3% hydrogen peroxide and a layer of calcium hydroxide applied to the carious pulpal wall. The calcium hydroxide is covered with modified ZOE cement and a permanent filling placed. The preparation is *not* reopened. This technique has been advocated by several authors in the past ten years and its remarkable success should be recognized by the dental profession. The technique is especially useful for patients that may not be able to return in the six-month period required by the first method.

DENTINOGENIC PULP CAPPING

Pulp capping is a procedure that aims to close a pulp chamber, accidentally exposed, and thus conserve a healthy pulp. One of the most important works has been published by Glass and Zander (1949) who have established what really happens when calcium hydroxide is placed on the surface of a wounded pulp.

Effect of Calcium Hydroxide on the Pulp

The histological pictures can be consulted in the above-mentioned paper, but the present text is illustrated by schematic drawings to make it more comprehensive.

Immediately: A small necrotic zone of amorphous structure is created, bordered on the pulp side by a small basophilic layer of calcium proteinate, which shows how far calcium hydroxide has penetrated the pulp (Fig. 5a).

After two weeks: The necrotic zone and the basophilic zone are still present but inside the basophilic zone, at the junction of the pulp, small areas of calcification resembling osseous reparative tissue are created. A few fibroblasts of the pulp are emigrating to the border of this area (Fig. 5b).

After four weeks: The necrotic zone disappears gradually, leaving an empty space, which can easily be discovered when the cavity is reopened. The basophilic layer is still present but invaded more and more by dystrophic calcified tissue. On its pulpal border more and more cells are lined up; the fibroblasts have turned into odontoblasts. As soon as this layer is completed, the formation of orthodentin will begin at full speed (Fig. 5c).

After eight weeks: A layer of 0.1 mm of dentin is formed and the whole basophilic zone is now mineralized (Fig. 5d).

After six months: The dentin bridge will reach the thickness of 0.3 mm and this can be seen on a well-oriented radiograph.

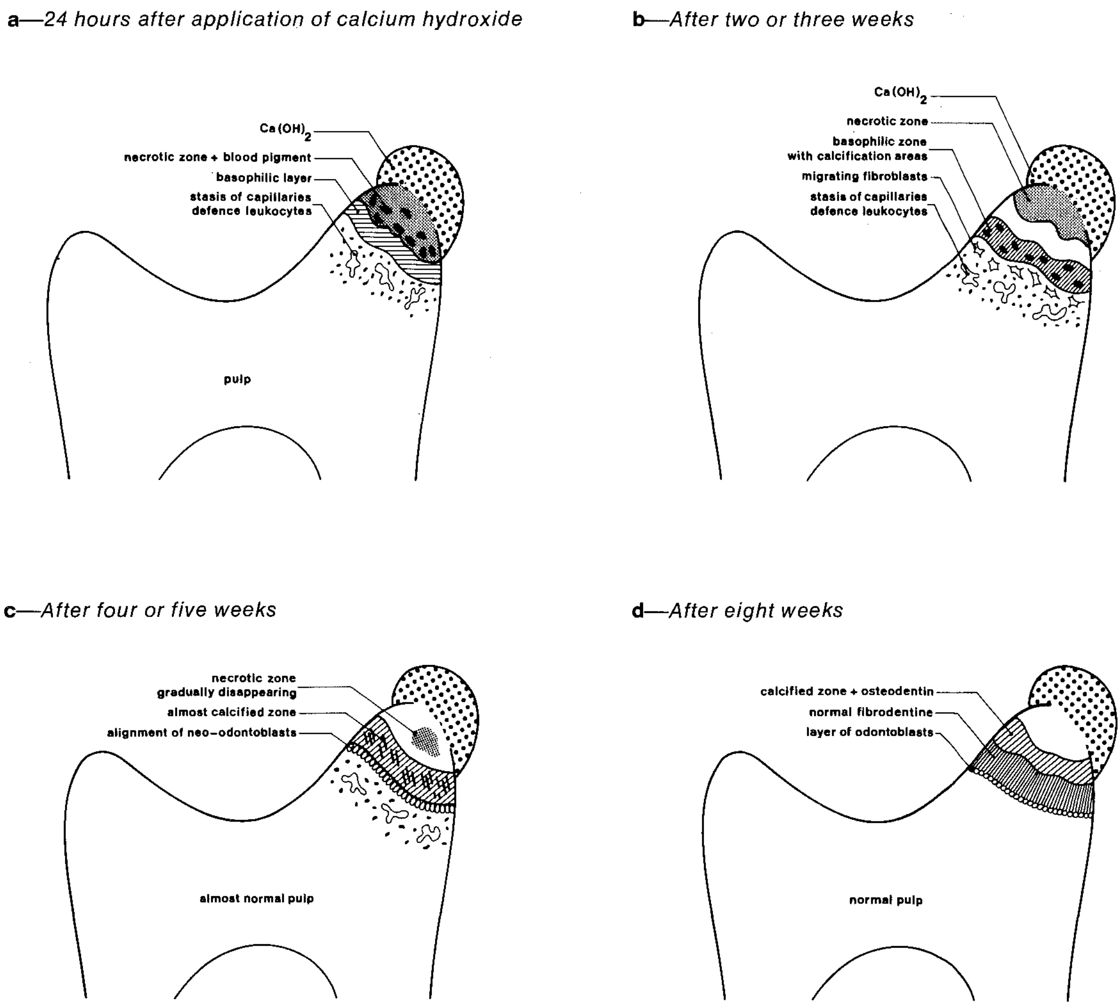
Technique of Dentinogenic Pulp Capping

The technique for dentinogenic pulp capping is similar to the procedure for indirect pulp capping. Anesthesia without a vasoconstrictor is recommended. Isolation of the field is imperative. Caries is removed from the periphery of the preparation toward the pulpal wall. If the pulp is exposed the prepared cavity is cleaned with a disinfectant—1% solution of aminoacridine or 0.05% solution of chlorhexedine—and the exposure site covered with Dycal (L. D. Caulk Co., Milford, DE 19963, U.S.A.). The preparation is then closed with modified ZOE (I.R.M., L. D. Caulk Co., Milford, DE 19963, U.S.A.). After six weeks the temporary filling is removed without anesthesia to test the vitality of the pulp. If the pulp is vital a definitive restoration may be placed. If the tooth is nonvital a pulpectomy is performed.

ANTI-INFLAMMATORY PULP CAPPING

Anti-inflammatory pulp capping is indicated at beginning stages of acute serous pulpitis before the pulp becomes suppurative, and where there is postoperative pain resulting from aggressive instrumentation of the cavity or from an irritating restorative material. Anti-inflammatory pulp capping is also indicated for

FIG. 5. EFFECT OF CALCIUM HYDROXIDE ON THE PULP



extensive pulp exposures or for failures of either remineralizing dentinogenesis or dentinogenic pulp capping.

The treatment uses the anti-inflammatory powers of the corticosteroid drugs, such as Terracortryl (Pfizer, Inc., New York, NY 10017 U.S.A.), Ledermix (Lederle, Pearl River, NY 10965 U.S.A.), or Septomixine (Septodont Laboratory, Paris, France), as advocated by Schroeder and Triadan (1962). All these drugs contain a corticosteroid and an antibiotic.

Technique of Anti-inflammatory Pulp Capping

The site of exposure is swabbed with the corticosteroid and then covered with a ZOE temporary cement. The drug is left in place for two to three days, five as a maximum, and then washed away with lukewarm water. If left longer the corticosteroid could inhibit the formation of the dentin bridge (Fiore-Donno & Baume, 1966; Hansen, 1969; Mjör & Östby, 1966). The final capping is identical to pulp capping. Calcium hydroxide is placed over the exposure and a resistant ZOE temporary placed for six weeks. The final definitive restoration may be placed if the signs and symptoms of inflammation have disappeared and the tooth remains vital.

CONCLUSION

There is much to be gained from trying these three methods of conserving the pulp, where they are indicated, especially if we use an aseptic technique, explain the treatment to the patient, and give the reasons for its use. If we succeed we save a pulp and that is sound judicious treatment.

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DENTAL EDUCATION

Is Our Island Sinking?

Quality levels in operative dentistry as observed on state board examinations

HUNTER A. BRINKER

Summary

A survey of the opinions of state board examiners in 36 states reveals that the clinical competence of dental graduates has declined since 1960.

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Presented at the Section on Operative Dentistry of the American Association of Dental Schools, March 22, 1976, in Miami Beach.

