

OPERATIVE DENTISTRY

FOURTH EDITION

GILMORE
LUND
BALES
VERNETTI



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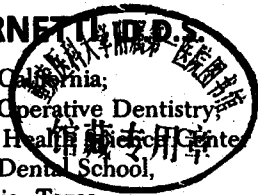
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To everyone everywhere

There is a slogan used at campsites by the Boy Scout organization:
"Leave it better than you found it."

In a much broader interpretation this thought can be associated with anything we do in life, such as greeting a person with a smile, picking up a piece of trash, and showing concern for patients.

We have compiled this text with the hope that the contents will "leave dentistry better than we found it." We also encourage you to offer suggestions and criticisms that we can include in future revisions, thereby allowing you to help us fulfill our dedication. Therefore, jointly, we the authors and you the readers can help "leave the dental world better than we found it."

FOURTH EDITION

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PREFACE

The field of operative dentistry is recognized as the core of general dental practice and incorporates many diagnostic, preventive, biological, materials science, and mechanical techniques. It is impossible to define the limitations of the operative discipline because of the broad scope, and there is no recognized specialty to describe this part of clinical dentistry. Because of this broad scope, many approaches are used to teach and practice operative dentistry. Regardless of the approach used, however, the main goal of the profession is quality dental treatment. With all the developments in research and instrumentation, such quality, or mastery, of operative dentistry is the number one challenge of the practicing dentist.

The objective of this book is to present the proven aspect of operative dentistry that are recognized as quality dental treatment. The emphasis given to all subjects is directed to accurate and refined procedures. The purpose is not only to produce optimum oral health care but also to reinforce the understanding and efficiency of the dentist and office team. Preservation of the natural dentition with the preventive, diagnostic, and restorative treatments described in this book is a realistic objective for most dental patients.

Also important are some of the social and political issues influencing the dental care delivery systems of the country. Subject to continual change and public sentiment, the demand for dental care challenges the manpower of the profession; dentistry will always be given problems to solve regarding the cost, quality, and distribution of dental care to the American public.

The beginning chapters include the basics that are necessary to support any dental care delivery system. The patient record, diagnosis

of the condition of the natural teeth, terminology, principles, and treatment planning are discussed because they are essential to all office systems. The types of instruments used with each design formula, the terminology of caries, cavity preparation, and the establishment of the surgical field have not changed significantly but must be learned by the student before acceptable tooth restoration can be achieved. The subjects are also presented to refresh the interested practitioner or educator.

New illustrations have been used throughout this edition. They were planned to simplify the basic and most recent operative procedures and are supported by the dental literature. Each chapter contains current references to support the procedures being recommended.

Three co-authors were again prominent in producing this edition. Dr. David Bales, Dr. Melvin Lund, and Dr. James Vernetti made many contributions. Their expertise has been recognized for many years, and the subjects of resins, cast gold restorations, cohesive gold restorations, and management of endodontically treated teeth have been upgraded to present-day procedures with quality control. The co-authors have significantly improved this edition.

Mr. Jeff Bales provided many new illustrations, which support our recommendations for a quality system of dental practice. The Indiana University School of Dentistry, the facilities of Lackland Air Force Base of the U.S. Air Force, and the University of Texas Dental Branch at San Antonio are gratefully acknowledged for lending their services and support for this revision.

Although this book is intended for the student, the principles and updating are equally

essential for the undergraduate, instructor, and practitioner. Auxiliaries can also enhance the understanding of their tasks by examining the material.

Many procedural changes were caused or dictated by the improvement and better understanding of biomaterials; for additional informa-

tion, a text concerned with that subject should be consulted.

Producing a useful book in a field as challenging as operative dentistry has been a rewarding experience. Our goal has been to update and simplify all aspects of the subject and to make a contribution.

H. William Gilmore

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Chapter 1

THE SUBJECT OF OPERATIVE DENTISTRY

The area considered to be operative dentistry is a large portion of clinical treatment, and there are no completely separate boundaries for the subjects it contains.¹ The name is really a misnomer; "operator" was the term analogous to "surgery" for the physician. In the past the term "operative" was synonymous with dental practice, but today operative dentistry is often confused with oral surgery. Operative dentistry can be defined as the subject that includes diagnoses, prevention, and restoration of problems and conditions of the natural teeth, vital and nonvital. The problems most often confronted in general practice are caries and periodontal disease and to a lesser extent the functional, developmental, traumatic, and genetic conditions that occur in the oral cavity. The ultimate goal is to preserve the natural dentition or to restore it to the best state of health, function, and esthetics. This makes operative dentistry the vanguard of the stomatognathic system; the benefits are contributing to the general well-being of the patient.

