

CLINICAL EVALUATION OF AN ACRYLIC PONTIC "ADHESIVELY"
BONDED TO UNCUT ABUTMENT TEETH: 18 MONTH RESULTS

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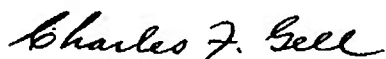
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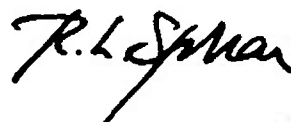
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SUMMARY PAGE

THE PROBLEM

To evaluate the use of a composite dental resin in construction of an "adhesive bridge", as has been described in the dental literature. Rapid chairside construction makes this "bridge" of obvious interest to the Navy dentist who must frequently operate without laboratory support. We wish to know whether this new prosthesis is as esthetically pleasing, as effective, and as durable as the muco-adhesive partial denture it would presumably supplant.

FINDINGS

Evaluations over a period of 19 months indicated that "adhesive bridges" offer definite advantages in ease of construction, oral tissue compatibility, and esthetics, particularly to the service dentist. The advantages were offset to a considerable degree however by uncertainties in service life of the restoration. Re-examinations showed that the dislodged bridges failed at the interface between the pontic and resin suggesting that an effective "tie coat" between the resin and pontic would improve the success rate for this technique.

APPLICATIONS

Navy dentists without laboratory support have available to them in their dental operatories a technique that will permit at least short-term esthetic replacement of missing single anterior teeth. It is suggested that those dentists with complete laboratory support should consider this technique for those cases where treatment (temporary) partial dentures were previously constructed.

ADMINISTRATIVE INFORMATION

This investigation was conducted as part of Bureau of Medicine and Surgery Research Unit M4305.04-3009. The present report is Number 1 on this work unit. It was submitted for review on 20 December 1974, approved for publication on 23 December 1974, and designated as NavSubMedRschLab Report No. 798.

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ABSTRACT

An "adhesive bridge" technique permitting the chairside replacement of missing single anterior teeth was evaluated over a 19-month period in 18 subjects.

Results indicated that "adhesive bridges" offered definite advantages in ease of construction, oral tissue compatability, and esthetics, particularly to the Navy dentist without access to laboratory support. These advantages were offset to a considerable degree however by uncertainties in service life of the restoration.

Re-examination of the failed "bridges" showed that delamination occurred at the interface between the pontic and Bis-GMA resin used to cement the pontic to the natural teeth. This consistent mode of failure suggested that an effective "tie coat" between the resin and pontic would improve the success rate for this technique.