INTRODUCTION

In the past two years it has become obvious that not only state board examiners but educators as well have become concerned over the level of competence of their dental graduates. Most of the dental schools that adopted it have by now felt the impact of the three-year curriculum with its resulting trauma to the graduating dental student.

Although there has been a definite decline in clinical teaching in our dental schools since 1960, when the U.S. Public Health Service entered the dental picture, the most drastic decline has been noticed since the inception of the Comprehensive Health Manpower Training Act in 1971. The level of performance of clinical restorative skills has rapidly declined in most of our dental schools, and is now evidenced in most states through the quality of dentistry demonstrated by applicants taking state board examinations.

A recent survey of opinions (Ingraham, 1977) has revealed that West Coast educators agree that from 1960 to 1975 there was a definite decline in the level of competency of dental graduates in the clinical skills that are evaluated by state board examiners (Fig. 1.)

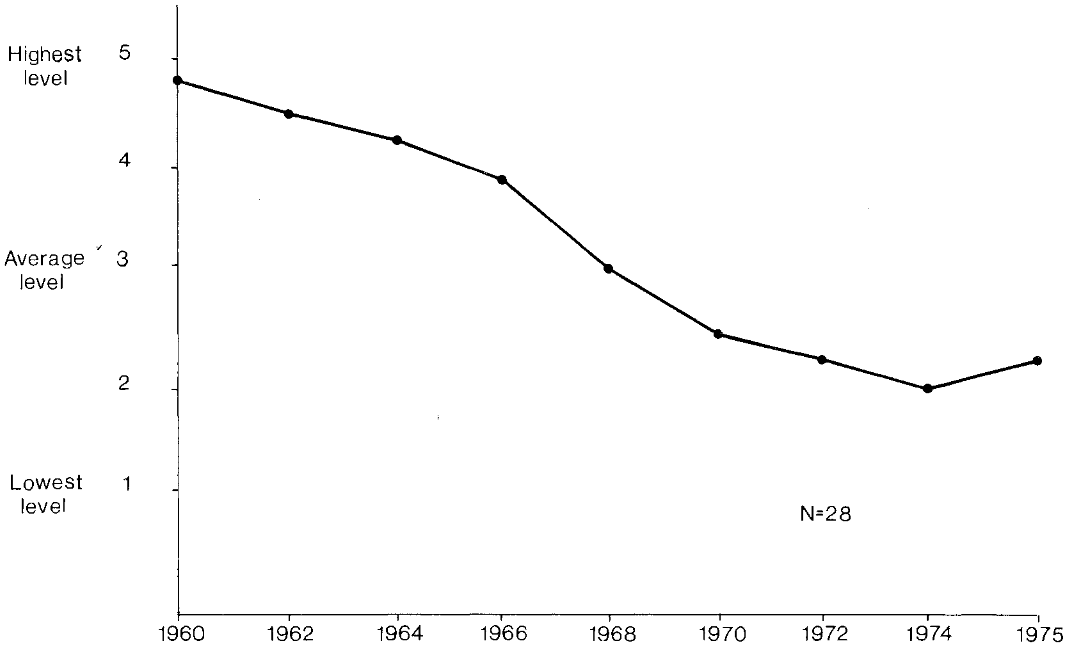

FIG. 1. Mean of observations of 76% of respondents to question: In your opinion has there been a change in the level of clinical competency of your dental graduates in those clinical skills traditionally tested by State Board Examinations from 1960 to 1975?

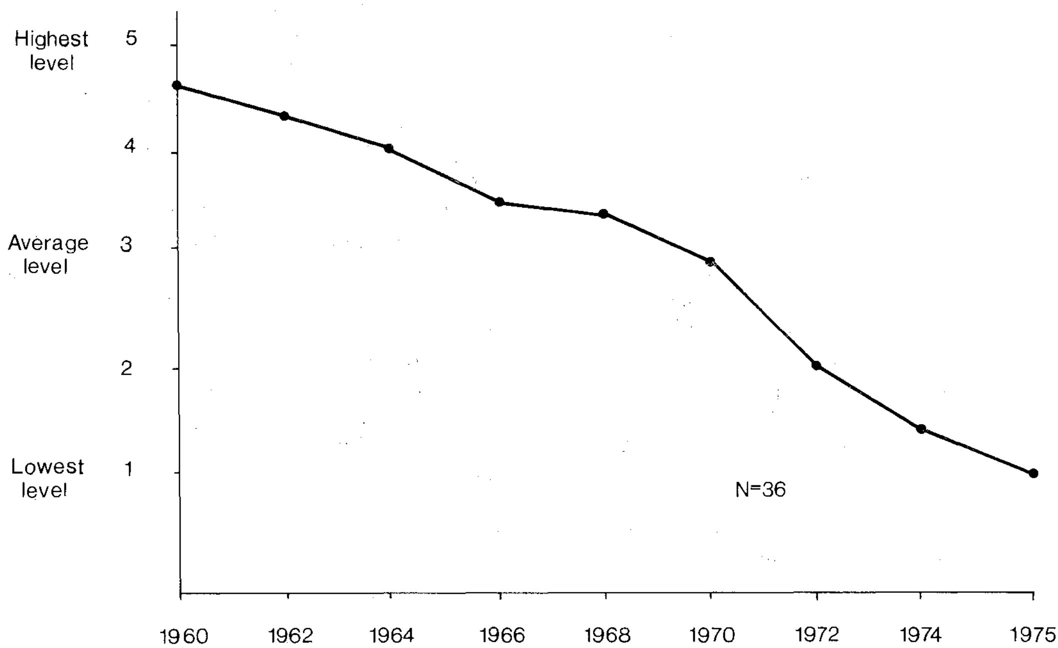

FIG. 2. Mean of observations of 100% of respondents to question: Has there been a change in the level of clinical competency of applicants in those clinical skills traditionally tested by your state board examinations from 1960 to 1975?

OPINIONS OF STATE BOARD EXAMINERS

As a follow-up on Ingraham's survey of dental educators and to update a previous publication (Brinker, 1974) I conducted a survey of the opinions of the examining boards of 52 states. Thirty-six states, or 69%, responded to the questionnaire. The results show a definite correlation between Ingraham's survey of educators on the clinical preparation of dental students and the survey of state board examiners on the clinical performance of their applicants. This survey of clinical competence also showed that most state boards agree that the level of clinical competence of applicants declined drastically between 1960 and 1975 (Fig. 2).

Instruments and the Rubber Dam

Perhaps one of the most noticeable trends in the quality of dentistry demonstrated by state board applicants is evident in the comparison of those candidates that took the Florida state board examinations during my tenure in office and the applicants that have taken state board examinations in the thirty-six other states. In Florida, out of 242 candidates who took the Florida examinations, nearly half were using inadequate, dull, or rusted instruments, and were attempting to prepare inlay cavities entirely with diamonds and burs with no use of hand instruments (Table 1). Visual checks were made on these same 242 candidates in placing the rubber dam prior to cutting the cavity preparation (Table 2). Of the 21% using the rubber dam, approximately half used it correctly and only 16 out of the 242 candidates used the rubber dam for cementing their castings. In comparison, the latest opinion survey, representing responses from 36 different states, shows that in most of the states only 0–25% of the applicants use rubber dam effectively for crown preparations and final cementation of castings, whereas 50–75% of the applicants effectively use the rubber dam for condensation and finishing of amalgams. Only 0–25% of the applicants use hand instruments effectively (Tables 3 & 4).

Table 1. *Condition of instruments of 242 applicants for the dental examination of the state board of Florida*

Hand-cutting Instruments	Number of Candidates	Proportion of Total Candidates *percent*
Sharp and in good condition	124	51.2
Rusted or dull	76	31.4
Inadequate to do procedure	42	17.4

Table 2. *Rubber dam application of 242 applicants for the dental examination of the state board of Florida*

Rubber Dam Application	Number of Candidates	Proportion of Total Candidates *percent*
Applied rubber dam for cavity preparation	51	21.1
Applied rubber dam correctly	27	11.1
Applied rubber dam for cementation of casting	16	6.6

Table 3. *What percentage of applicants use rubber dam effectively for the following operations?**

	0-25%	*25-50%*	*50-75%*	*No Answer*
Crown preparations	19	3	9	5
Final cementation of casting	16	6	8	6
Condensation and finishing of amalgam	8	6	15	7

*Opinions of examining boards of 36 states.

Table 4. What percentage of applicants effectively use hand instruments?*

0-25%	*25-50%*	*50-75%*	*No Answer*
20	12	4	0

*Opinions of examining boards of 36 states.

