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U. S. NAVAL SUBMARINE MEDICAL CENTER

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DENTAL SUPPORT FOR SEA LAB III

by

Commander W.R. Shiller, DC, USN

Bureau of Medicine and Surgery, Navy Department
Research Work Unit MR005.20.01-6024B.10

Released by:

J.E. Stark, CAPT MC USN
COMMANDING OFFICER
Naval Submarine Medical Center

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SUBMARINE MEDICAL RESEARCH LABORATORY
NAVAL SUBMARINE MEDICAL CENTER REPORT NO. 638

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SUMMARY PAGE

THE PROBLEM

The project Sea Lab III required special dental support in order to prevent dental problems and to afford acquisition of knowledge for future operations.

FINDINGS

A dental support program was planned and initiated which appeared well suited to the dental needs of the program. Preliminary data collected prior to termination of the project were not remarkable.

APPLICATIONS

The principles and methods evolved for the Sea Lab III project are recommended as a starting point for dental support of any such future operation.

ADMINISTRATIVE INFORMATION

This investigation was conducted as a part of Bureau of Medicine and Surgery Research Work Unit MR005.20.01-6024B - Effect of Stresses of Submarine Service on Oral Health. This report has been designated as Submarine Medical Research Laboratory Report No. 638. It is Report No. 10 on this Work Unit and was approved for publication as of 3 August 1970.

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ABSTRACT

The dental support for Sea Lab III was carefully planned to prevent and care for dental problems and at the same time to yield information needed for the support of such future operations. The operation was terminated prior to the collection of complete data but the dental support program was seen to be well suited to the needs of the Sea Lab program without interfering with the operation. The principles and methods evolved for the Sea Lab III project are, therefore, recommended as a starting point for dental support of any such future project.

DENTAL SUPPORT FOR SEA LAB III

INTRODUCTION

In meeting the responsibility of military dental support the Navy Dental Corps must adopt a dual role; attempt to assure optimum oral health for carrying out of military missions and acquire knowledge of military environments and their relationships with oral health.

Two rather dramatic examples of the role of military environmental dentistry may be found in the submarine service and in the Antarctic operations. Dental problems accounted for a significant portion of the morbidity reported in World War II submarine patrols¹ and in the early Antarctic expeditions². Recent studies have shown a much reduced incidence of dental problems in these populations^{3,4,5}; however, the isolated and arduous nature of some military duties such as submarines, the Antarctic, and Sea Lab focuses attention to factors in the environment which may influence oral health. So far studies have revealed environmental relationships only between the cold and oral bacteria and between cold and dental thermal responses. With these two exceptions the causes of dental problems have been unknown or have been related to poor oral hygiene and improper dental treatment for the particular environment^{6,7,8,9,10,11,12,13}. Each new environment must be studied, however, if only to rule out factors which may effect the oral health of military personnel subjected to it. It is for this reason that the Navy Dental Corps

became closely involved in the Sea Lab III project.

MATERIALS AND METHODS

It was proposed that the Dental Branch, Submarine Medical Research Laboratory, provide support to the Sea Lab III Program in two main areas: operational and dental monitoring.

1. Operational area

The operational area of support is of course concerned with the prevention and elimination of dental problems which may detract from the military aspects of the project.

A careful dental examination was to be performed on each Sea Lab III participant two months prior to the scheduled operation. They were to be evaluated particularly with regard to factors known to contribute to dental emergencies in submarine personnel. If necessary, consultations were to be held with dental specialists in the area of operation and necessary treatments instituted. At this time individual oral hygiene instructions were to be given as indicated.

Another careful examination was to be performed just prior to the operation. All of these examination records were to be maintained in proper order to afford assistance in diagnosis and treatment in the event of dental problems occurring during the Sea Lab III operation.

2. Dental monitoring area

In meeting the responsibility of military dental support, particularly for special missions, the Navy Dental Corps requires factual information from the military population concerning the prevalence, incidence, progression and correlates of oral disease. For this reason dental monitoring of special operations such as Sea Lab III is particularly attractive to the Dental Corps.

Dental monitoring on special missions should be aimed at obtaining information needed for complete dental support on three levels of concern. These levels are given in the order of importance as far as military dentistry is concerned: the performance level, the pathological level, and the physiological-oral environmental level.