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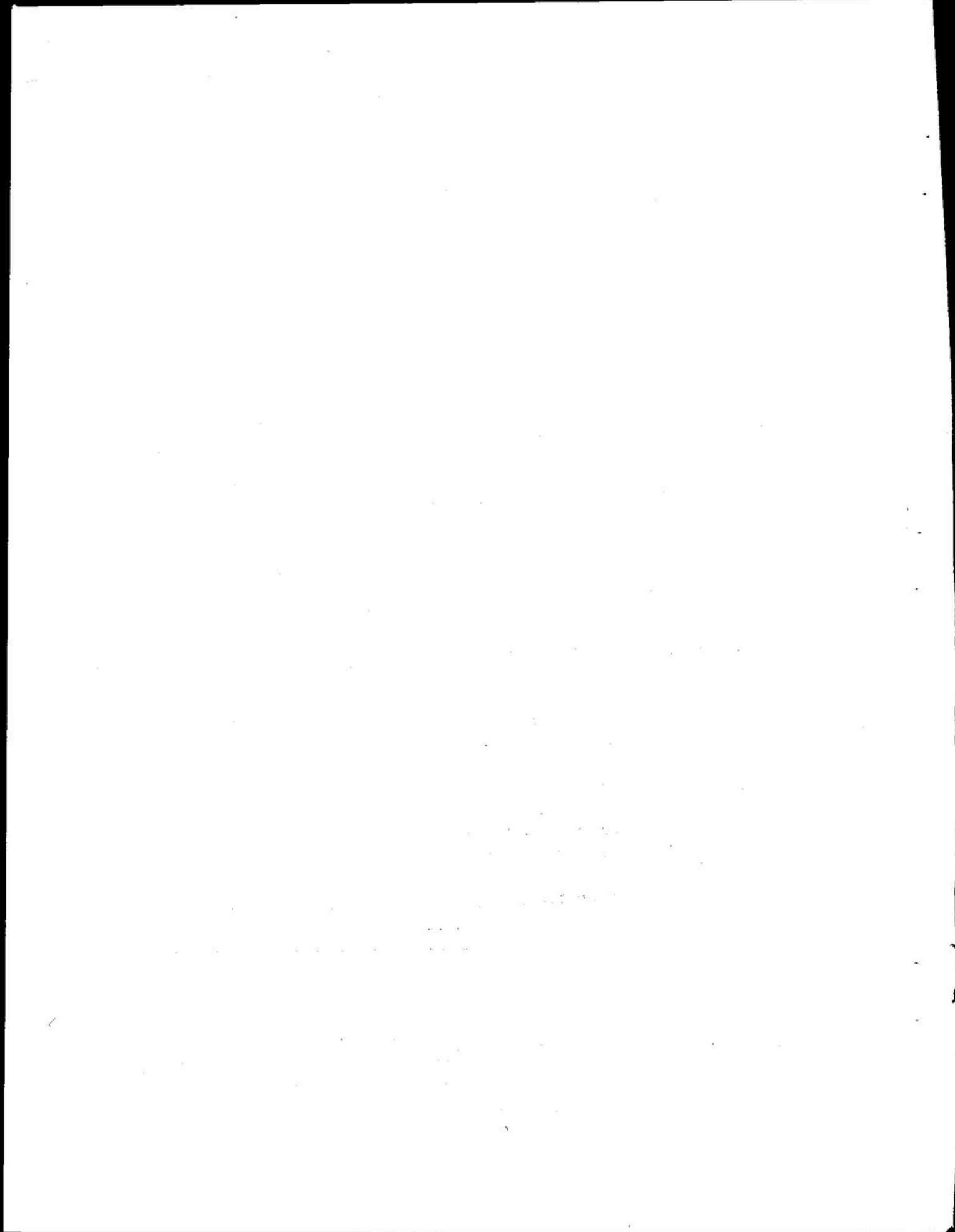
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CLINICAL EVALUATION OF AN ACRYLIC PONTIC "ADHESIVELY" BONDED TO UNCUT ABUTMENT TEETH: 18 MONTH RESULTS

INTRODUCTION

Buonocore in 1955 described a successful acid etch technique which promoted the bonding of dental resins to the enamel of human teeth.¹ A modification of this technique used in conjunction with the dimethacrylate monomer (Bis-GMA) developed by Bowen² has become a large and growing part of the dental armamentarium.

1. Pit and fissure sealants provide highly significant reductions in occlusal caries for newly erupted posterior teeth for at least two years.^{3,4}

2. "Adhesive" # anterior restoratives, combining the superior esthetic and physical properties of Bis-GMA composite resins with the tenacious bond produced through the acid etch technique, permit reconstruction of fractured anterior teeth in one sitting often without anesthesia.^{5,6}

3. Orthodontic banding is accomplished effectively using simple appliances "adhesively" bonded directly to one enamel surface of the tooth in place of the traditional and time

intensive banding technique which employs appliances encircling the coronal portion of the tooth and held in place with zinc phosphate cement.⁷

The current enthusiasm for this "new" tool of "adhesive" dentistry will probably be tempered with time and a better understanding of the limitations of the various polymer-etchant-enamel combinations useful to dentistry. Present trends indicate however that "adhesive" procedures will be used extensively both properly and improperly in this decade.

A potentially useful technique reported by Ibsen⁸ and Portnoy⁹ and described in greater detail by a dental manufacturer¹⁰ advocates the use of a composite Bis-GMA resin[†] to "adhesively" bond an acrylic pontic directly to natural abutment teeth having suitable unrestored and caries free proximal surfaces. The resulting "bridge," which can be constructed entirely at chairside without laboratory support, is suggested for use in place of mucoadhesion partial dentures (flippers).

The durability of these "bridges" in intraoral service has not been reported however, so that the dentist contemplating this procedure cannot logically rank it among his various accepted alternatives for prosthetic treatment.

The American Dental Association accepts the term adhesion only where the bonding mechanism places no reliance on mechanical interlocking effects. The terms "adhesion" and "adhesive" are used here in their popular context.

† Restodent
Lee Pharmaceuticals
South El Monte, California

Extensive experience in this laboratory, both with sealants¹¹ and "adhesive" anterior restoratives, led us to consider the "adhesively" bonded pontic as a logical application of the materials involved, and to assess this technique which might prove to be both cost effective for the Navy and satisfying to the dentist and patient. Also, its use if indicated by the significant portion of Navy dentists without laboratory support would be an important extension of prosthetic services.