Major Factors of Decline

This survey also indicated that the three major factors causing the decline in clinical competence of applicants in the past fifteen years are: general administrative permissiveness, permissive attitudes of clinical teachers, and political and social trends and pressures (Table 5).

Areas of Decline

A comparative study of the clinical performance of applicants during the period 1960 through 1975 (Table 6) clearly indicates that the four critical areas in which our board examiners feel applicants have definitely declined are: clinical skills; wax pattern techniques; clinical gold foil procedures; and full denture set-ups.

Table 5. *Factors contributing to any decline in clinical competency of applicants during the past 15 years**

	Agree	Disagree	No Answer
General administrative permissiveness	28	3	5
Permissive attitude of clinical teachers	29	4	3
Inadequate system of clinical evaluation	20	8	8
Poor student attitude	24	6	6
Political and social trends and pressures	31	3	2
Decreased number of clinical hours (patient contact)	27	1	8
Accelerated three-year program	27	4	5

*Opinions of examining boards of 36 states.

Open Comments

In open comments taken from the opinion surveys of both educators and examiners, a definite relation between student performance and individual school was stressed; however, most of the open comments revealed that shorter curriculum, fewer clinical hours, and teacher motivation, combined with student apathy, were the basic reasons for the decline in clinical performance of students and applicants.

Another very important notation in the open comments of both the educators and state board examiners in both surveys is the lack of concern for patients and of self-discipline on the part of students and applicants. This, together with the basic reasons for decline in clinical performance, was attributed to the fact that in many of the dental schools only inadequately prepared, part-time teachers are being used. Combined with reduced clinical hours and supervision this has resulted in a laxity in faculty standards, thus lowering the overall clinical competence of students and applicants. Both educators and examiners unanimously felt this was due directly to most of our schools having to face the major problems of reduced clinical hours, some because of the three-year curriculum, as well as to the crowded conditions of most of the schools.

Table 6. *Clinical performance of applicants by three-year periods: S = superior; A = average; I = inferior**

	1960-63	*1964-67*	*1968-71*	*1972-75*
Clinical skills	S	A	A	I
Motivation and attitude	S	A	A	A
Theoretical knowledge	A	S	S-A	A
Concern and management of patients	A	A	A	A
Design and preparation of full and partial veneer crowns	S-A	A	A	A
Wax pattern techniques	A	A	A	I-A
Clinical gold foil procedures	S	A	A-I	I
Full denture set-ups	A	A	A-I	I
Management of rubber dam	A	A	A	A
Oral pathology	A	A	A	A
Diagnosis and treatment planning	A	A	A	A
Removable partial denture design	A	A	A	A

*Opinions of examining boards of 36 states.

CONCLUSION

The definite weaknesses observed in applicants taking the Florida state board examinations have also surfaced in applicants taking state board examinations in most other states. This is indicative of the problems which most of our state boards have faced and are still facing today.

The first big step has been taken, however, in that the situation has been recognized by both educators and board examiners. By working together, we can plunge forward and give operative dentistry its proper place in the curriculum. Operative dentistry must be put back into our schools at the level necessary to ensure equality with other specialties, which means there must be less emphasis on allied subjects and more time allocated to actual clinical experience. Our new and sophisticated methods and techniques are of no value without basic operative procedures.

A very provocative and soul-searching thought is this: there is no limit to that which can be accomplished, but only if we can individually abandon man's instinctive possession of the human behavioral trait—egotism. No Man Is An Island. Through unlimited dedication, hand-in-hand cooperation, and timeless concern we can keep our Island from sinking. It is entirely up to us.

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OPERATIVE DENTISTRY, 1977, **2***, 116-117.*

POINT OF VIEW

Operative Dentistry in a Changing Temperament of Professional Interest

CHESTER J GIBSON

As more emphasis is being placed on the specialties of dentistry in undergraduate training, operative dentistry is being de-emphasized. The strict discipline that has historically been the basis of operative dentistry in the United States must not be neglected. Supplemental continuing education for the graduating student is necessary if clinical efficiency is to be obtained.

Traditionally, the skill of a dentist has been measured by his ability to execute well in the field of operative dentistry. In dental schools, more clinic time was required in operative dentistry than in any other segment of clinical instruction. State boards placed most, if not all, of the clinical examination around operative procedures. An amalgam, an inlay, and a gold foil were usually the requirements of a state board examination. Some states varied the cast restoration to a crown, and a few even required the placement of a bridge. These concepts are changing rapidly. Today, less than half of the states require compacted gold in their testing procedures, and many have dropped even the cast restoration.

Pressure on state and regional boards by legislatures, citizen groups, and educators has forced the lowering of standards required by testing institutions. Government and citizen groups seem to have lost sight of the fact that state boards were instituted to protect the public. Instead, they see them as agencies that protect the dentist by limiting competition. There is a discernible lack of urgency on the part of government to improve the quality of dental care for the people. It seems that the desire for quantity of care is the overriding concern of our health agencies. The citizens themselves are more likely to condone mediocrity rather than reward excellence.

A heavy responsibility to maintain high quality dentistry falls to the Academy of Operative Dentistry and the American Academy of Gold Foil Operators. Because of the government-instituted capitation programs, the ability of the graduating dental student to operate well has declined significantly in recent years. With the crowding developed by increased

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enrollment and the increased student:faculty ratio, nothing else could be expected; our teachers can spread themselves only so thin. Thus it becomes incumbent upon the leaders in operative dentistry to assist these young men in improving their operative skills.

From June to December 1977, departments of continuing education in the dental schools of the United States and Canada are giving 18 courses relating to operative dentistry, 47 in endodontics, and 55 in practice management. Perhaps if 47 courses were given in operative dentistry, only 18 would be needed in endodontics.

It is not enough for our leaders and educators to decry the unpreparedness of today's graduating student and the poor operators already in practice. It is our responsibility to change the trend and continue the education of every dentist that shows the slightest interest in improvement of his techniques and skills. Continuing education courses are fine, but if they are not related to clinical instruction, much of the value of the course is lost. Study clubs comprising small groups of participants can provide a stimulating catalyst that will produce better dentists and better dentistry. Further, we as leaders, are responsible for finding ways to interest the disinterested dentist in group participation.

Study clubs need not be structured so that they seem prohibitive in time to the young dentist. Nor do they have to be excessive in cost. Too often a beginning dentist saddled with the cost of maintaining a new office sees little benefit in an improved amalgam or a fine gold foil. His concern is the next payment on his equipment. It is not the fault of the schools that three times as many courses are given in practice management as in operative dentistry; it is simply that that is what sells. Those of us who have learned that responsibility goes hand in hand with prestige must find ways to incorporate these talented young people into continuing education groups.

The end result of all our efforts must be a patient well treated. Operative dentistry well done is the only way that this can be ensured. Dentistry through the years has taken this responsibility, and now more than ever we must see to it that dentists new and experienced, young and old, correlate excellence in operative dentistry with the responsibility to our patients.

 *OPERATIVE DENTISTRY, 1977, **2**, 118-124.*

PRODUCT REPORT

Bonding Agents for Repairing Porcelain and Gold: An Evaluation

Some bonding agents are effective in repairing fractured porcelain

WILMER B EAMES • LARRY B ROGERS • PAUL R FELLER • WILLIAM R PRICE

Summary

Two bonding products for porcelain repair, Fusion and Den-Mat, were evaluated under several laboratory conditions. Fusion with Concise composite resin was found to give higher bonding strength than the Den-Mat repair system although the latter was considered to be adequate.

Two other composite resins, not advertised as porcelain repair materials, were included because they had been compared unfavorably in Den-Mat advertisements. These products, when used with Fusion, gave considerably higher values than those of the Den-Mat system.

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INTRODUCTION

Until an indestructible dental porcelain can be fabricated, a method of repairing fractures must be employed. The usual procedure for repairing porcelain is to remove the prosthesis and refabricate the veneering. Although this may be the best method to ensure a complete repair of porcelain, the method is not always the most practical for a small repair or for emergency treatment.

Recently, products have been marketed for expediting repair of fractured porcelain in the mouth. Some of these products are filled Bis-GMA resins bonded to the exposed metal and porcelain with silane coupling agents. An evaluation was made of composite resins and their bonding systems used in porcelain repair.