The core areas for operative dentistry are diagnosis and treatment planning, the properties of tooth structure, the reduction of tooth structure and design of the cavity preparation, materials science, pulp physiology and pathology, preventive measures, management of the gingival tissues and supporting structures, occlusion, control of pain and anxiety, management of auxiliaries, and financial and management matters. There are many definitions of operative dentistry that include these core areas as well as the other aspects of caring for the natural dentition. For example, the term "rehabilitative dentistry" is used in some areas; "general dentistry" is used by the armed forces and a

national academy; and "restorative dentistry" is used by others. However, the overall objective is still the preservation and restoration of the natural teeth. The fields of prosthodontics are often combined with operative dentistry and given different names.

The quality and quantity of treatment are the parameters that measure the delivery of dental care. The skill required of the dentist is unique because it is difficult to work in the oral cavity. A dentist's psychomotor ability, or degree of skill, must be high if he is to provide quality dental care. Skill development and the maintenance of the performance level are of top priority for both the student and the practitioner. Furthermore, the longevity of the operative service is directly related to the quality level of the care. A high performance level must first be established in any system of dental care delivery before the variables can be evaluated to increase the production.

In addition, the knowledge explosion in the last 20 years has pressured the general dentist to be a true professional. Being knowledgeable in all areas requires the discipline of regular continuing educational activity. This can be done independently by taking postgraduate courses and reading journals or with the study clubs. There are several areas of concern that provide the interest and opportunity for continuing education. The criteria of any profession include motivation, dedication, mastery of the information, and the skill that is required for the delivery of the service. It is interesting that one fourth of dental research has been in materials science and that an even distribution has occurred in the remainder of the subjects. Reliance on special knowledge and the requirement

for continuous study are the earmarks of a profession.

Nevertheless, the body of knowledge in the operative field is overwhelming. It is too large and too specialized for one person to master or to utilize completely. It is also accepted that no two patients or their problems are alike, and the lack of specificity explains the broad base and complications that operative programs have in gaining acceptance or staying up with the specialties. There is no end to what can be learned or utilized; the knowledge is eventually passed on as improved patient service or better dentistry.

The programs of the dental profession have also increased in number and knowledge. One sign of the growth has been the development of specialties.² There are eight dental specialty groups: oral surgery, periodontics, pedodontics, orthodontics, endodontics, public health, oral pathology, and prosthodontics. Many other groups are recognized for postgraduate training and make valuable contributions. Another positive sign of growth is that cross-fertilization of operative dentistry with the specialties has become the rule rather than the exception. Finally, an objective evaluation of the literature with new procedures is reflected in the change and improvement in the operative procedures rendered by the general practitioner.

The recognized specialties represent approximately 10% of the work force of the dental profession. The general practitioner remains the key provider of dental care for the population. It is he who first surveys the patient, collects the records, and formulates the treatment plan. Furthermore, the general practitioner provides the treatment as a diagnostic, preventive, or restorative service, and he also is trained to recognize the complicated problems that call for referral to the specialists in the dental and medical fields.

The major areas of operative dentistry produce many overviews for teaching the subject and are found to influence the organization of dental schools throughout the world. Geographic differences, dental school philosophies, and state board examinations have lacked agreement, which has caused some confusion and has retarded the growth of the new concepts in many areas of the country. The responsibility for teaching the subject and manpower shortages in

dental education have generated a need for consensus in the subject of operative dentistry.

The American Association of Dental Schools has faculty groups that form sections for teaching subjects and their philosophies. This association has an operative dentistry section that has been the nucleus and catalyst for the operative dentistry departments in American universities. The position operative dentistry should have in the curriculum and the leadership for teaching the subject have originated with this essential group. The American Dental Association has an operative dentistry section that deals more with the scientific matters of the subject. The section meets during the annual session of the American Dental Association and contributes significantly to the level of operative dentistry in the world. Through these two groups and with the help of several national academies, operative dentistry is kept at the same level as the other subjects and specialties in the dental profession. The dental manpower working to develop quality operative procedures is increasing, and the future is brighter than ever before. By having better-qualified practitioners available to provide these dental services, the American public will be the winner.