METHODS AND MATERIALS

Subject selection for this investigation was made from patients with unsatisfactory "flipper" partial dentures, patients with gingival and/or palatal inflammation resulting from their own misuse of "flipper" partial dentures, patients scheduled for full arch extractions whose previous partial dentures were no longer usable because of already completed extractions, and some few patients with no previous prosthetic experience who, after being made aware of the alternatives, chose an "adhesive bridge." Conventional fixed bridge-work was not a practical alternative at this activity because of constant excessive demand for that service. No immediate replacements were made. All but one of the "bridges" were placed in mouths wherein at least 6 weeks healing had taken place.

Two patient sittings were involved. At the first sitting the occlusal relationships were evaluated, an alginate impression was made and a shade

taken for the pontic.* During the interval between sittings the selected pontic was adjusted using the model obtained from the alginate impression.

At the second sitting the pontic was checked in the mouth for shade, form, and possible final adjustment. The pontic was further reduced incisally and gingivally on its proximal aspects to allow a greater bulk of resin in the contact area. A deep dovetail was cut mesiodistally in the lingual of the pontic to create space for a continuous bar of resin from one abutment to the other in the completed "bridge." The pontic was then scrubbed with isopropyl alcohol to remove debris and adherent organic material. During the cleaning and all subsequent steps, the pontic was held by the incisal portion, and in no case was the area of intended contact with the resin touched. The abutment teeth were cleaned with flour of pumice in a rotating rubber cup and rinsed. The teeth were isolated with gauze, etched for two minutes with a gel type proprietary etchant[†] and washed for 30 seconds. The etched areas included the proximal surfaces and a small portion of the adjacent facial and lingual surfaces. The gauze was replaced and the teeth thoroughly dried for at least 30 seconds with clean, dry air, avoiding any salivary contamination, to achieve a characteristic chalky white appearance. A flattened strip of utility wax was

*Trubite Bioblend
Dentsply International
York, Pennsylvania

†Restodent
Lee Pharmaceuticals
South El Monte, California

pressed to the lingual surface of the tooth next to the distal abutment for later use.

Resin⁺ was then mixed (to a thinner consistency than used for incisal fracture restorations) and placed on the etched areas of the abutments and on the proximal and lingual portions of the pontic. The pontic was held in position while the wax strip was adapted with finger pressure to the lingual of the abutments, and the pontic adjusted for optimal position. This procedure was not allowed to displace the resin from the contact area nor from the lingual groove in the pontic. Additional resin was added as desired to the facial aspect of the abutments and pontic at this time. Polymerization was allowed to go to completion without movement or stress application which could disturb the development of the greatest possible strength in the adhesive joint. The set of the resin was determined from excess material on the mixing pad but in no case was the bridge disturbed in less than five minutes.

The occlusion was absolutely cleared in centric relation. Occlusion was also cleared in excursive movements except that excursive contacts were not reduced to the point where an unacceptable esthetic result occurred.

Contouring was accomplished with a flame shaped diamond point followed

⁺Restodent
Lee Pharmaceuticals
South El Monte, California

by sandpaper discs. DEDECO** midget tan proximal finishing points provided a convenient and acceptable final surface.

RESULTS

Twenty-four "adhesive bridges" were placed over a 13-month period from March 1973 to April 1974. Teeth replaced were central and lateral incisors only (Table I). Eighteen subjects have been re-examined or contacted by phone. Six subjects have apparently been lost to the study.

At the time of this report, ten "bridges" were still in place functioning normally. The mean time of service for the intact "bridges" was 13.4 months with a range of 7 months to 19 months. Eight "bridges" were dislodged. The mean length of service before loss was 5.4 months with a range of one month to 16 months, and with two of the eight failures occurring after more than five months service.

Re-examinations showed that the dislodged "bridges" did not fail at the interface between tooth and resin but instead failed at the interface between the pontic and resin.

