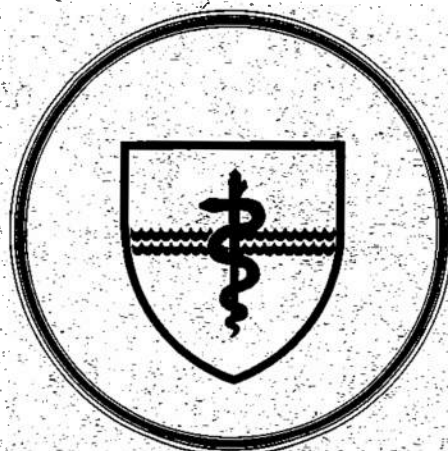


**NAVAL SUBMARINE MEDICAL
RESEARCH LABORATORY
SUBMARINE BASE, GROTON, CONN.**



REPORT NUMBER 818

CLINICAL EVALUATION OF ACIDULATED-PHOSPHATE-FLUORIDE
IN THE NAVY'S PREVENTIVE DENTISTRY PROGRAM

by

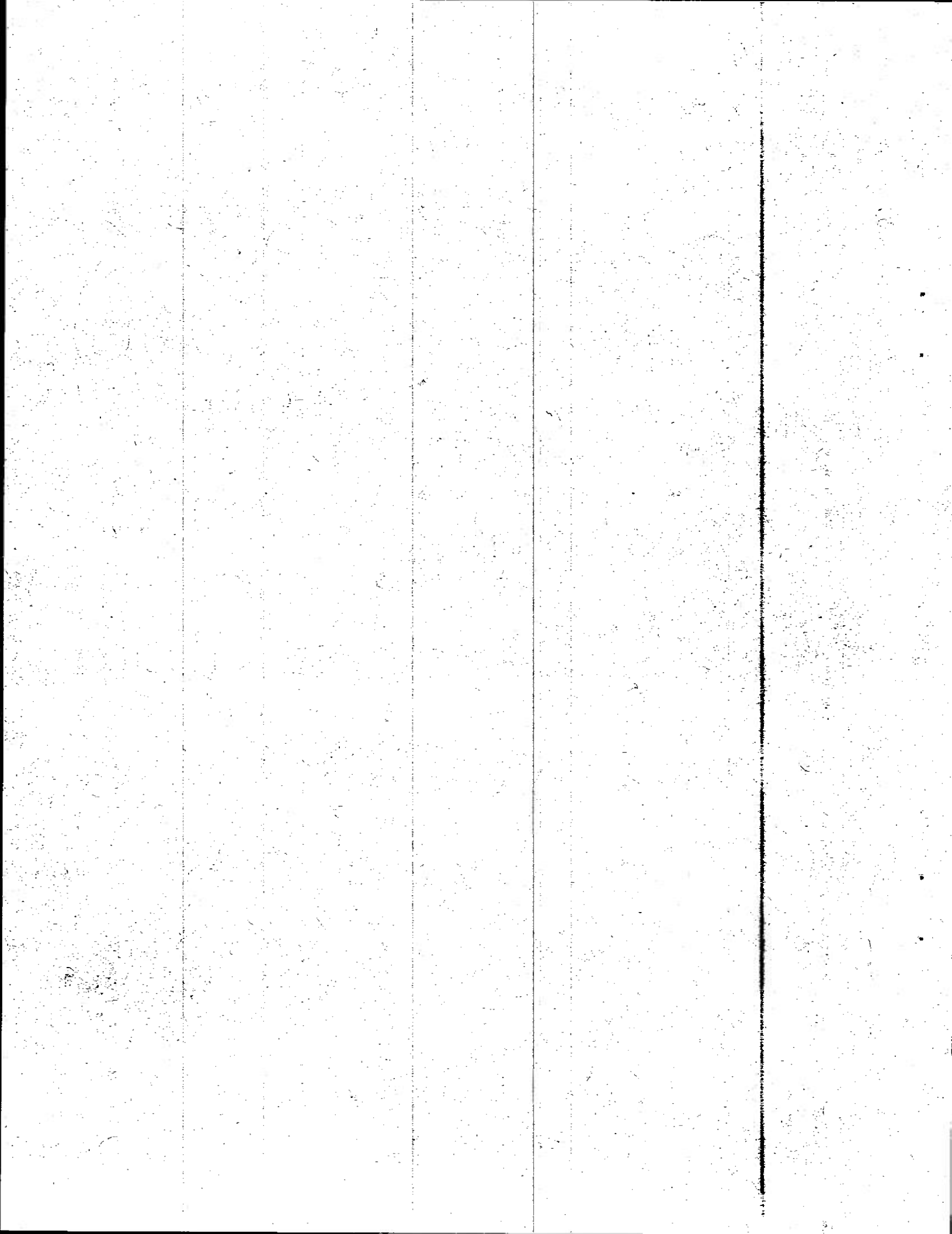
W. R. Shiller
and
F. P. Scola

Bureau of Medicine and Surgery, Navy Department
Research Work Unit MR005.20.01-6054.02