From the preceding discussion the reader should be able to visualize the size and importance of this subject to dental practice as well as the growth problems and interesting future. The motivation for doing operative dentistry continues to surface at all stages of professional life because the field is large and constantly changing. Its challenge is to integrate the material to the advantage of the patient.

HERITAGE OF OPERATIVE DENTISTRY

At the beginning of the nineteenth century dentists came to the United States from Europe, mainly from France and Germany. In the eastern cities new men were trained as apprentices until they were confident enough to open their practices. Dentistry at this time was considered more a trade than a profession. Most services were given for the relief of pain, with restorative dentistry being a limited concern of the system.

Much of the progress in the field of dentistry was due to the issue created by the introduction of amalgam into the country.³ Two French dentists brought a product called "Royal Mineral

Succidaneum" into the country as a mineral paste. This compound was definitely a departure from what was being used, and the promoters suggested that it be wiped into existing caries and pre-carious areas of the tooth to restore the affected tooth as well as prevent caries. Some of the dentists at the time felt that this amalgam paste should not be used to treat patients. The political issue that developed soon became the "amalgam war." There were, of course, dentists representing both sides of the issue, but for a short time it was considered malpractice and unethical to use amalgam for the restoration of teeth. There were many publications on the subject, and creeds developed that were used as a code of ethics for dental societies in several areas of the country.

The cities involved in the amalgam war were New York, Philadelphia, St. Louis, and Chicago. One or two leaders in each of the cities managed to prolong the amalgam war for several years. This controversy inspired one of the amalgam antagonists, Dr. Chapin A. Harris from New York, to open the first dental school in the United States in Baltimore in 1841. This became the Baltimore College of Dental Surgery, which is presently part of the University of Maryland. Harris was also instrumental at this time in starting the first national dental society in New York City. Thus it can be said that amalgam and its controversy served as an incentive for much of the development of dentistry as a profession in the United States.

Some of the techniques and materials used in operative dentistry helped to create interest in the field and to further unite the profession. When the rubber dam was developed by Sanford C. Barnum in 1864 in New York City,⁴ many articles were published concerning its use as well as the feasibility of certain men being able to patent the rubber material and technique. Many debates developed in the dental societies over its application. Although it was not realized at the time, invention of the rubber dam by Barnum remains one of the greatest developments in the field of operative dentistry. It became possible to develop a surgical environment in the oral cavity for placing different types of dental restorations. The advent of the rubber dam made contoured restorations possible. Gold foil was very popular in the early days of dentistry, but it was not used then as it is

today. The material was noncohesive and was simply packed and wedged into a tooth to fill up the crater. This technique was responsible for the origin of the term "filling."

In some areas the leaders also became investigators. By 1875 numerous dentists were researching a number of technical procedures. Although their work was elemental and done by trial and error, it was very useful as a guide. Some of this early research is still quoted in academic circles because it formed the foundation of modern research. For the most part, research today is done largely by trial and error. Further interest in research soon developed; some of the early investigators had a profound influence on the practice of operative dentistry, and in most sections of the country their principles are still in evidence. Investigators developed special interests and confined themselves to certain areas. This resulted in writing and publishing in their respective regions, giving dentistry a geographic recognition in the country. Certain areas of the United States were recognized for one procedure over others because of the leadership that produced the heritage. Several examples are offered in the following paragraphs.

The father of modern operative dentistry is Dr. G.V. Black, who practiced in Jacksonville, Illinois, and held both dental and medical degrees.⁵ He became associated with Northwestern University as professor of operative dentistry and dean of the school of dentistry. Black's writings were novel and extensive and have not been equaled to this time. His writings developed the foundation of the profession and caused the field of operative dentistry to become organized and scientific. Black's early writings were concerned mainly with caries, erosion, and oral pathology. Much attention was given to the diseases of the pulp and the soft tissue appearance with clinical conditions. Black established the principles of cavity preparation, set up nomenclature, and identified the attributes of the restorative materials. Today the practice of operative dentistry has changed, but Black's work should be understood and applied to the variables of oral disease. Other outstanding contributions by Dr. Black include the original work on annealing amalgam and the mercury alloy ratio and formulation of the first notable silver amalgams available for the profession.