Five subjects, transferred following placement of their "adhesive bridges," were evaluated at their new duty stations by 14 Navy dentists not associated with the study. These examiners responded to a questionnaire prepared by the authors. All

**Dental Development & Mfg. Co.
653 Washington Avenue
Brooklyn, New York

TABLE I
RETENTION DATA FOR "ADHESIVE BRIDGES"

Subject	Missing Tooth	"Adhesive Bridge" Placement Date	Failure Date	Intact Date	Length of Service In Months	
					Failure	Intact
1	7	Apr 73		Nov 74		19
2	Not recorded	Apr 73	Sept 73			5
3	8	May 73	June 73			1
4	8	May 73		Nov 74		17
5	8	May 73		Dec 74		18
6	10	May 73	Sept 74			16
7	10	Jun 73		Aug 74		13
8	10	Jun 73	Sept 73			3
9	10	Aug 73	July 74			10
10	26	Aug 73		Nov 74		15
11	24	Oct 73		Dec 74		14
12	10	Dec 73		Dec 74		12
13	8	Dec 73	Jan 74			1
14	7	Jan 74		Nov 74		10
15	10	Jan 74	June 74			5
16	9	Feb 74		Nov 74		9
17	8	Mar 74	May 74			2
18	7	Apr 74		Nov 74		7

6 subjects lost to study

3 upper central incisors
2 upper lateral incisors
1 lower central incisor

Mean 5.4 13.4

examiners did not respond to every question. Three of the five subjects had intact "bridges" at the time of examination.

Eight responders judged the "bridges" superior in esthetics, four satisfactory and none unsatisfactory. As to the physiologic result, (i.e., gingival health, oral hygiene and effect on abutments) all 12 responders rated the "adhesive bridge" superior to muco-adhesion partial dentures without reservation and also to cast framework partial dentures, but with unstated qualifications in some instances. All 12 responders stated that they would use the technique after evaluating an intact "adhesive bridge." All 14 responders reported using the acid etch technique in one form or another for "adhesive" type bridges and/or other "adhesive" anterior restorations.

DISCUSSION

The results reported here indicate that the "bridge" described should be considered as a possible alternative to muco-adhesion partial dentures. The technique should be particularly attractive to the service dentist who frequently must operate without laboratory support. The failure rate experienced in this study however also attracted notice to the fact that all "adhesive bridges" do not perform indefinitely. The advantages of oral tissue compatibility, ease of construction and superior esthetics inherent in this prosthesis were offset to a considerable degree by uncertainties in service life of the restoration.

We have attempted to place this valuable new technique in sensible perspective. Prior reports in the literature are confined to descriptions of individual cases without documentation of intra-oral performance with time and do not comment on acknowledged failures by other operators. Non-citable failures have been described to the author by dental trade scientists and the overall pattern of these failures was consistent with our results.

Although a multitude of clinical variables existed in different degrees for each subject, three are identified here which appeared to markedly affect the possibility of success:

1. The area of both the tooth and the pontic wetted by the resin. The greater the wetted area, the greater the possibility for success.
2. The width of the space to be filled. The shorter the span the greater the possibility for success.
3. Occlusal stress transmitted to the pontic. Minimizing biting stresses to be borne by the pontic through careful clearing of the occlusion in all excursions increased the possibility of success.

These factors obviously are interrelated. Increased span and/or exposure to strong biting forces can be compensated for up to a point by increasing the cross-section of the adhesive joint and thereby increasing its strength. It is interesting to note in this context that the one bruxist in the study dislodged the pontic replacing #8 in less than one month.

Tolerance limits for success cannot be described because of the unique

character of each patient, but the factors described should be of help in identifying cases where success might be expected and those where the technique is logically contraindicated, i.e., a long span where the abutment teeth are short inciso-gingivally, offering little area for adhesion, would not be a sensible case for an "adhesive bridge."

Since all observed failures occurred at the interface between the pontic and the Bis-GMA resin, an improvement in the strength of this interface should materially improve the success rate for the technique.

It is highly unlikely that effective chemical crosslinking can occur between the high molecular weight, highly crosslinked, heat cured, polymethyl methacrylate pontic and the viscous Bis-GMA resin. It is also unlikely that the freshly mixed Bis-GMA resin effectively penetrates the surface of the pontic because of the relatively large size of the Bis-GMA molecule. A lower molecular weight methacrylate polymer however with inherently lower viscosity and much smaller molecular size when applied as a "tie coat" to the pontic, would presumably penetrate its outer surface and polymerize in an interlocking fashion with the non-reactive polymer chains of the pontic, forming a strong mechanical bond. Finally, crosslinking of freshly mixed Bis-GMA resin to a still unset "tie coat" should complete a physically improved joint, better able to withstand dislodging forces.

SUMMARY

Eighteen "adhesive bridges," replacing central or lateral incisors, were evaluated over a 19-month period to document the intra-oral performance of this new prosthesis.