A. The human performance level

On this most important level we are concerned with the identification, prevention and treatment of those conditions which may impair human performance. On a practical basis we are chiefly speaking of dental emergencies, although less acute conditions may provide a nuisance effect mitigating against highest performance capabilities.

In Sea Lab III every attempt was to be made to prevent the occurrence of dental conditions associated with this level; however, postoperational evaluations were planned with these factors in mind. These evaluations were to consist of diary type reports and of postoperational questionnaires.

B. The pathological level

The Navy Dental Corps essentially provides a "public health" service. As such it is responsible for the oral health of the military population even in the absence of a clear, immediate relationship between pathological process and military efficiency. For this reason, the incidence, progress, and associated factors of all oral disease are of interest. This is particularly true of special arduous environments such as Sea Lab III. The two pathological conditions of chief concern are of course dental caries and periodontal disease.

1. Dental caries: While the Sea Lab III operation itself was not to be long enough to permit any real evaluation of its effect on dental decay, the fact that many of the personnel involved would be expected to take part in such exercises over a period of some time in the future makes it desirable to document caries history and caries activity. Caries index scores and x-ray records were to be maintained on the Sea Lab personnel. Standard DMF and DMFS (surfaces) measurements methods were to be used.

2. Periodontal disease: In the case of gingival tissue and other supporting structures we were faced with selecting measurement methods which would allow study of slowly progressing destructive changes for much the same reasons as were stated in the discussion of dental caries. We also had the opportunity to measure rather rapid changes which might be displayed in the highly reactive marginal gingiva. For these reasons, a combination of indices were modified to forms suitable

for the study. The periodontal index of Russell¹⁴ was selected to provide a measure of both rapid and slow periodontal changes. The only modification was to consist of recording both the periodontal pocket and the inflammation contribution to the index scores so that each of the two factors could be analyzed. The periodontal index is admitted to be a somewhat crude measurement method. It was therefore decided to also employ a part of the periodontal disease index of Ramfjord¹⁵. This index has been shown to be precise enough to reflect minor changes such as gingival crest edema. The measurement consisted of a determination of the depth of the gingival sulcus on the mesial and distal surfaces of the six teeth employed by Ramfjord. A calibrated periodontal probe was used and all measurements were made at the facial aspect of the contact point except in the case of the lower left first molar in which case the measurement was made at the lingual aspect of the contact point.

C. The physiological, psychological and oral environmental level (predisposing level)

One very large area of effort in dental research deals with changes in the oral milieu and the factors which may bring about these changes. When these studies are related to the purpose of preventing or treating oral disease they become an important level of concern to the Navy Dental Corps. The special environment of Sea Lab III is certainly of interest with regard to how it may affect oral conditions. Even if no gross pathological effects

were to be found in these personnel, the future dental support of Man-in-the-Sea operations carries the obligation to learn as much as possible on this "predisposing" level.

1. Plaque measurement: The amount of bacterial plaque on the teeth was to be evaluated by means of two indices. The simplified Greene and Vermillion¹⁶ oral debris score was to be computed in order to give an overall idea of mouth cleanliness. In addition, a plaque score of the areas of those teeth measured for the Ramfjord periodontal disease index was to be determined. This latter score was to be taken in order to afford assessment of the relationship between amount of plaque and any fine changes noted in the gingival crest.

2. Dental calculus formation rate: Calculus formation rates are individual traits which probably mirror the overall oral milieu. Two standard indices were selected for measuring this factor: The Volpe-Manhold Index¹⁷ and the Marginal Line Calculus Index of Schroeder and Muhlemann¹⁸. The former index is used to measure over a two or three month period while the later gives results in as short a time as 12 days.

3. Oral bacterial analyses: The oral cavity contains probably a greater variety of bacteria than does any other area of the body. The problem in monitoring for bacterial changes then really becomes one of deciding on limits within which to restrict the study. Bacterial types about which we have the greatest background knowledge in dentistry are the

acidogenic organisms. It seemed natural, therefore, to concentrate on these bacteria.

The overall acidogenic flora level was to be assessed by means of the Snyder's¹⁹ caries activity test. This test measures the acid producing ability of the bacteria in a standard sample of saliva.