MATERIALS

The manufacturer of Fusion (George Taub Products, Jersey City, NJ 07307, USA) suggests that it can be used with a composite resin and its unfilled resin, or an acrylic resin, as a compatible repair system. The manufacturer of Fusion claims that this product is a bonding material to be used with gold and porcelain. Fusion has been identified as containing a commonly used bonding chemical and other proprietary agents.

Another more recent product sold for porcelain repair, Den-Mat, was tested under the same conditions as Fusion except that, as the manufacturers of Den-Mat do not claim bonding to gold, Den-Mat was evaluated using only porcelain. The Den-Mat repair package contains a weak acid primer, bonding agent, and a filled resin. The bonding agent of Den-Mat was analyzed for us and found to contain a chemical known to be commonly used for this purpose.

Den-Mat advertises its product as superior to two other leading composite resins (*ADA News*, **7**, Dec. 27, 1976). These were identified by the manufacturer of Den-Mat as Cervident (S S White Dental Products, Philadelphia, PA 19102, USA) and Simulate (Kerr Manufacturing Company, Romulus, MI 48174, USA). The manufacturers of these materials have made no claims for bonding to porcelain, nor are they advertised as such, but were compared in our study because of their inclusion in the Den-Mat statement.

Concise (Minnesota Mining and Manufacturing Company, St Paul, MN 55101, USA) with its unfilled resin was included as a control.

METHODS

Uncast ingots of Firmilay (J F Jelenko & Co, Inc, New Rochelle, NY 10801, USA) were sanded with silicon carbide paper (240 grit), and mounted in self-polymerizing acrylic, Quickmount (Fulton Metallurgical Products Corp, Pittsburgh, PA 15220, USA). The ingot was cleaned with absolute alcohol for the Fusion test, air-dried, and a coating of Fusion applied as recommended by the manufacturer. After air-drying, the specimens were placed in a mold with an opening 7.4 mm in diameter.

Porcelain denture teeth (Universal-Lactona Corp, Philadelphia, PA 19114, USA) were roughened with silicon carbide paper (240 grit) with the same sequence of grit used to abrade the gold ingots and cleaned ultrasonically. The variables were the same as used to test bonding to gold. Porcelain for Den-Mat testing was prepared similarly except that for Den-Mat the porcelain was treated with an acidic priming agent, rinsed, and the bonding agent applied.

Composite resins were injected into the opening of the mold by syringe to help eliminate bubbles and ensure good contact with the surface of the gold and porcelain.

Specimens were made with Fusion and Den-Mat as the bonding materials as well as control specimens without Fusion. The conditions of the test were:

Specimens stored at room temperature (23 °C) for 24 hours

Soaked in 37 °C water for 24 hours

Soaked in 37 °C water for 7 days

Cycled from 2 –60 °C for 24 hours

The cycling test consists of immersion for 3 seconds in each of hot and cold water bottles with 1 second in transit, totaling approximately 9 complete cycles per minute, or 12,340 cycles in 24 hours.

Each specimen was placed in a special jig-die (designed by R W Joos, 3M Center, St Paul, MN 55101, USA) (Fig. 1), which provided a stable, rigid shearing force. The jig was designed to simulate clinical stress developed during incisal biting. The jig was attached to a Chatillon tension testing apparatus, Model HTCM (John Chatillon & Sons, Kew Gardens, NY 11415, USA) so that the shearing stress was at the interface of the composite resin and the gold or porcelain (Fig. 2).

If the fracture occurred in the porcelain rather than at the interface on 5 successive specimens for each condition, no more specimens were tested as the purpose of the experiment was to determine the strength of the bond, not the porcelain. If the porcelain did not fracture, a total of ten specimens of each was tested.

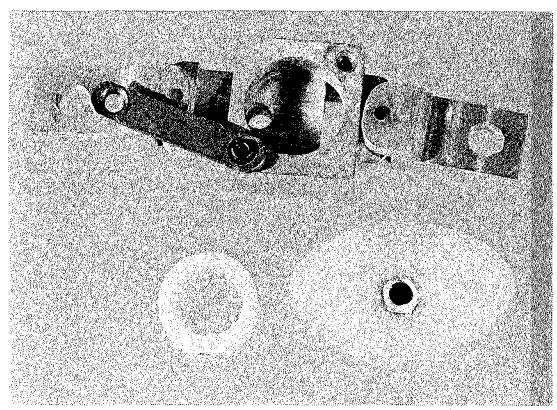

FIG. 1. A jig-die designed to provide a stable, rigid shearing force; a Teflon ring used to secure composite resin specimens in the jig; and mold used to place composite resin on gold or porcelain.

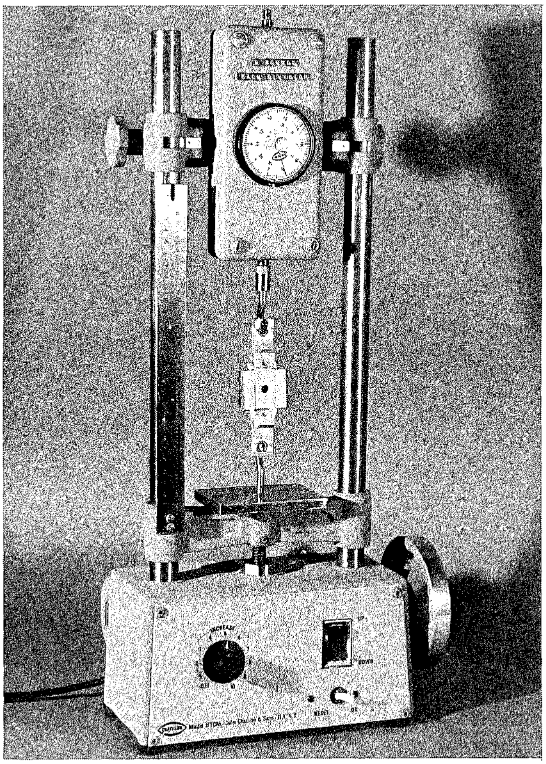

FIG. 2. The jig-die mounted on the Chatillon shear-testing machine

RESULTS

As seen in Figure 3, when Fusion was used as a bonding agent for Concise to gold, the forces required to remove specimens were no higher than when composite resins were placed with unfilled resins only. Fusion did not improve the bonding of composites to gold under the test conditions.

When Fusion was used prior to placement of composite resins on porcelain (Fig. 4) bonding was greatly improved with all the composite resins including Den-Mat with its own bonding agent. It should be noted that the specimens did not fracture at the interface of Fusion and porcelain; the values in pounds reported are the result of the fracturing of the porcelain itself (Fig. 5).

Although its bonding values were lower, the Den-Mat system appeared to produce acceptable values when compared with other products (Figs. 6–8). When Fusion's bonding agent