Released by:

R. L. Sphar, CAPT, MC, USN
Commanding Officer
Naval Submarine Medical Research Laboratory

15 January 1976



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W. R. Shiller, CDR, DC, USN (Ret)

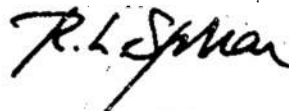
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SUMMARY PAGE

THE PROBLEM

The stannous fluoride used in the Navy's preventive dentistry program has certain objectionable features; unpleasant taste and a tendency to stain the teeth. Another fluoride agent, acidulated-phosphate-fluoride has been reported to be free of these qualities and to be effective in caries prevention. A clinical trial was required to assess the relative effectiveness of these two agents.

FINDINGS

No meaningful interpretation of the fluoride effects was possible because of noncomparability of the groups. Good agreement between examiner results was present with the assessment technique used.

APPLICATIONS

The assessment method using posterior interproximal surfaces for caries studies appear to be well suited to some Navy preventive dentistry studies. The study is reported for historical interest and as an example of clinical trial hazards.

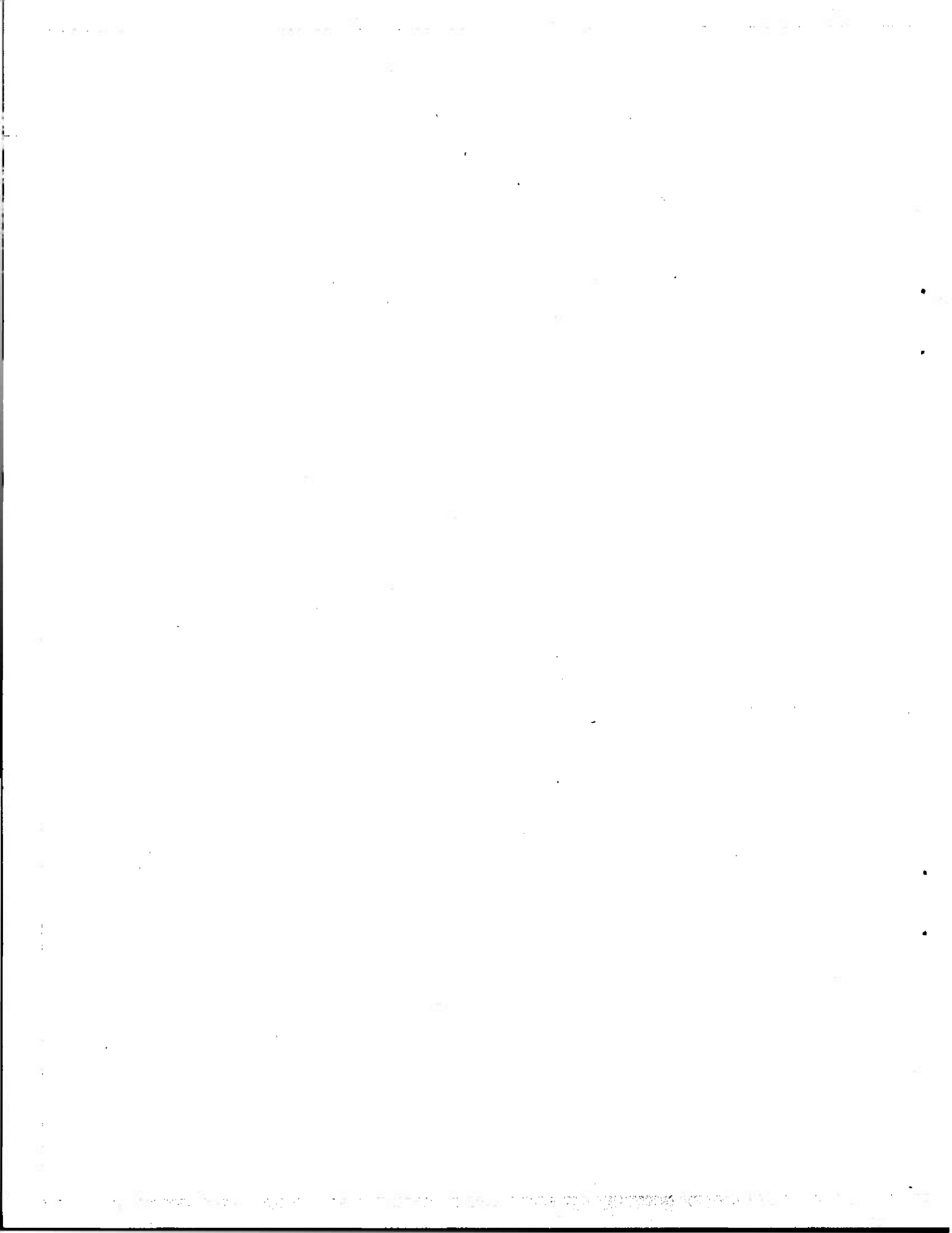
ADMINISTRATIVE INFORMATION

This investigation was conducted as a part of Bureau of Medicine and Surgery Research Work Unit MR005.20.01-6054 - Clinical Evaluation of Acidulated-Phosphate-Fluoride in Preventive Dentistry. This report has been designated as Naval Submarine Medical Research Laboratory Report Number 818. It is Report Number 2 on this Work Unit and was approved for publication as of 15 January 1976.

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ABSTRACT

The stannous fluoride used in the Navy's preventive dentistry program has certain objectionable features: unpleasant taste and a tendency to stain the teeth. A study was designed to assess the feasibility of substituting acidulated-phosphate-fluoride which is reported to be as effective as stannous fluoride but does not possess the objectionable features. Naval recruits were used as subjects and were placed in three groups; stannous fluoride, acidulated-phosphate-fluoride and a placebo control. Assessments of effectiveness were based on caries increments in the posterior interproximal teeth surfaces during a one year period. It was discovered that the groups were initially noncomparable and the study essentially yielded no meaningful results. The study is reported for historical interest and as an example of clinical trial hazards.



CLINICAL EVALUATION OF ACIDULATED-PHOSPHATE-FLUORIDE
IN THE NAVY'S PREVENTIVE DENTISTRY PROGRAM

INTRODUCTION