It was planned to study specific acidogenic organisms also; namely *Streptococcus mitis*, *Streptococcus salivarius*, *Lactobacilli*, yeasts, staphylococci, and *Veillonella*. This phase of the study was to be conducted by Captain M.A. Mazzarella, DC, USN, who was attached to the Naval Biological Laboratory, Oakland, California.

Administrative procedures:

The times for examinations and data collections were scheduled to meet the needs of the dental program and to fit the operating schedule of the personnel involved.

The first examinations were conducted during the third week in September 1968 at the Naval Shipyard, San Francisco. This was two months prior to the planned start of the Sea Lab operation. Dental spaces and technical assistance was made available by the Dental Department, Hunter's Point Naval Shipyard.

Careful Type II dental examinations were performed on each man. His dental condition was evaluated on the basis of diseases of hard and soft tissue and of other defects. A respon-

sible assessment was then made of the dental work required before the individual would be ready for the Sea Lab operation. This information was immediately made available, in writing, to the medical officer in charge of the personnel. Hygiene instructions were given to each man. These instructions consisted essentially of the Bass²⁰ technique of personal hygiene.

Base line data for monitoring purposes were also collected at this first examination time. The periodontal indices were computed, and the plaque quantity was scored. The lingual surfaces of the lower anterior teeth were cleaned and polished in preparation for the calculus scoring.

The second examination series was performed during the first week of December 1968 at the operations site on San Clemente Island. The purpose of this series was threefold: to ensure optimum dental condition of the personnel, especially of the first two teams; to provide a second base line measurement (10 weeks after the first); and to ready the dental facilities for examinations and treatment required during and after the operation.

Even though liaison had been maintained with the Sea Lab medical officer and with the dental facilities, some uncorrected dental defects were still present at the time of the second examination. Most of these were corrected by the investigator, especially for personnel of teams one and two. Periodontal indices and plaque scores were again recorded. The calculus was scored after the method of Volpe and Manhold and the lingual surfaces

of the lower anterior teeth were again scaled.

The Sea Lab III operation was cancelled soon after the second dental examination. It had been planned to obtain immediate pre and post operation monitoring data on teams two and three. These data were to include the bacteriological studies, the periodontal indices and plaque scores and the marginal line calculus indices. These data would afford comparison between these scored factors in the two weeks prior to living on the bottom and the actual two weeks on the bottom. The final examinations were to have been performed at the end of the entire operation. This time was to have been approximately 10 weeks after the second dental examination and thus would have afforded comparisons in teams one, four, and five of the measured factors in the 10 weeks before the operation with the 10 weeks during the operation. It is apparent that these plans would have enabled some assessment of effects of bottom living per se versus the "stresses" of the operation as a whole.

RESULTS AND DISCUSSION

Probably the most important results are to be found in the standard dental examinations. The results were recorded on the Standard Form 603 and were reduced for ease of interpretation by the medical officer in the form depicted in Figure 1. The overall results of the first examination are tabulated in Table 1. It is im-

mediately recognized that the total numbers add up to greater than 51. If one begins with the fact that 27 men were in good dental condition, then the other 24 men had one or more of the other conditions: caries, serious periodontal disease or poor hygiene. Thirteen men had conditions requiring treatment prior to the operation. These data would certainly indicate the need for making a dentist responsible for the dental condition of personnel in any such operation as Sea Lab III.

The only other data collected in meaningful form was the first and second base line periodontal indices and plaque scores. These data are presented in Table 2. It is apparent that no significant changes occurred during the 10 weeks prior to the operation. These data are very similar to those found in submariners. If the operation had continued, one other column would have been added to Table 2: "post operation." The t test for paired data would have been used to test for significance of differences.

As an overall assessment of the dental program for Sea Lab III, it is still felt that the methods were well suited to give needed information and at the same time not interfere with the operation itself. These plans are therefore recommended as a starting point for dental support of any other such future operation.

B____, R. M.

Teeth: Three (3) carious lesions. Requires early treatment.

Soft tissue: Fair condition; five (5) areas of inflammation.

Hygiene: Fair; could stand improvement.

Other: N.A.

Evaluation: Has a dental appointment. When lesions are filled, he will be ready for Sea Lab III.

D____, G. B.

Teeth: Three (3) carious lesions; not urgent.

Soft tissue: Fair; four (4) areas of inflammation and generalized shallow periodontal pockets.

