

The Forsyth Experiment in Training of Advanced Skills Hygienists

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Introduction

The rationale for the educational experiment reported in this paper is that a significant increase in the individual dentist's capacity to provide quality treatment for more people at the lowest possible cost may be achieved by greater utilization of trained auxiliaries.

Extension of duties of dental hygienists is not a new idea. In 1949 the Forsyth Dental Center, with the assistance of a grant from the Children's Bureau of the United States Public Health Service, embarked upon an extensive educational experiment to liberate the dentist by training New Zealand-type dental nurses. However, the concept was premature, and the project was abandoned under pressure from organized dentistry.

In hindsight, two crucial mistakes which helped accelerate the demise of the 1949 project can be readily identified. First, the dental profession was not made aware of the purposes of the program prior to its inception. Second, the educational experiment was incorporated into the ongoing programs, of the dental hygiene school. This provoked the criticism, possibly justifiable, that these students upon graduation would not be qualified for licensure to practice dental hygiene since their course was quite different from that approved by the Council on Dental Education. Although the experiment ended after one year, it lasted long enough for several young women to demonstrate considerable proficiency in cavity preparation and restoration. These favorable preliminary observations facilitated approval of the present project by the Forsyth trustees in 1965.

Subsequently, several other experimental programs have been initiated, training hygienists to perform other than reversible procedures while working under the direct supervision of a dentist. At the University of Iowa, dental hygiene students are being taught aspects of both restorative dentistry and periodontal therapy. At the University of Pennsylvania, instruction in expanded duties is given in the field of periodontal therapy. The University of Kentucky has already graduated hygienists with advanced skills in restorative dentistry. The Forsyth project is also in the field of restorative dentistry and has centered on cavity preparations and restoration. The study was designed specifically to provide data on the following aspects of advanced training: 1) time required for the training of advanced skills hygienists, 2) the productivity of the trainees under clinical conditions, and 3) the financial impact of such auxiliaries in dentistry.

Selection of Trainees

After a number of different populations of hygienists had been considered, a group of ten graduates who in June 1971 had completed two-year hygiene programs were selected for training as advanced skills hygienists. Selection was completed by September 1971, but because of delays in the construction and equipping of the new educational and clinical facilities, instruction was not started until March 1972. Therefore, when the instruction in advanced skills began, all trainees had accumulated seven months of experience as conventional hygienists working in private practices.

Prior to their selection, consideration had given to developing an in-depth psychological profile for each candidate through the use a battery of personality and aptitude tests. However, the consulting psychologist

Abstract: A curriculum for teaching restorative procedures to dental hygienists has been developed. It was found that with the hygienist's knowledge of basic sciences only 12 weeks of additional didactic and preclinical training was needed for her to master cavity preparation and placement of filling materials which are in a plastic state at the time of insertion. During the 13 weeks of internship which followed completion of the preclinical training, the advanced skills hygienists performed high quality restorative work and achieved a reasonable level of productivity. After an additional 12 weeks of practice, the mean productivity was five surfaces per operative hour and approached the productivity of experienced staff dentists, six surfaces per working hour. The study demonstrated conclusively that the advanced skills hygienist is capable of providing high quality restorative dentistry while working under the direct and immediate supervision of the dentist.

The cost of the additional training was calculated at \$2,300. Projections were also made of productivity and income potential. It was concluded utilization of this type of auxiliaries may provide high quality dental care to more people while containing, if not in fact decreasing, the cost of restorative services.

advised against this since the number of trainees to be selected was small and it appeared that the best predictor for success in this experimental program would be an assessment of each candidate's commitment to complete all phases of the program. Consequently, past performance in hygiene school, as reflected in the candidate's overall grade point average, was used as the basis for selection. Also, the candidates were interviewed in an attempt to assess their resolve to complete the program. All those selected were licensed by the state of Massachusetts, but they came from three different schools of dental hygiene - Bristol Community College, Fones School for Dental Hygienists, and Forsyth School for Dental Hygienists - and thus possessed different educational backgrounds.