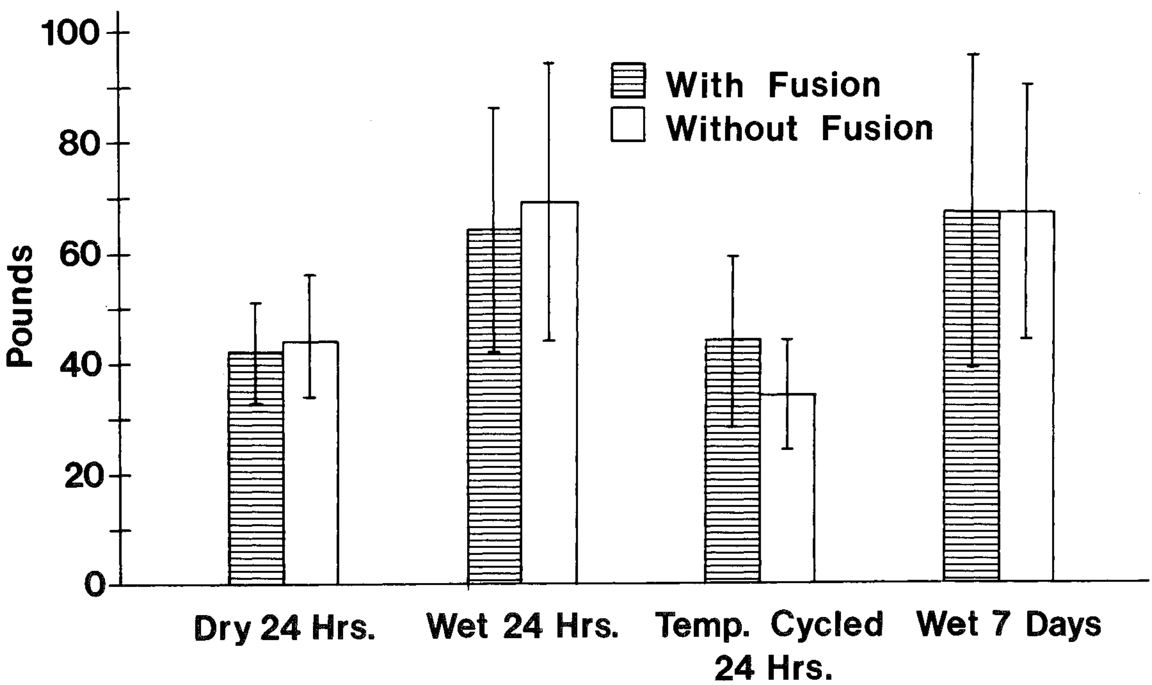

FIG. 3. Bonding strengths of a composite resin to gold, with and without Fusion

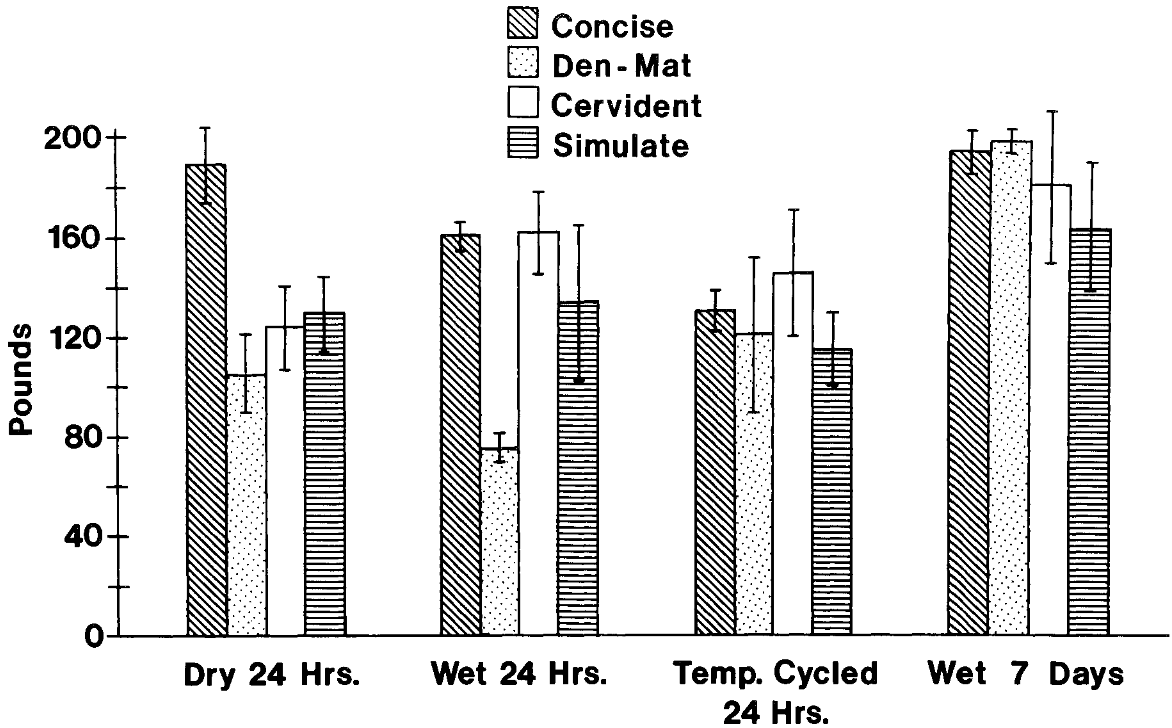

FIG. 4. A comparison of four composite resins using Fusion as a bonding agent on porcelain

was used, the bonding of both Cervident and Simulate was improved. They are not inferior products, as portrayed in promotional media. The results of the control, Concise, with 5 bonding agents are shown in Figure 9.

DISCUSSION

Cervident and Simulate are not sold for repairing porcelain. Advertisements that promoted the use of Den-Mat compared its successful use with "two other leading bonding systems." The manufacturer of Den-Mat supplied us with the information that the comparison was made with Cervident and Simulate, as did a representative of the advertising agency who accepted the copy.

The manufacturer of Den-Mat has advertised its product with photographs of a "gouged-out crater" in glass claiming the bond to be "stronger than glass." Several specimens received by mail failed to support this claim (Figs. 10a, b & c).

Fusion is sold as an agent capable of bonding acrylics and filled resins to gold or porcelain. We found that bonding to gold was not a valid claim. But Fusion was found to be an excellent bonding agent for porcelain. For years, random communications with clinical dentists have revealed successful use of Fusion, and it is now felt that the bonding of the composite resin was to porcelain (Fig. 11) rather than to gold. Undercuts may also have provided additional mechanical retention to the restoration.

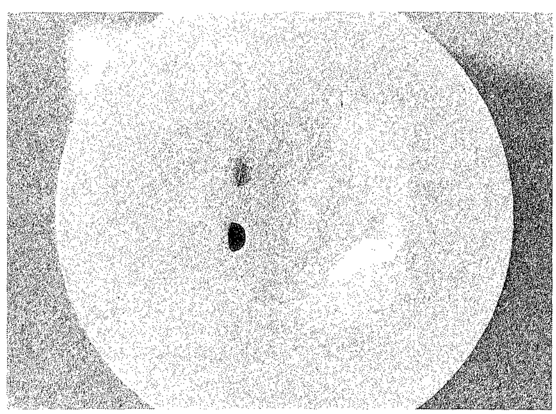

FIG. 5. An example of a porcelain tooth that has been fractured during the removal of a composite on which Fusion was used as a bonding agent

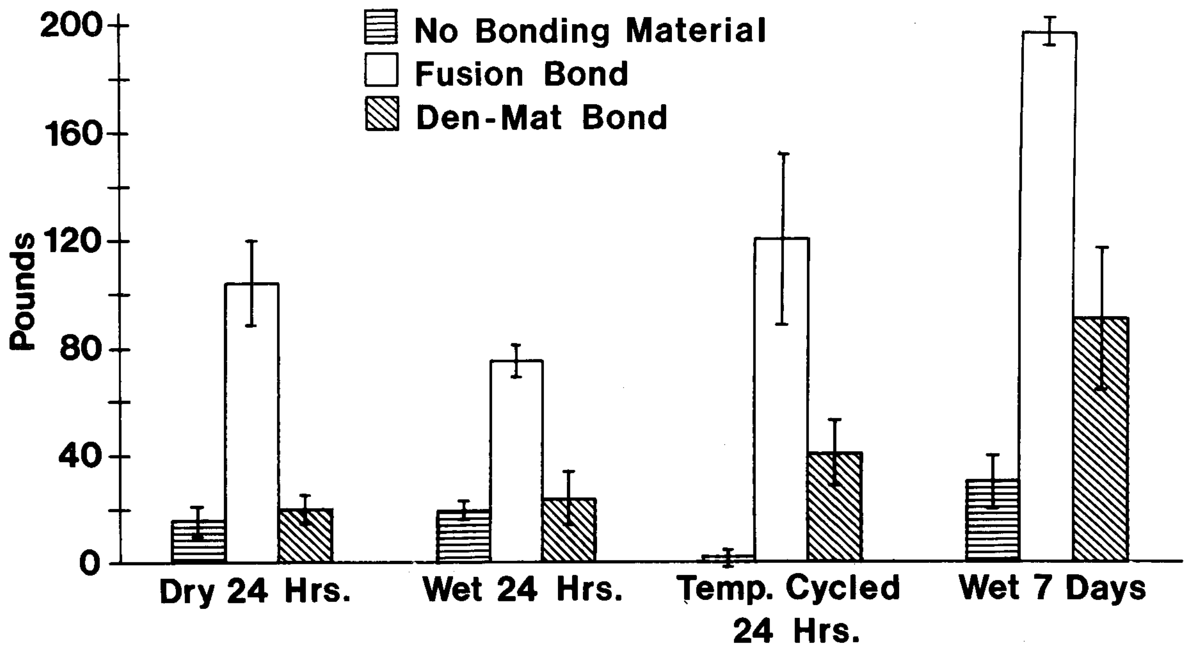

FIG. 6. Bonding strengths of Den-Mat composite resin on porcelain, with and without Den-Mat bonding agent, as compared with Fusion bonding agent