Hygiene: Fair; requires improvement.

Other: Lower right third molar impacted (bony). Extraction not indicated.

Evaluation: Ready.

Fig. 1. Format of Report of Sea Lab III Personnel Dental Condition

Table 1. Results of Initial Exam of Sea Lab III Personnel (N=51)

Number with minor caries	-----	15
Number with serious caries	-----	10
Number with serious periodontal disease	-----	11
Number with poor hygiene	-----	16
Number in good dental condition	-----	27

Table 2. Dental Characteristics of Sea Lab III Personnel (N=51)

	First base line exam	Second base line exam
Periodontal Index	0.17* ± 0.029**	0.20 ± 0.032
Debris Score	0.56 ± 0.094	0.54 ± 0.084
Mean Sulcular Depth (Ramfjord Teeth)	1.84 ± 0.052	1.82 ± 0.049
Plaque (Ramfjord Teeth)	0.70 ± 0.099	0.90 ± 0.104

*Mean

**Standard error of mean.

REFERENCES

1. Duff, I.F. Medical study of the experiences of submariners as recorded in 1,471 submarine patrol reports in World War II. Bureau of Medicine and Surgery Report P-1295. Downgraded to Unclassified per BuMed Notice 55-10 of 2 June 1960.
2. Frazier, R.G. Reports on scientific results of the United States Antarctic Service Expedition. Proc. Am. Philosophical Soc. 89:251, 1945.
3. Nielsen, A.G. Oral health problems of submarine personnel and a suggested program for their management. U.S. NavMedResLab Memo Rept. No. 63-14 of 10 Dec 1963.
4. Shiller, W.R. Incidence of dental problems and their management on FBM submarine patrols. SMRL Memo Rept. No. 67-4 of 17 April 1967.
5. Stanmeyer, W.R. and Adams, R.J. Antarctic stress and the teeth. J.A.D.A. 63:665-670, 1961.
6. Shiller, W.R. Periodontal health of submarine school candidates: A correlative Analysis. J. of Periodontology 37:224-229, May-June 1966.
7. Shiller, W.R. Oral health of operating conventional submarine crews: A cross-sectional survey. SMRL Memo Rept. No. 66-10 of 7 April 1966.

8. Shiller, W.R. Oral health of operating Fleet Ballistic Missile Submarine Crews: A cross-sectional survey. SMRL Memo Rept. No. 67-6 of 25 July 1967.
9. Powers, W.E. and Shiller, W.R. Gingival health and oral hygiene aboard a FBM submarine on patrol. SMRL Memo Rept. No. 66-19 of 21 Dec 1966.
10. Stanmeyer, W.R. and Adams, R.J. Reduced oral temperatures and acid production rates in dental plaque. *J Dent Res* 38:905, 1959.
11. Adams, R.J. and Stanmeyer, W.R. Effects of prolonged Antarctic isolation on oral and intestinal bacteria. *O.S., O.M., and O.P.* 13:119, 1960.
12. Lindsay, J.S. and Nielsen, A.G. Antarctic environment and gingival health. *J. of Periodontology* 33:315, 1962.
13. Mazzarella, M. Effects of prolonged submarine patrol on oral microbiota. I.A.D.R. Program Paper 234, March 1967.
14. Russell, A.L. A system of classification on scoring for prevalence surveys of periodontal disease. *J Dent Res* 35:350-359, 1956.
15. Ramfjord, S.P. Indices for prevalence and incidence of periodontal disease. *J. of Periodontology* 30:51-59, 1959.
16. Greene, J.C. and Vermillion, J.R. The simplified oral hygiene index. *J.A.D.A.* 68:7-13, 1964.
17. Volpe, A.R., Manhold, J.H. and Hazen, S.P. In vivo calculus assessment: Part I. A method and its examiner reproducibility. *J. of Periodontology* 36:292-298, 1965.
18. Muhlemann, H.R. and Villa, P.R. The marginal line calculus index. *Helv. Odont. Acta* 11:175-179, 1967.
19. Snyder, M.L. A simple colorimetric method for the estimation of relative numbers of lactobacilli in the saliva. *J Dent Res* 19:349-355, 1940.
20. Bass, C.C. An effective method of personal oral hygiene. *J. Louisiana State Med. Soc.* 106: 57-73, 102-112, 1954.

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