Black also exhibited biological interest in stains of the teeth and did a great deal of work on staining and the problems produced by oral bacteria and their relationship to caries and periodontal disease.

Dr. Arthur D. Black, son of G.V. Black, followed closely in his father's footsteps. It has been stated that "Dr. Arthur Black added glory to the reputation of his illustrious father who was the most beloved as well as the most distinguished man in the dental profession."⁵ Arthur Black developed many of the instruments and techniques advocated by his father and used them in teaching, which was his greatest interest. He developed a model organizational plan for the Illinois State Dental Society that was also copied by many states. The card catalog system for dental books used daily in libraries is another one of Arthur Black's contributions. The connection of the Blacks with the Northwestern Dental School extended over an uninterrupted period of 40 years. The impact these two gentlemen had on the dental profession at the beginning of the twentieth century gave the dental profession the first respect and growth centered in a university.

Leadership in the profession extended to different areas of the country as new urban centers developed. The Blacks' reputation was instrumental in inspiring Dr. Charles E. Woodbury, who practiced in Council Bluffs, Iowa. In addition to practicing in Council Bluffs, Dr. Woodbury taught in Omaha, Nebraska. He greatly influenced dental education in this area and started a gold foil study club that is still active and meets twice a year. He started study clubs in other states and traveled to give instruction all over the Midwest. Some of the clubs functioned for a while, but none has remained as active as the original Woodbury Club in Omaha, Nebraska. Woodbury is noted for his work with the gold foil restoration and was one of the first to modify Black's instrumentation and cavity designs.⁶ The Class III Woodbury preparation was designed to improve esthetics for proximal anterior gold foil restorations. Woodbury also designed a set of hand instruments that he recommended for the Class III cavity preparation. This set of 39 instruments became known as the Woodbury kit and for years was the most universally used set of hand instruments. In addition to these instruments and different foil prepara-

tions, Woodbury designed several condensing points for building the gold foil restoration. Through his work he did much to raise the level of dentistry in the Great Plains states, and his name is registered as a pioneer of the dental profession for what resulted in improving operative dentistry in the country.

A colorful pioneer in operative dentistry was Dr. E.K. Wedelstaedt of St. Paul, Minnesota. He was strongly influenced by the Blacks and visited them many times, discussing research topics and the growth and problems of dentistry. Dr. Wedelstaedt started the G.V. Black study clubs in the Midwest and persuaded Dr. Black to travel around Iowa and Minnesota to teach postgraduate courses. Today the most active club is the original G.V. Black Club in Minneapolis, which at one time was larger than the Minnesota State Dental Association.

Dr. Wedelstaedt became associated with Dr. Searl of Minneapolis, and the two traveled through the United States giving courses and starting study clubs. Because of the lack of dental schools and the popularity of these men, the courses were very successful. The information in these courses was practically the only training in modern techniques of tooth restoration available at the time. Publications and communications did not keep dentists adequately informed, nor was there a concerted effort in continuing education.

Wedelstaedt's outstanding contribution was the system he developed for measuring dental instruments. This system is still being used. He also developed some hand instruments that could be used in the techniques being taught in the study clubs. The most popular of these instruments was the Wedelstaedt chisel, now referred to as the curved chisel. The curved chisel has a mesial and distal cutting edge and is advocated for most anterior cohesive gold preparations. This instrument and the system of measurements Wedelstaedt developed are the outstanding marks that he left.

Another leader in the field of operative dentistry was Dr. Waldon I. Ferrier of Seattle, Washington.⁷ In the 1920s he was taught by Wedelstaedt and Searl and was noted for his outstanding work in the study clubs. Because of the distance and complications in teaching the courses, Dr. Ferrier was appointed by Wedelstaedt and Searl to teach their courses in the

Pacific Northwest. He soon developed a study club and taught the techniques being used in operative dentistry at that time. Today there are more active study clubs in the state of Washington than in any other place in the United States, and the credit for them is given to Ferrier. Ferrier again modified the gold foil procedures and developed new cavity preparation designs to correspond with the techniques. He is considered the father of modern gold foil procedures. Because the Ferrier concepts are more refined and the qualities are more esthetic, this approach with cohesive gold restorations is now used more than any other. The system is copied and modified all around the United States. The Ferrier instruments are still the best manufactured.