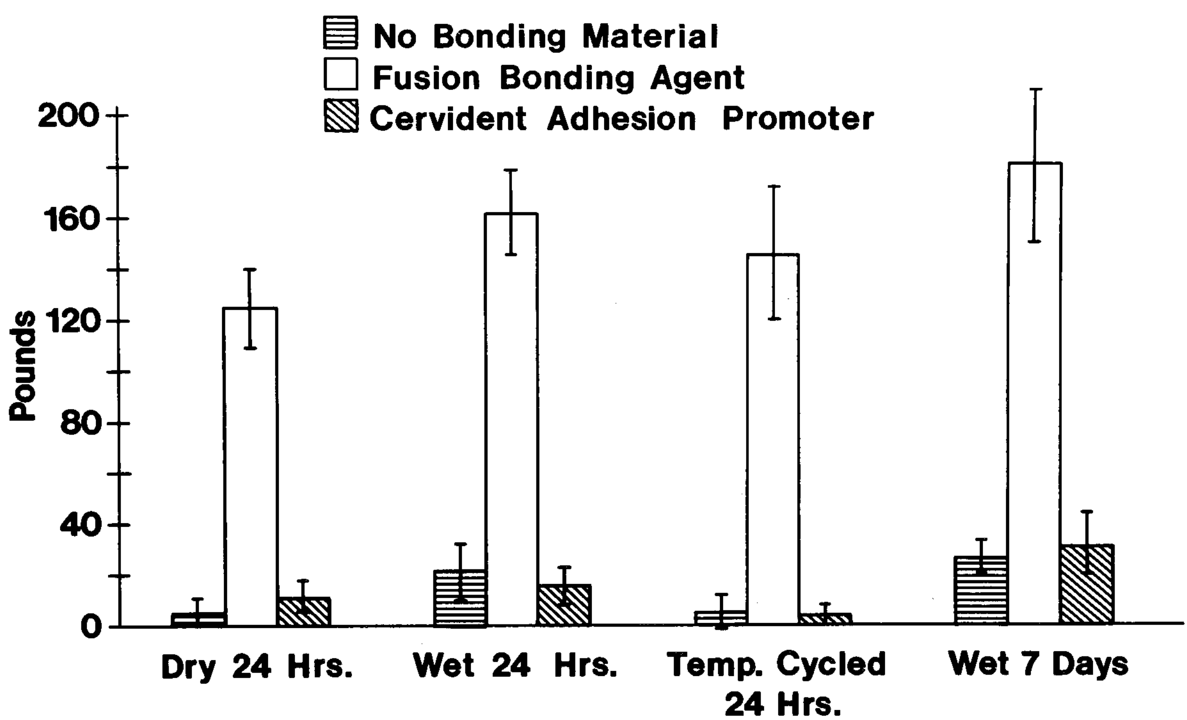

FIG. 7. Bonding strengths of Cervident composite resin on porcelain, with and without Fusion bonding agent

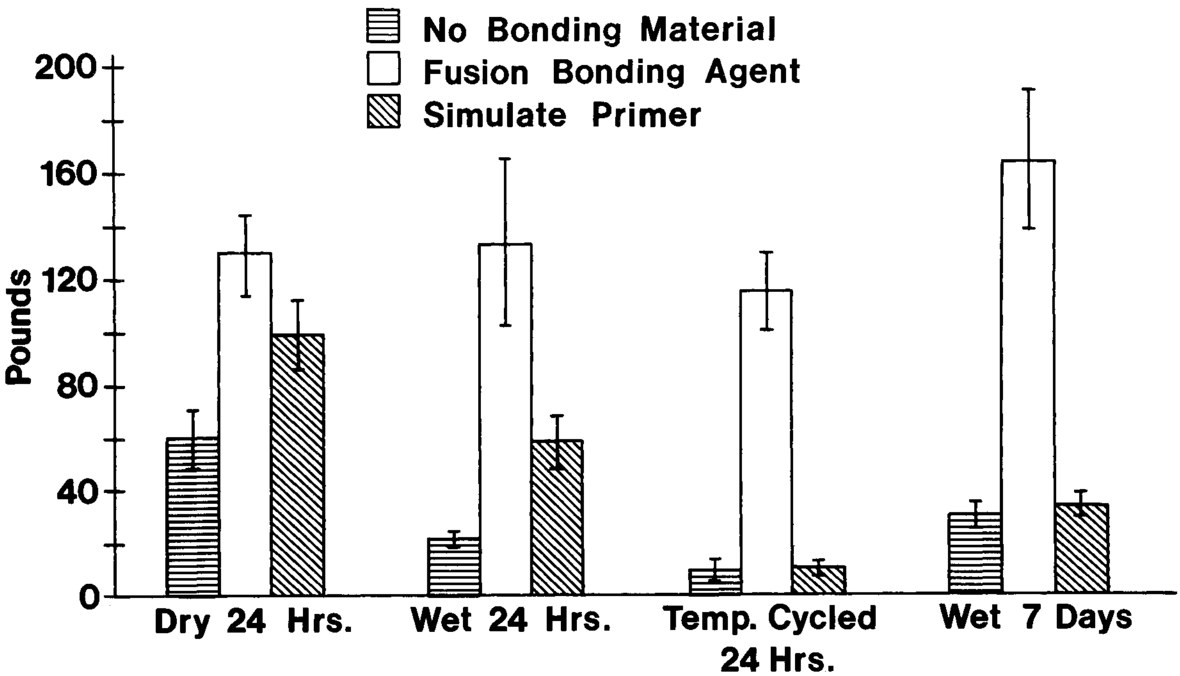

FIG. 8. Bonding strengths of Simulate composite resin, with and without Fusion bonding agent