Educational Facilities

Interference with the activities of the undergraduate school for dental hygienists was avoided through the construction of new facilities. A new clinic was designed to serve multiple functions in instruction during pre-clinical training and during the clinical internship phase and as a patient treatment facility for the study of dental care delivery. The advanced skills hygienists received their preclinical and clinical training in the rotunda (Figure 1), which has ten completely equipped operatories. This design provides direct supervision of the trainees by the instructional staff, since the partitions between operatories do not obscure the view of individual operatories regardless of where an instructor is located (Figure 2). The operatories are open at the central end, providing easy access for distribution of instruments and supplies. The peripheral areas of the Rotunda house a dental laboratory and provide facilities for radiology (including automatic developing equipment), examination and diagnosis and sterilization. Operatories 1, 2, and 3 (Figure 1) are used for blind evaluations of cavity preparations and finished restorations by outside examiners; this is part of a continuous monitoring of the quality of services provided by the advanced skills hygienists. These three operatories also provide isolation when necessary for surgical procedures or for patients who may be difficult to manage.

A television laboratory makes possible the monitoring and recording of teams in operation so that a team may study its own operating procedures to determine how the ability of the team to deliver care effectively can be improved.

Curriculum

The instructional staff, which included two full-time and two half-time instructor-dentists, with the part-time help of educators and instructional

designers, was charged with the responsibility for development of the new curriculum. As part of the preparation for this task, the curricula of the following programs were studied to obtain background information: the Royal Canadian Dental Corps program for advanced training of auxiliary personnel (1,2); the New Zealand Dental Nurse program (3); the program of the New Cross School for Dental Auxiliaries (4); the University of Alabama program (5) of expanded functions for dental auxiliaries; and the program of the Forsyth School for Dental Hygienists (Table I).

Since the major objective of the experiment was to train dental hygienists to perform selected restorative procedures, including the use of local anesthesia when indicated, the curriculum contents of the New Zealand Dental Nurse and the New Cross School for Dental Auxiliaries programs were studied in depth and contrasted with the curriculum for the Forsyth School for Dental Hygienists - a typical curriculum of an American two-year dental hygiene school. It was apparent that the hygienist had the oral biology background necessary for the performance of restorative dental procedures (Table II). After careful analysis of these programs it was estimated that a maximum of 47 weeks would be required for completion of the training which included 1,396 hours of pre-clinical and clinical instruction and practice (Table III). This time estimate compared favorably with the portion of the New Zealand and New Cross School curricula devoted to restorative dentistry. It also compared favorably with the time devoted to simple restorative procedures in a typical American four-year dental school (Table IV). However, the data in Table III show that in actuality less time was required to achieve the stated objectives. For instance, it had been estimated that 184 hours would be required for lectures, demonstrations and laboratory exercises in restorative dentistry to provide an adequate basis for clinical practice, which only 129 hours actually were used for these purposes. The estimated time for preclinical manikin practice was 296 hours, but only 172 hours were used. Subsequently, 76 hours (Table III) of projected instruction time which had not been needed was used in teaching extensive cavity preparations, cusp reductions, and pin placement. Instruction in these procedures had not been anticipated during preparations of the curriculum. With regard to clinical practice, the original estimate was that 896 hours would be necessary to develop clinical competence and reasonable operating speed. Based on the accomplishments during the pre-clinical phase of instruction, this figure was revised downward to 516 hours. However, it was found that only 360 hours of clinical practice were necessary to demonstrate competency. Thus the total instructional time turned out to be 25 weeks, instead of the projected 47 weeks.

Lectures, demonstrations, and seminars were used for the didactic part of the training. The exercises in cavity preparation and restoration were specified in terms of performance objectives based on task analyses of the procedures. The trainees progressed from Class I through Class II, MOD, Class III, and Class V to Class IV cavity preparations and restorations. The preclinical training was carried out with a new manikin training aid developed by the U.S. Public Health Service's Division of Manpower Education (Figure 3). The manikins were mounted on the dental lounge chairs in the Rotunda clinics and simulated a patient in the supine position. All cavity preparations were made using standard instrumentation and high speed dental handpieces. During the preclinical phase, the trainees worked without trained chairside assistants, while in the clinical phase assistants were utilized.