The three-agent method of stannous fluoride use is an accepted part of the Navy-wide preventive dentistry program. This method consists of a prophylaxis using a lava pumice containing 8.9% stannous fluoride followed by a topical application of 10% aqueous stannous fluoride. The third agent is a fluoride containing dentifrice. The effectiveness of this method in young naval personnel was first demonstrated by Scola and Ostrom.¹ A modification² consisting of a self-preparation prophylaxis was found to be equally as effective as the older method in which a dentist or technician performed the prophylaxis.

Anyone associated with the Navy preventive dentistry program realizes that the stannous fluoride agents used have some unpleasant qualities with regard to taste and tissue reactions. Shiller and Scola³ found that these qualities probably did not result in patient rejection of the treatment. The fact remained, however, that some disagreeable characteristics were present; the elimination of which could do nothing but enhance the overall preventive dentistry program.

It was felt that acidulated-phosphate-fluoride might be the answer to the problem. The anticaries effectiveness of this agent had been reported by several workers.^{4,5,6} In addition, this agent was reported to be free of objectionable taste and tissue reactions.

The present study was conducted to discover if acidulated-phosphate-fluoride could be substituted for the stannous fluoride in the Navy's preventive dentistry program without impairing the effectiveness of that program.

MATERIALS AND METHODS

The widespread use of fluorides in the Navy's preventive dentistry program has made it impossible to inaugurate a fluoride study anywhere except at one of the recruit training centers. It was, therefore, decided to use incoming recruits at the Great Lakes Naval Training Center. The subjects were assigned to three treatment groups as depicted in Table I. Group A received stannous fluoride; Group B received acidulated-phosphate-fluoride; and Group C received placebo treatment agents in which sodium chloride was used.

The stannous fluoride pumice and topical agents were prepared in the standard manner for the Navy's preventive dentistry program; namely, 8.9% SnF_2 in pumice and 10% SnF_2 in the aqueous solution. The acidulated-phosphate-fluoride topical solution was prepared according to the manufacturer's directions; namely, to contain 1.23% fluoride ion in 0.1 molar o-phosphoric acid. The acidulated-phosphate-fluoride pumice mixture was prepared to contain a concentration of fluoride ions about equal to that of the stannous fluoride pumice paste. The calculated percentages for the fluoride ion concentration were 2.2% for the stannous fluoride paste and 2.05% for the acidulated-phosphate-fluoride paste.