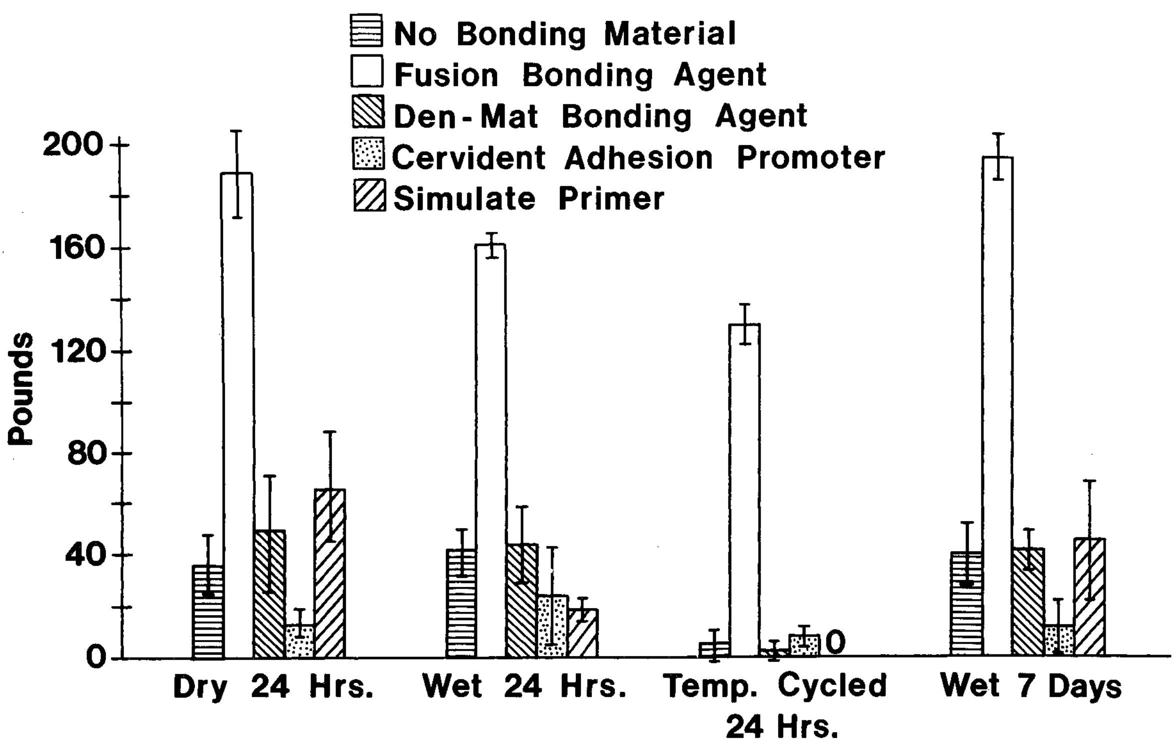

FIG. 9. The control, Concise, with five bonding agents

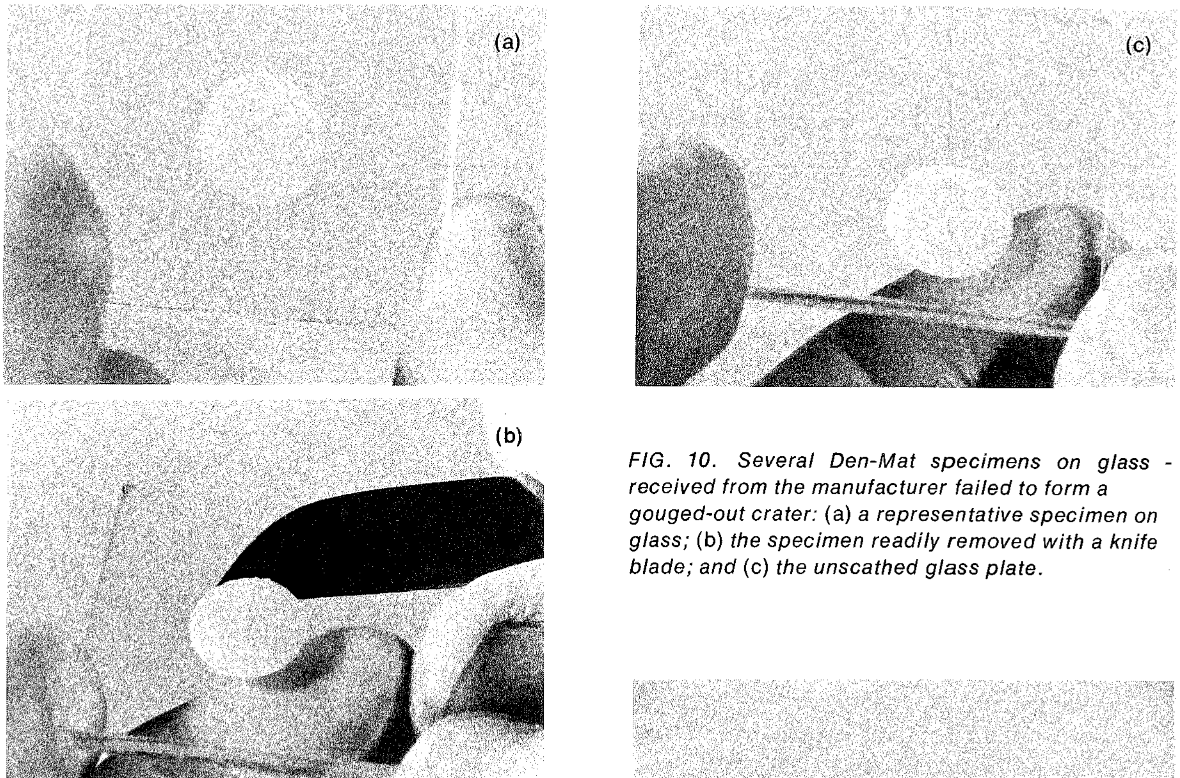

FIG. 10. Several Den-Mat specimens on glass - received from the manufacturer failed to form a gouged-out crater: (a) *a representative specimen on glass;* (b) *the specimen readily removed with a knife blade; and* (c) *the unscathed glass plate.*

When Fusion or Den-Mat, supplemented with unfilled resin, are applied to roughened porcelain, composite resins may provide adequate temporary or emergency repair. The fact remains that no available product can be expected to repair porcelain or exposed metal permanently.

CONCLUSION

Two products were evaluated for porcelain repair. Fusion was found to enhance the repair of fractured porcelain with composite resin but did not improve bonding to gold.

Den-Mat gave lower, but acceptable, values as a system for repairing porcelain.

Cervident and Simulate are not sold for porcelain repair but could be used for that purpose when a suitable bonding material is used prior to the repair, as could many other composite resins.

The retention of composite resins using bonding materials with unfilled resin gave high retentive values when used for porcelain repair, but bonding to gold is apparently ineffective under the conditions of the experiment.

FIG. 11. Scanning electron micrograph (1000x) of porcelain silhouette, finished with silicon carbide paper, 240 grit, to show crevices that may induce mechanical bonding with tags of composite resin or unfilled resin.

This study was supported in part by the National Institutes of Health, National Institute of Dental Research, Research Grant No 5-RO-1-DE03504-08 and by the Fifth District Dental Society of Atlanta.

DEPARTMENTS

Press Digest

Factors producing failure of class II silver amalgam restorations in primary molars. Myers, D R (1977) *Journal of Dentistry for Children* (44), 226-229.

A recent study of silver amalgam fractures has reported that 88.7% of amalgam restorations in primary molars require replacement. The interaction of several factors in Class II cavity preparations likely to cause failure is discussed. Extended outline form and sharp line angles at the cavosurface enhance the possibility of breakdown due to chemical and physical factors. The outline should be as narrow as possible, while eliminating all caries and defects. Proximal retentive grooves are unnecessary. Moisture contamination should be avoided and all restorations should have a final polish. Occlusal forces produce tensile stress in the tooth and the restoration. Therefore adequate depth of cavity preparation is necessary and the child's occlusion should be checked to prevent immediate fracture of the amalgam.

Microleakage around a pit and fissure sealant. Powell, P B & *others* (1977) *Journal of Dentistry for Children* (44), 298-301.

This investigation addresses the relative sealing properties of one commercially available pit and fissure sealant (Nuvaseal) when applied to human teeth, in vitro and in vivo. Fifty-two extracted teeth were cleaned and sealed with sealant according to manufacturer's instructions for the in vitro portion of the study. Sixty-three teeth designated for extraction were selected for the in vivo study. The procedure for determining microleakage as described by Swartz and Phillips utilizing ^{45}Ca isotope solution and autoradiographs was used. Of the in vitro teeth 31% exhibited initial leakage while 39% exhibited leakage after three months. The in vivo specimens had a 48% leakage over three months. Of the teeth in occlusion 75% demonstrated leakage.

Moisture contamination appears to be the most significant detriment to sealing. Even though moisture leakage is likely to occur, food particles and plaque cannot gain access to the pit and fissure areas with the sealant in place and this is thought to be a possible explanation for the apparent success of occlusal sealants.

Dress and grooming in dental schools. Terkla, Louis G (1977) *Journal of Dental Education* (41), 535-536.

The attitude of a professional person toward himself, his profession, and his society is influenced not only by his personal beliefs and background but also by the attitude of society toward him. Although people cannot judge professional competence, leaving much to trust, they can judge personal appearance, manners, and personality characteristics. In the absence of specific guidelines, the health professions have developed a generally recognized standard of grooming and dress that they assume the public expects and that has become an integral part of the professional image. Appearance is important; if an individual is very cavalier about his appearance, can we believe he will work with great skill and precision in the delivery of quality oral health care? Shortcuts in grooming may suggest shortcuts in treatment of patients. Standards represented in physical appearance suggest an overall interest in putting out that extra bit of effort.

Anger at £1750 ($3062) pay cut for dentists. Loshak, D (1977) *The Daily Telegraph*, Monday, August 22, p. 2.

The British government is considering docking dentists £1750 ($3062) each over the next three years because according to a "balance sheet principle" for assessing remuneration the dentists have been overpaid. The "balance sheet principle," under which annual increases in expenses are adjusted to compensate for over or under-payment of expenses in previous years, was instituted three years ago at the request of the dentists who now want to scrap it. It has been claimed that several dentists have been forced into bankruptcy and some who have committed suicide may have been driven to it by financial worry. The problem is that expenses of dentists have risen more rapidly than increases allowed by the government. Dentists are demanding substantial increases in fees while the government wants cuts of up to 10%.

The target net income for dentists was £7643 ($13,375) in 1975–76. Dentists claim that if their target gross incomes have been exceeded, it is because dentists have worked harder. They say they each complete 2300 courses of treatment a year, which is double the number completed by Community dentists who are on government salaries, and double the average workload of dentists in other countries. One practitioner remarked that, "The real trouble is that dentists do not get enough time or enough expenses to complete a decent job." Under the circumstances standards are bound to deteriorate.

Letters

Dear Sir:

I read with mixed emotions your editorial, "Expanded Duties: An Economic Fallacy" in the Winter issue. Since *Operative Dentistry* is a journal of potentially great value to practicing general dentists, I feel obliged to comment on your remarks.