This outstanding teacher also developed a set of new instruments that is called the Ferrier set. These instruments are also more refined than others and have a uniform thickness on the cutting edge in addition to the standard measurements. Precise cavity preparation, which is the forte of the Ferrier method, can be accomplished with the use of these instruments. A group of separators was also designed by Ferrier. The separators came in sets and were applied to all sizes of teeth, but they are no longer available. Ferrier stated that his greatest accomplishment toward the improvement of the practice of operative dentistry was to advocate the use of the linguogingival shoulder in the Class III gold foil preparation.

Another leader in operative dentistry deserving mention was Dr. George Hollenback. After graduation he moved west and for 60 years was outstanding in the practice, teaching, and research elements of operative dentistry. Hollenback published many articles on operative dentistry; his most important contribution is his work on the physical properties of gold foil and the shrinkage of gold during the casting process.^{8,9} Much work was also done by this investigator on the science and technique of the cast restoration, and he published numerous other articles associated with individual tooth restorations. Hollenback's research was enhanced by his ability to design and build research tools. When a research problem was recognized, Hollenback was able to construct different types of instruments for measuring the physical and chemical changes within the laboratory. Cer-

tainly the operative dentist benefited greatly from the teaching and inspiration of the late George Hollenback.

Many outstanding people contributed to and are still working in the field of operative dentistry. Although they are too numerous to mention, their work is evident in the literature and textbooks. They will always be respected for their laborious efforts to increase the understanding of general practice. The field of operative dentistry can be credited with the development of the dental profession in both the United States and the world.

DELIVERY OF DENTAL CARE

The problems of oral health care challenge the dental profession. Oral disease, developmental and genetic factors, and oral trauma in the total population establish the need for dental care in the United States. It is an alarming statement that caries and periodontal disease affect nearly everyone in the population, but it is also encouraging that nearly all of these problems can be controlled by preventive methods available to the dentist and the patient. Of concern are the discrepancies between the demand and the need for dental care.

Before dental care delivery can be studied and implemented, definitions of these concepts must be established. The marketplace includes the number of patients treated and the types of services that are received. These factors form the base that is used for planning by the profession, the consumer groups, and the various levels of government. The *demand* for dental care reflects the services completed and is measured by the number of patients requesting care and sometimes by the number of treatments provided during a specified period. The demand figure quoted indicates that only 50% of the U.S. population seek regular dental care. The *need* for dental care is measured by the prevalence of oral disease or by the number of treatments that would be needed to eliminate and prevent these problems.

The need for dental care in the United States is summarized in the next few paragraphs.

A survey conducted by the U.S. Public Health Service¹⁰ in 1962 shows that a large portion of the population of the United States needs some kind of dental treatment. The survey states that (1) 98% of the population have either

had or will have dental caries, (2) two thirds of all adults eventually have periodontal problems, (3) one fifth of the population of children have orthodontic problems, and (4) to further complicate the situation, 20 million adults in the United States are edentulous. Another survey stated that there are 4 million new untreated cavities per year in the United States.¹¹ Simply providing treatment and nothing else would not eliminate dental caries in the United States. These figures were helpful in creating interest in preventive dentistry.

The latest figures on dental need in the United States show¹²:

1. There are 22,000 victims of oral cancer each year.
2. One in every 700 children is born with a cleft lip or palate.
3. Twenty percent of the children have deforming orthodontic problems.
4. Sixty percent of the young adults, 80% of the middle aged, and 90% of the older population have periodontal disease.
5. Ninety-five percent of the population have caries.

The dental need of the population is overwhelming and is not close to being met by the dental profession, either the private or the governmental sector.

Deficiencies in the materials being used in tooth restoration affect the amount of treatment needed. Although restorative materials serve a useful and critical health purpose, they are far from perfect. An ideal restoration would be one that would never need to be replaced, and at the present time we have no compound that can be considered entirely permanent.

The primary objective of dental education is to train competent practitioners to fulfill the demands of the public for oral health service.¹³ At present, a majority of these problems involve restorative treatment. It has often been stated that even if caries and periodontal disease were totally prevented, the wear on the teeth and the restorations over a period of years would require additional treatment by a more complex restorative service. The need for dentists extends into the unforeseeable future.