Evaluation of Restorative Procedures

The performance requirements in this study were that the restorative dental services consistently must be of high quality, equal to that produced by graduate dentists. Since evaluation of restorative procedures is

Figure 1: Original Floorplans for the Rotunda Clinic

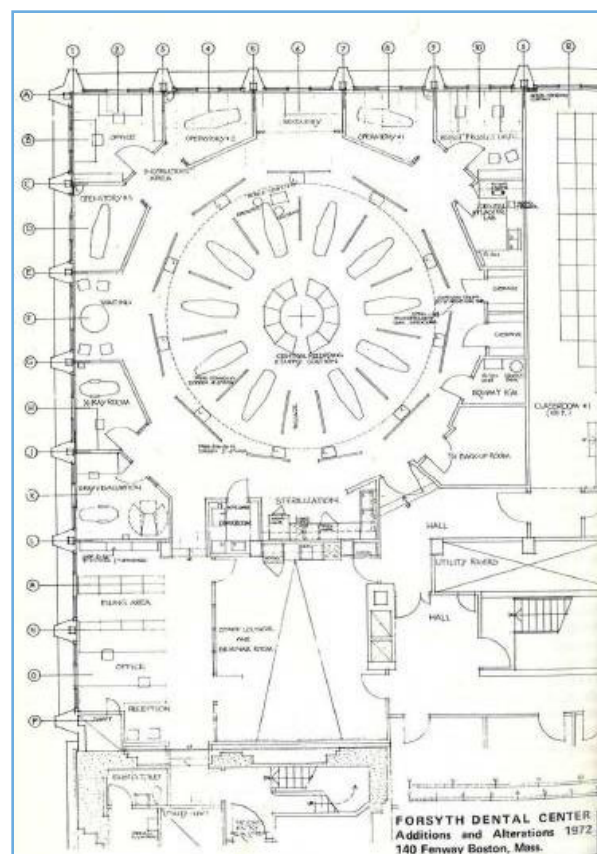


Figure 2: The Rotunda Clinic in Use



subjective and may vary markedly among observers, definite standards were developed for the examiners in the form of a performance scale and specific criteria. These standards and criteria were used for evaluation of the restorative procedures in the preclinical laboratory and during the internship phase of clinical practice. After completion of the training program, the same procedures were used to evaluate the services provided during the experiments in delivery of dental care

Self-evaluation and peer review of completed exercises were used throughout the instructional period. To be effective in evaluating cavity preparations and restorations, the trainees had to have a thorough understanding of the criteria for evaluation and be able to apply the performance scale to the evaluation of restorative procedures in a consistent manner. The staff prepared ideal examples of each cavity preparation and the performance of the trainees was judged against these allowing a tolerance of ± 0.5 mm. In order for the trainees to learn to make this judgment, an exercise in application of metric measurement was de-

Table I: Duration of Curricula in Dental Auxiliary Training Programs

New Zealand Dental Nurse	2 years	1,608 hours
New Cross Dental Auxiliary	2 years	2,052 hours
Canadian Dental Corps Auxiliary	44 weeks	1,852 hours
Alabama Expanded Auxiliary	2 years	2,085 hours
Forsyth Dental Hygienist	2 years	1,742 hours
Pre dental-Dental School	8 years	9,700 hours

Table II: Comparison of Duration of Curricula in Biological Sciences

New Zealand Dental Nurse	340 hours
New Cross School Auxiliary	263 hours
Forsyth Dental Hygienist	516 hours

signed. Known dimensions of burs and hand instruments were used as aids in judging the depth, width, and length of cavity preparations.

Self and peer evaluation preceded all evaluations by the instructors, who recorded their scores on an appropriate form (Figure 4). Two of the three instructors had to agree as to the acceptability of the preparation or restoration. If anyone criterion (Figure 4) in the evaluation of these preclinical procedures was not met, the procedure was unacceptable and had to be repeated.

Results

The success of the instructional program was assessed by comparison of preinstructional and postinstructional didactic test scores. It was found that deficiencies in specific areas of knowledge, which had existed at the outset of the instruction, had been remedied by the instructional program.

The total time needed for acquisition of the skills required for clinical work was only 13 weeks. The clinical internship, which followed the preclinical phase, also lasted 13 weeks. After 26 weeks, the staff judged the group to be competent to perform the selected procedures in restorative dentistry. In this respect, the procedures performed by the advanced skills hygienists were regarded as equivalent to those performed by recent graduate dentists.