Proponents of expanded duties are *not* "mainly government employees and academics" as you wrote. One need only talk to practicing dentists everywhere and listen to their thoughts and needs about expanded duty auxiliaries. Talk to those dentists who are seriously grappling with the problems of keeping fees in line, managing tremendously increasing office overheads while providing more efficient services, and treating greater numbers of patients. Do not talk to the men who have never spent the late hours desperately seeking the answers, nor to those who have simply given up, cut their staffs, their overhead, and their availability to 3½ or 4 days a week.

In your thoughts on the cost of training an auxiliary vs. the cost of training a dentist you rely heavily on the current working life of a dental auxiliary—a generous four years by your estimate. For 1977 that is true. But we may also assume that right now there is very little incentive and motivation for a person to attempt to make a career as a dental office auxiliary. Pay is low, hours long and hassled, and serious, well-thought-out responsibility seldom delegated. The ability to advance in the job is practically nil. Why should anyone aspire to a career in such an environment?

On the other hand, travel the country and visit some of the more progressive offices. Visit them and see the auxiliaries who are alive, fresh, exciting, and interested in their work. Watch them work. Listen to them tell about their job. Understand that they have well-delegated authority and they accept total responsibility for their tasks; understand that it *is* possible for them to think in terms of long-range career. Visit these offices in the cities, suburbs, and rural areas and realize that they are organized by honest, dedicated dentists who are seriously meeting the contemporary challenges head-on. Yes, you are right. Presently the worklife of a dental auxiliary is short, the turnover great. But it's beginning to change—and will continue to do so.

Your reference to Adam Smith and his wisdom in identifying the problems of overspecialization is worthy of consideration. But Adam Smith was speaking, writing, and teaching about the manufacturing industry. Dentistry is a *service* industry. As a nation we have just begun to apply the principles of specialization to services. The problems will undoubtedly surface with time. However, our ability to deal with those problems will also improve with time. The end result will be a vastly more efficient industry than we now see. Not one without new problems, but at least one that has responded to the needs of the time.

You are right when you say that "in the final analysis, there are human beings attached to teeth, and, in any event, human beings are not machines." But the doctor's role is working with those human beings; in communicating with them, in organizing a continuum of care for them, and in making the all-important judgment decisions relative to that human being's dental treatment. Many of the mechanical tasks can be, and presently are, in many areas, delegated to less expensive operators without the loss of the respect and dignity the patient deserves.

Better methods of *organizing* new technology must evolve hand-in-hand with the technology itself. One of those means will be the delegation of chairside tasks to expanded duty auxiliaries. Fortunately—because it's the patients' only hope in receiving faster, more efficient dental care at a reasonable fee.

Sincerely,
Carl A Flecker, Jr
760 Medical Center East
Pittsburgh, PA 15206

Book Review

PATHWAYS OF THE PULP

Edited by Stephen Cohen, DDS, FICD, FACD, and Richard C Burns, DDS, with 32 contributors.

Published by C V Mosby, St Louis, 1976. 681 pages, 1737 illustrations. Principal illustrator, Richard C Burns. $29.50

As a restorative dentist outside the specialty of endodontics, my purpose in reviewing this generously illustrated and highly understandable text was not to evaluate its worth as a technical treatise, but rather to bring my own knowledge up to date and to find answers to problems the restorative dentist constantly faces in pulp pathology, problems either immediately resulting from or as a future consequence of operative procedures. The time and effort spent was a useful and fulfilling endeavor.

At the outset, the editors have stated two general objectives, both effectively followed. One is "that endodontic concepts and perception can best be acquired through graphics"; the other, that with the virtual explosion in the body of knowledge of endodontics "no single dentist can possibly know all that pertains to this phase of dentistry" and that the cooperative work of the contributing authors "simultaneously mirrors their individuality and [yet] blends together as a unified whole." The text is divided into four main parts, each part logically and sequentially subdivided so as to form a unified whole.

Although the first section, "The Art," is devoted strictly to endodontic treatment, the operative dentist will nevertheless find this section beneficial, particularly the first chapter, "Diagnostic Procedures." It lays out an orderly and organized procedural method for making diagnostic decisions when the clinician is confronted with tooth-related problems possibly necessitating endodontic intervention.

The entire second section, "The Science," is of fundamental informational value. The chapter on histology and physiology is excellent, as are the electron microscope photographs. This chapter, coupled with the chapter on pathology, is important as a means of better understanding normal tissues, physiologic changes that occur in normal tissues, and this relationship to pathology. The section on pharmacology is thorough and should be of importance to the practitioner who must occasionally treat a dental pathology complicated by a superimposed medical problem.

Chapter 20 in Part III, "Postendodontic Restoration," is of special importance, particularly in today's orientation to the value of "saving" teeth. It addresses itself to methods of restoring teeth whose previous endodontic treatment has severely weakened the restorative base. It is excellently written and superbly illustrated.

The index is complete, extensive, and well detailed, and enhances the value of the book as a reference text for the busy practitioner.

To have successfully put a book of this magnitude together is laudable, and to ask for more seems inappropriate. However, with the current emphasis in all dental fields on prevention, it seems that a valuable and timely addition would be a section devoted to those questionable and inadvisable restorative procedures that, when entered into, are likely to cause irreversible pulp changes. Such an addition would make the book multipurpose for students—basically a text on endodontic therapy, but also a guide for the restorative student on how best to avoid pulp-oriented problems.

Lyle E Ostlund

Announcements

Former Dean of Dentistry Assumes Vice-Presidential Position

Dr Jose E Medina, director of space planning and utilization at the University of Florida Health Center since 1974, has been named assistant vice-president for facilities planning and operations. His responsibilities will include those of professor of operative dentistry.

Dr Medina served as associate dean, then dean, of the College of Dentistry from 1967 through 1974. In all positions, Dr Medina has been instrumental in developing the college academically and physically. Construction of the Communicore, as well as the eleven-story Dental Sciences Building with its outpatient clinics, offices, and laboratories, was managed through Dr Medina's office. The college, which is the first of its kind in Florida, admitted its first 24 students while Dr Medina was dean.

In his new position, Dr Medina is responsible for the management and control of the J Hillis Miller Health Center's 2,100,000 square feet of space, including Shands Teaching Hospital.

Working with the Board of Regents and university architects, Dr Medina coordinates all planning, renovation, and refurbishing of existing facilities and construction of new ones. In addition, the Physical Plant Division, including all maintenance operations, reports to Dr Medina. An emerging area of responsibility for the position is management of life safety.

Before coming to the University of Florida, Dr Medina served as assistant dean and professor of operative dentistry at the University of Maryland's School of Dentistry.

Among the honors he holds are fellowships in the American College of Dentists, American Association for the Advancement of Science, and the International College of Dentists. In 1973 he was named Honorary Fellow in the Academy of General Dentistry. He was the first editor of the *Journal of the American Academy of Gold Foil Operators.*

Presently he is a member of the American Dental Association, the Florida Dental Association, the American Academy of Gold Foil Operators, the Academy of Operative Dentistry, and the International Association for Dental Research. He is the director of gold foil study groups in Florida, West Virginia, and New England.

NOTICE OF MEETINGS

Academy of Operative Dentistry

Annual Meeting: February 2 and 3, 1978
Hyatt Regency Hotel
Chicago, Illinois

American Academy of Gold Foil Operators

Annual Meeting: October 19 and 20, 1978
Pearl Harbor
Hawaii

INSTRUCTIONS TO CONTRIBUTORS

Correspondence

Send manuscripts and correspondence about manuscripts to the Editor, Professor A. Ian Hamilton, at the editorial office: OPERATIVE DENTISTRY, University of Washington, School of Dentistry SM-57, Seattle, Washington 98195, U.S.A.

Exclusive Publication

It is assumed that all material submitted for publication is submitted exclusively to *Operative Dentistry*.

Manuscripts

Submit the original manuscript and one copy; authors should keep another copy for reference. Type double spaced, including references, and leave margins of at least 3 cm (one inch). Supply a short title for running headlines. Spelling should conform to *Webster's Third New International Dictionary,* unabridged edition, 1971. Nomenclature used in descriptive human anatomy should conform to *Nomina Anatomica,* 3rd ed., 1966, and *Nomina Histologica,* 1975; the terms 'canine', 'premolar', and 'facial' are preferred but 'cuspid', 'bicuspid', and 'labial' and 'buccal' are acceptable. SI (Système International) units are preferred for scientific measurement but traditional units are acceptable. Proprietary names of equipment, instruments, and materials should be followed by the name and address of the source or manufacturer, in parentheses. The Editor reserves the right to make literary corrections.

Tables

Submit two copies of tables typed on sheets separate from the text. Number the tables with arabic numerals.

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References

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