The dental manpower problems have been studied, and the present demand for dental care is being met by the work force. This includes approximately 130,000 dentists and a larger number of auxiliaries. The controversies about

manpower and the delivery systems are centered around predictions of increasing demand and the methods for increasing the demand. As the number of people seeking service increases, particularly as a greater number and type of services are made available, the profession will be challenged to meet the demand for dental care if it does not expand.

Various factors affect the demand for dental care¹⁴:

1. The price of the dental care
2. The economic level of the patient
3. The patient's level of educational attainment
4. The aggregate growth in the population base demanding dental services

Measurement systems are being used to assess these variables, particularly at the state level. The figures will be useful for developing and structuring the training positions in the health science schools; a delicate balance between demand and manpower is needed to avoid surplus and waste. The figures previously used were the dentist per population ratio. These are useless, however, because they do not measure production or any of the other problems related to the need or demand for dental care. These variables need to be studied further and subsidized if the purpose is to increase the demand for treatment.

Increasing the demand

If the overall goal is to eliminate dental problems, we must first upgrade the dental need population to the dental demand group. A survey conducted by the American Dental Association reported that economics and anxiety (fear) are the two main deterrents of patients seeking dental treatment. Hoping to increase the demand, professional and government groups are studying these and other factors that serve as barriers to patients requesting dental treatment. Examples of other problems are poverty conditions, the rural areas, dentist shortage areas, and the methods of transporting patients to the dental office or locating dentists near the patients who have transportation problems. Even when financial support is available, there are still problems with some socioeconomic groups that prevent or discourage them from obtaining regular dental care. It is true that one half of the population does not have a regard for the importance of dental health; even when

there is no cost for dental services, such as in the military or institutions, the demand for care stays close to 50%.

Increasing manpower

Manpower assessments are made on dentistry's capabilities of meeting the demand for service. The work force composed of the dentist and auxiliaries is assigned equivalents that measure the work capacity of the team members active in providing treatment. The distribution and structure of the dental manpower—that is, the dentist and auxiliaries, where they practice, and what they are legally covered to perform in the delivery of service¹⁵—remain a concern. The general practitioner represents 75% of the dentists delivering dental care. As mentioned, with the increase in knowledge and the related services, eight specialty groups have developed and have been recognized by the American Dental Association. The coordinator of most treatment is the general practitioner; however, special problems are referred to and treated by the specialist. (The reported higher income and additional training are listed as the reasons for the increase in specialty training.) The surge for specialty status is now declining, but the training in general dentistry at the undergraduate and postgraduate level is increasing to meet the needs existing in the present delivery system. The U.S. Department of Health and Human Services reports that there are 19 delivery system types being used in the private sector producing dental care.

PROBLEMS OF DENTAL HEALTH

As previously mentioned, some of the problems of dental health are related to patients' socioeconomic status;^{16,17} it influences patients' loss of teeth, behavior, and attitude toward dental care. For example, parents of different income groups were surveyed to determine the relationship between their socioeconomic status and dental health of the family unit. This survey evaluated several factors and focused on many of the health education problems that must be confronted to increase the demand for dental care. The following results were obtained:

1. Participation of parents in the dental examination was significantly related to their level of education.
2. Educational level was related to the loss of teeth in women.

3. The loss and retention of both mandibular first molars were related to the level of education of both sexes and to the occupation of the man.
4. For individual teeth the greatest difference in lost teeth between groups of high and low education occurred for the mandibular first molars.
5. The difference between loss of teeth between socioeconomic groups complicated the assessment of their periodontal status.
6. Socioeconomic status, participants in the examination, lost teeth in adults, and dental debris in the participants' children were interrelated.
7. Participation in the study and loss of teeth reflected dental attitudes and behavior, which are related to educational level.