The agents were prepared by the investigators and were administered by the Great Lakes Preventive Dentistry Unit in their routine manner. This consisted of having the men brush with the pumice paste under instruction then having each man's teeth swabbed with an aqueous topical solution for 15 seconds. At the same time the group was urged to use one of the ADA (American Dental Association) approved fluoride containing dentifrices in his home care program.

Table I
Initial Group Characteristics

Group	N	Examiner A DMFS(IP)	Examiner B DMFS(IP)	Age
A	437	9.29* ± .331**	9.95 ± .342	18.96 ± .05
B	395	10.51 ± .359	11.35 ± .377	19.03 ± .06
C	393	8.25 ± .337	9.13 ± .360	19.06 ± .06

*Mean
**Standard error of the mean.

Table II
Posterior Interproximal Caries Attack Rates (RID)

Group	N	Examiner A	Examiner B
A	437	3.99* ± 0.336**	6.25 ± 0.415
B	395	4.66 ± 0.465	7.05 ± 0.482
C	393	4.30 ± 0.370	6.44 ± 0.417

*Mean
**Standard error of the mean.

Table III
Posterior Interproximal Caries Increments

Group	N	Examiner A	Examiner B
A	437	.64* ± .068**	1.12 ± .065
B	395	.66 ± .073	1.20 ± .071
C	393	.70 ± .068	1.22 ± .073

*Mean
**Standard error of the mean.

The manner of evaluation departed somewhat from the usual clinical caries study. This was necessitated by the fact that after recruit training the subjects would be scattered all over the world. It was decided to use posterior bite-wing x-rays alone for examining purposes. The effective use of x-rays has previously been reported by other workers.^{7,8}

For this study, film packets were made to contain two films in each so that one could be retained by the investigator and one could go into the subjects' dental record. The x-rays were exposed and developed in the standard manner. Each subjects' dental record jacket (Form 722) was marked in bold letters "RESEARCH SUBJECT." Inside this jacket, in addition to an ordinary standard dental Form 603, there was included a set of instructions for the exposing and forwarding of bite-wing x-rays and for the completion of a questionnaire.

In order to get maximum return of completed cases, the Bureau of Naval Personnel electronic data processing facilities were utilized. One month prior to the first anniversary of the study, the IBM card file of the study sample was forwarded to the Bureau of Naval Personnel. A list of the current duty stations of the subjects was provided by that office. A form letter was then sent to each command giving the names of subjects at that command and containing a reminder to follow the instructions in the dental record.

Out of the 1800 subjects placed in the study, one-year data were received for 1332. A total of 1225 sets of data were complete and contained x-rays of satisfactory quality.

The two sets of x-rays were mounted in a plastic mount so that they could be compared while being evaluated. Each of the 32 posterior interproximal surfaces (excluding third molars) were evaluated by each investigator according to the following criteria:

- 0 (Sound) - No evidence of surface involvement
- D₁ - Enamel caries not extending to the dentino enamel junction
- D₂ - Enamel caries at the dentino enamel junction
- D₃ - Caries with minimal dentin involvement
- D₄ - Caries extending over 1/4 of the distance from the dentino enamel junction to the pulp
- D₅ - Caries at or in the pulp.

A total score for each subject was computed by counting the number of involved surfaces at each examination time. Some consideration for those surfaces not clearly visible had to be included in this score. It was, therefore, assumed for convenience that if the surface in question was clearly visible in one examination, its condition was the same in the other examination; and if the surface was not clearly visible in either examination, it was sound. The incidence score so derived was termed the DMFS (IP) (Decayed, Missing, Filled Surfaces) (Interproximal Posterior) score.

A caries attack rate was also computed for each subject by dividing the DMFS (IP) score by the number of surfaces initially at risk (not involved at first examination).

RESULTS

The initial noteworthy characteristics of each group are presented in Table I. The ages were closely comparable between groups. Unfortunately, the initial DMFS (IP) scores were not so evenly distributed. Surprisingly, with such large numbers the control group (Group C) had significantly lower initial scores than did the other two groups. This undoubtedly resulted from the slight departure from strict random distribution necessitated by the mechanics involved in giving fluoride treatment to such large groups in such a short period of time. It is seen that the investigators are in general agreement particularly with regard to the relative ranks of the groups. Actually the means assigned to each group do not differ significantly between investigators.