Time Required and Quality of Specific Procedures

The performance of the advanced skills hygienists in developing proficiency in cavity preparations of Class I, II, III, and MOD is shown in Figure 5. The mean time required for completion very first Class I occlusal cavity preparation on the manikin was 34 minutes, while the fourth preparation took only 19 minutes. As would be expected, the more difficult multiple surface preparation, Class II and MOD, required more time. However, on each successive attempt the mean time decreased. The group performance on Class IV cavity preparations with the placement of pins is not shown, but completion time ranged from 10 to 75 minutes, with a mean of 35 minutes by the fourth attempt.

Figure 3: Life-like Manikin Used to Teach All Classes of Cavity Preparation and Restoration in Typodont Teeth

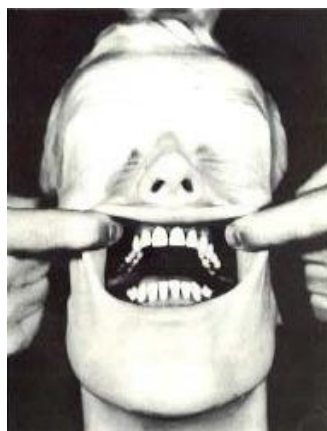


Table III: Experimental Curriculum to Train Dental Hygienists in Selected Restorative Procedures

	Projected Hours	Actual Hours
Lectures, Demonstrations and Laboratory		
Restorative Dentistry – Cavity Design – Preparation	40	52
Instrumentation Lecture – Demonstration	40	18
Dental Materials Laboratory Exercise: Amalgam, Cements, Silicates, Plastics	64	26
Assistant Utilization Lecture - Demonstration	40	33
Subtotal	184	129
Preclinical Manikin Exercise		
Rubber Dam	16	11
Matrix	40	5
Amalgam – Class I, II, V	160	110
Composites, Resins, Silicates – Class III, V	80	46
Subtotal	296	172
Extensive Preparations, Cusp Reduction, Pins	0	76
Local Anesthesia – Instruction and Practice	20	9
Subtotal	20	85
Clinical Practice	896	360
Total	1,396	746
Training Time, Weeks (30 hours per week)	47	25

Table IV: Typical Dental School Curriculum Related to Restorative Procedures

	Hours	Total
First Year		
Preclinical Lectures	11	–
Dental Materials	44	–
Operative Techniques	88	143
Second Year		
Dental Materials	33	–
Operative Techniques	132	–
Operative Clinic	33	198
Third Year		
Operative Clinic	165	–
Lectures	33	198
Fourth Year		
Operative Clinic	352	–
Lectures	33	385
	Total 4 years	924

The use of trained chairside dental assistants had a profound effect on the time required for the more difficult multiple-surface cavity preparations (6); it reduced cavity-preparation time by approximately 50 percent without any loss of quality. However, the use of assistants did not have much effect on the time required for Class III and Class V preparations.

The times required for placement and finishing of fillings are summarized in Table V. Condensation and carving of Class I amalgam restorations required a mean time of 11 minutes. The finishing of these restorations, which could not be completed at the time of condensation, required a mean time of 14 minutes. More time was required to place

and finish Class II restorations and MOD amalgam restorations. This finding was expected in view of the complex nature of the more extensive restorations. In evaluating the completed Class II amalgam restorations in the manikin typodont, 30 percent were found unacceptable and had to be redone; 36 percent of the MOD amalgam restorations suffered the same fate. The mean time required to finish Class III restorations was 11 minutes, and only 10 percent of these restorations were unacceptable. The Class IV restoration requiring rebuilding of the incisal edges of anterior teeth was considered the most difficult. The mean finishing time for this restoration was 47 minutes, but the success rate was high; only 15 percent of the completed restorations were found unacceptable.

Productivity

It should be noted that at 13 weeks, the productivity of the trainees was between three and three and one-half surfaces of completed restorative dentistry per operative hour (Table VI). During the succeeding weeks of clinical practice, the productivity steadily increased so that by the time 25 weeks had elapsed the group could consistently produce five surfaces of completed restorations for every hour spent with patients. The staff dentists on this project, who delivered restorative services for patients in the same environment and under identical working conditions, consistently produce a mean of six surfaces per operative hour.