Financing dental care, as previously stated, is the number one deterrent, and financial difficulties obviously are more acute among poverty groups.¹⁸ The need for treatment in this area is not being met. Studies report that poverty groups also have more dental problems of more severity. As expected, they also have lower levels of oral hygiene and less restorative treatment. Some of the poverty patients surveyed were found to have more problems at all age groups; they have more periodontal disease, untreated cavities, missing teeth, and more edentulism. Moreover, poverty groups seek less dental care, particularly preventive services. Because such groups demand less dental care, an even greater need for dental care is created. This compounds the problems in these sectors of the population each year. The findings concerning the poverty groups have been the basis for the legislation and dental care programs—mainly for the inner cities—enacted by government. These programs are directed toward the children and have not been successful in increasing the demand for more dental care. Thirty-four states have Medicaid programs; it is possible for the needy to receive dental care through these programs.

FINANCIAL AND MANAGEMENT FACTORS

The general dentists has many financial and management factors to consider that reflect the quantity and quality of the dental care delivered. It is also known that as the gross income

and office expenses escalate, additional problems will confront the dentist¹⁹.

1. Equipment design, purchase, and repair
2. Inventory control
3. Dealing with dental laboratories
4. Record keeping and bookkeeping procedures
5. Appointment control
6. Payment mechanisms
7. Hiring, management, and evaluation of personnel

For these reasons the general dentist must adjust with the times and growth of the practice. These factors, combined with the economy, influence the cost and delivery of dental services. Furthermore, the survival of the general practitioner is dependent on the control of the business aspects that are listed.

The auxiliaries, often discussed as the team members, influence the production, quality, and cost of the treatment. The team members other than the dentist are the hygienist, assistant, and laboratory technician.²⁰ Each team member has responsibilities for supporting and expanding the role of the dentists, which in turn makes the practice more productive. General practices are noted for their individuality, and the functions of the auxiliaries are governed by the purpose and objectives of the dentist and the licensure of the team members. States vary in what the auxiliaries are legally covered to do for the patient. The leadership and medical-legal responsibilities of the practice are centered on the dentist.

The Council on Dental Care of the American Dental Association has listed the individual practice association as a method of competing, in the private practice sector, with the programs of the government.²¹ This is when a group of dentists form an association and provide dental care through contracts with a health maintenance organization, a business, or a special group of workers such as unions. In some states it is said that the private practices are moving in this direction; this has been of economic necessity in some regions. Apparently the competition for expenditures for dental care is forcing private practitioners to form groups and enter into contract negotiations.

The expense and the traditional curriculum have regulated the training of dentists. The number of trained dentists cannot be increased

easily, because the resources of the dental schools, such as the amount of space and the number of faculty, are limited. If the dental demand were suddenly increased by prepayment or a national health program, the present delivery system would be unable to meet the demand for services.

Conversely, the reduction of the number of dental students trained is not an easy matter. It involves reductions in government funds and shifts in emphasis concerning financial support of the dental schools. The private and land grant universities have specific and different problems. At the present there is a shift toward reducing the number of students being trained because of the apparent surplus of dentists in the United States. Dental practices are more efficient and use more auxiliaries; much more dental care is being provided by the same number of dentists as compared with the practice systems of merely 10 years ago.

Other countries with dentist shortages have turned to the auxiliaries. Studies have evaluated the prospect of making the dental assistant or the hygienist the primary provider of dental service.²² The expanded duty dental assistant (EDDA) is the name given to the new auxiliary, who will be called to alleviate future manpower shortages. This new auxiliary is predicted to have an important role in delivering dental care when or if the demand is increased by health education and legislation. Because of the auxiliaries' support and expansion of the system of practice, the production and the quality of treatment performed by auxiliaries should be improved.²³

The main departure of the EDDAs from the traditional use of team members is direct involvement in restorative technique. The EDDAs are trained to perform the restorative procedures in general dental practice, thus greatly increasing the production of the team. The irreversible procedures are deemed the "cutting of hard and soft tissues" in the oral cavity; these and other critical procedures must still be done by the dentist. It is required that all of the work by an auxiliary must be under the supervision and direction of the dentist.

The economics of delegating restorative care have been determined, and the following conclusions are listed²⁴:

1. The supply of dental health personnel

- would be increased with a minimal charge to the taxpayer for training these individuals.
2. The cost of the delivery of certain dental services in tax-supported clinics and hospitals, where many of these auxiliaries would practice, would be reduced.
 3. The cost of delivering treatment in private dental offices, if the dentist passes on some of his savings to his patients, might be reduced.
 4. The dentist would be able to concentrate on the more difficult tasks that demand the knowledge and skill acquired in his professional training.
 5. Instead of the dentist's prestige being threatened, it will be enhanced by his consideration for providing more treatment to more people in his practice.
 6. History has shown that the use of auxiliaries leads to increased productivity and income.