The caries attack rates for one year are given in Table II. No significant differences were found between the group means. Similar results were found when evaluating the actual caries increments over a one year period (Table III).

The Navy urges a three-agent fluoride program. As was stated before, only a two-agent program was actually instituted in this study; the pumice paste and the aqueous topical. The third agent, a fluoride dentifrice, was left to the individual's volition. The questionnaire administered to each subject at the end of one year contained the question "What dentifrice did you use this past year?" The answers were pooled into fluoride and non-fluoride categories. The Colgate users were discarded from this analysis because fluoride was added to Colgate dentifrice about midway in the year.

Table IV

Caries Increments and Fluoride Dentifrice Use

Group	Dentifrice	N	Examiner A	Examiner B
A	Fluoride	315	.66* ± .085**	1.08 ± .080
	Nonfluoride	58	.53 ± .144	.83 ± .165
B	Fluoride	282	.59 ± .081	1.07 ± .092
	Nonfluoride	55	.93 ± .240	1.18 ± .178
C	Fluoride	284	.73 ± .083	1.15 ± .088
	Nonfluoride	46	.61 ± .137	1.35 ± .239

*Mean

**Standard error of the mean.

Table V

Correlational analysis of examination factors.

Factor	Factor					
	1	2	3	4	5	6
1	+1.0*	+0.35*	+0.05	+0.96	+0.36	+0.15
2		+1.0	+0.79	+0.35	+0.54	+0.41
3			+1.0	+0.07	+0.36	+0.44
4				+1.0	+0.31	+0.07
5					+1.0	+0.81
6						+1.0

*r; where perfect correlation exists, r = 1.

Factor 1 = Examiner B Initial DMFS

2 = Examiner B relative Increment of Decay (RID)

3 = Examiner B DMFS Increment

4 = Examiner A Initial DMFS

5 = Examiner A Relative Increment of Decay (RID)

6 = Examiner A DMFS Increment.

The DMFS (IP) scores are presented according to dentifrices used in Table IV. It is somewhat surprising that such a vast majority of the subjects used a fluoride dentifrice. When applying the Dunnett t test for multiple group comparisons to these data, it is found that none of the mean differences is statistically significant.

Inasmuch as the groups were non-comparable initially with regard to caries experience, a correlation matrix for six examination factors was obtained (Table V). The "r" values are derived from the product moment correlation formula where +1 or -1 equals perfect correlation and 0 equals no correlation. It is seen that there was no correlation between initial DMFS and the DMFS increment for either examiner. These findings made an analysis of co-variance for the initial DMFS concomitant variable effect useless. The fact that a significant positive correlation did exist between the Relative Increment of Decay Index (RID) and the initial DMFS score is discounted because of the intrinsic correlation present between the ratio and the initial score.

DISCUSSION AND CONCLUSION

A first look at the results of this study might prompt one to conclude that both topical fluoride methods were ineffective. Actually, this can not be safely concluded but the study certainly did not answer the question posed in its inception: "Is acidulated-phosphate-fluoride and stannous fluoride equally effective in the Navy's preventive dentistry program?" The fault in this study lies in the initial disparity of the study group.

It was initially planned to ensure comparability of study groups by strict adherence to random selection methods. In actual practice this was found to be impossible. The large number of recruits to be given the preventive dentistry treatment meant that group assignment had to be by roomful lots rather than by

individuals. It was hoped that this group randomization would prove to yield comparability, but such was not the case.

Even though the initial DMFS was not correlated with the caries increment, some unknown and uncontrolled variable in these groups could have accounted for any results. While no effectiveness was shown, the opposite conclusion should not be accepted; because uncontrolled and non-random variables could have erased any fluoride effects from the data.

This study certainly points again to the need for strict randomization when subject stratification or pairing is not employed.

The correlation analysis of the data yielded some interesting information. Even though no particular attention was paid to inter-examiner agreement, it is seen that the agreement was actually very good. This is evidenced by a correlation coefficient of $+0.96$ between the two examiners' initial examination scores.

It might be surprising to some that no correlation existed between the DMFS increment and the initial DMFS score. This was also found in previous caries studies at this laboratory (unpublished data) using total scoring methods. The fact that the RID showed a significant correlation with the initial DMFS score should not be accorded any importance. The inherent correlation present between these two variables makes these coefficients meaningless.

SUMMARY

1. No beneficial effect of topical fluorides was demonstrated under the conditions of this study.
2. Non-comparable groups resulted from enforced non-random selection methods.

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