The overall results indicated that "adhesive bridges" offered definite advantages in ease of construction, oral tissue compatibility, and esthetics, particularly to the service dentist without access to laboratory support. These advantages were offset to a considerable degree however by uncertainties in service life of the restoration.

Re-examinations showed that the dislodged bridges failed at the interface between the pontic and resin suggesting that an effective "tie coat" between the resin and pontic would improve the success rate for this technique.

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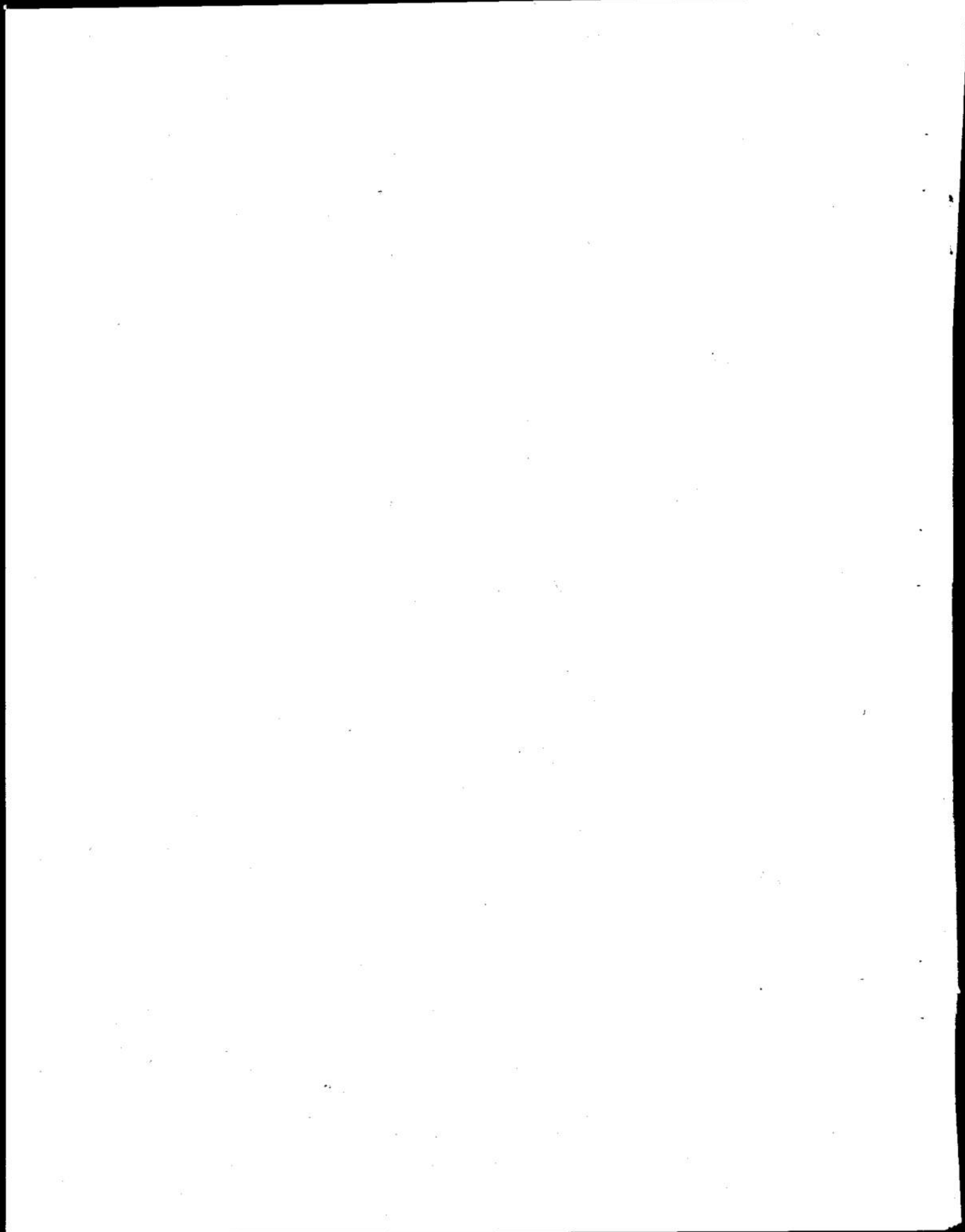
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This clinical study was conducted in a climate of active, interested cooperation between clinic and laboratory personnel.

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Bowen's resin						
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