Each team, composed of a trainee and a dental assistant, spent 65 per cent of each six hour working day in patient contact. The productive time for this team of auxiliaries was similar to that reported for therapists by Pelton et al (7) In the latter study the chairside time in a "surrogate private practice" was approximately 50 percent of each eight-hour day.

Patient Acceptance

Continuous monitoring of patient acceptance of the services provided by the advanced skills hygienists has revealed that there is no reluctance on the part of adult patients or parents of child patients to accept these auxiliaries in a role which has traditionally belonged to the dentist. This finding is similar to that previously reported by Lotzkar et al (8) for expanded duties dental assistants. It would appear that acceptance of expanded duty dental auxiliaries does not present a problem with the public, but it may be a problem with regard to the dentist's self image.

Educational Costs

The costs of educating advanced skills hygienists is an important factor in determining the practicality of using such personnel in the future. A comparison of estimates of the cost of educating a dentist and an advanced skills hygienist in private educational settings is found in Table VII. The combined cost of private pre-dental and dental education amounts to \$62,400, including living costs while in school. The cost of two years of hygiene education at

Forsyth School for Dental Hygienists is \$5,400. The additional cost of training the hygienist to become an advanced skills hygienist was \$2,300, based on a dentist-instructor to student ratio of one to ten. Therefore, the total cost of producing an advanced skills hygienist was \$7,700 and the total time 97 weeks. In the light of the savings of time and money which would accrue from the training of personnel other than dentists to provide 30-40 per cent of the needed dental care, it makes good sense for both the public and the dental profession to use advanced skills hygienists.

Income Producing Potential

The data on productivity of the advanced skills hygienists (Table VI) was used to project the possible income that a team made up of a dentist, an advanced skills hygienist, and a chairside dental assistant could produce in a year in a private practice setting. The projection in Table VIII only accounts for the income and expenses of the auxiliary part of the team and the supervision time of the dentist. Based on an effective six-hour day, the dentist would have 5.5 hours to do his own work since the team would require only one-half hour of supervision.

Using a composite fee, based on a welfare dental fee schedule, the team could produce a gross income of \$47,250. After paying salaries of \$12,000 to the advanced skills hygienist and \$6,000 to the assistant and calculating overhead at 50 per cent of the net income after salaries, the projected income for the dentist is \$ 14,625. The cost of these dental services to the public could be reduced if part of the net income from the use of this team were shared with the consumer in a manner that would also provide the dentist with adequate compensation for the time spent on supervision of the team. The economic aspects of the utilization of auxiliary teams in restorative dentistry are indeed most attractive, especially if their use results in a lowering of the cost of quality service to the consumer.

Concluding Remarks

The questions most often asked concerning the Forsyth program are the following. Why use hygienists when they are already in short supply? Why use the hygienist in restorative dentistry when, by tradition, hygienists belong in periodontics and prevention? The reasons are that hygienists are already licensed and can be regulated by existing dental boards, and the hygiene curriculum is extensive in those basic sciences which dental educators consider prerequisites to clinical dentistry. In addition, as now utilized in most private practices and as limited by some state laws, statutes, or regulations, most hygienists are overeducated and overtrained or underutilized.

Another strong argument in favor of the idea of expanding the hygienist's duties is that the potential breakthrough in the control of dental diseases may lead to a drastic decrease in the demand for restorative services. It certainly makes good sense to expand a pool of auxiliaries requiring far less education than dentists rather than to run the risk of overproducing professionals who must invest seven to eight years in preparation for a career. The current surplus of Ph.D.s, engineers, and teachers is a harsh reminder of this possibility. A look at educational facilities reveals that there are 150 schools of dental hygiene. These schools have well equipped clinics which, in the advent of a care crisis easily could be adapted to teaching advanced skills, including restorative procedures. In addition, if new facilities should be required to teach expanded intra-oral functions, it costs less than \$1 million to build a hygiene school, while current costs for a dental school range from \$15-35 million. Furthermore, as pressures create demands for more dental care, it is probable that the focus will be on children, for whom dental decay is the greatest problem. The Forsyth program has concentrated on restorative dentistry, because restorative services make up the bulk of the public's demand for dental care; this is the area where expanded duty auxiliaries will have the greatest impact on dentistry.