An important part of dental care delivery is the systems, or the setting and manner in which treatment is done.²⁵ Delivery systems vary in the number of team members that participate and in the method of purchase. Two primary systems exist: open panel and closed panel.

Financing dental care is a great concern because it is a barrier, and new systems result in regulation of the free enterprise system.²⁶ Although the fee for service system of the private office has survived in this country since the beginning of the profession, the current social movement is challenging the cost and the quality control associated with the fee for service system. The fee for service system employs a fee schedule with a range of costs for specific dental treatments. The range is estimated to cover the time, difficulty, and materials needed with the service. It is supported by the profession because it is traditional and, more important, because it has been workable and successful. However, consumers are looking for other financial plans to put dental care within the reach of more people. This would hasten the entry of special population groups, such as inner city residents, the poor, the aged, the handicapped, and the residents of rural areas, into the delivery system.

The profession, with study and research, is providing leadership in improving the delivery

system. Costs are being controlled by the use of auxiliaries, new equipment designs, better records, and computer systems for data collection and billing. The federal government is also working on programs and long-term goals for entering the health care industry.^{27,28} The concern of the government rightfully should be groups that cannot afford to enter the delivery systems of the private sector. Sound business principles should be used to develop cost effectiveness for all forms of health care. The costs of health care related to systems could then be determined and used for subsidizing the cost of dental treatment in the private office.

The fee for service system is acknowledged for not having interferences between the dentist and the patient. The relationship between provider and consumer, therefore, is free for each to do what best serves the situation. There is less administrative detail and more useful time to deliver the treatment.

The burdens of paying for dental treatment have produced the finance programs of prepayment, insurance, and the budget postpayment. These arrangements involve a financial source, or third party, to arrange payment between the patient and the dentist.²⁹ The administrative problems of cost control, alternate modes of treatment, benefit structures, fee determinations, and prior authorization are complications and controls for which the carriers in prepayment programs are responsible. The prepayment program is normally a fringe benefit for employees, the intention being to make medical costs reachable and a part of the financial remuneration along with the wages.

Facts from the American Dental Association estimate that one third of the U.S. population (roughly 74 to 75 million people) have part or all of their dental bills paid through some form of dental prepayment. This translates to about \$4 billion a year being provided through third-party prepayment programs. The majority of the patients are covered by the private insurance carriers and the dental service corporations.

With the increased use of fiscal intermediaries, the study of quality in dental procedures is being financed and studied. Much will be written about quality assurance, and guidelines will be afforded the practicing dentist to incorporate into dental office programs. The political push for quality is long overdue and has been cata-

lyzed by the methods of financing dental care.

There are parts of any prepayment system that need monitoring. Peer review, which judges the adequacy and fairness of the treatments and benefits, is a system available to the patient, insurance carrier, and dentist. The peer review mechanism is usually initiated at the local level. Prepaid dental programs, if conducted properly, should be used at a high rate and should increase the demand for dental services. They should also make dental treatment more attractive and available to more people.

PREVENTIVE DENTISTRY

To predict the need for dental care, one must study the effects of prevention.^{30,31} Dental disease is reduced, and problems in the oral cavity and their treatment are changed as a result of preventive services. The preventive attitude encourages changing the procedure when better methods of materials are developed. The practitioner must avoid being strictly traditional and using only techniques that were learned in school. Change, however, must be an improvement, and new techniques must not be employed only for the sake of changing. Again, the true professional incorporates many preventive concepts into his dental procedures.

Preventive dentistry involves methods of preventing dental disease, dysfunction, and oral health disorders.³² The taxonomy of preventive dentistry is listed below.

1. *Primary prevention (prepathosis)* includes fluoride therapy, diet control, plaque control, sealants, pulp protection, and many other valuable measures for the community or the dental office.
2. *Secondary prevention (intervention)* involves the services of restorative dentistry, periodontics, orthodontics, and other fields.
3. *Tertiary prevention (replacement)* includes the services of fixed and removable prosthodontics. Maxillofacial prosthetics would make a significant contribution as would the other rehabilitative restorative techniques that are the total mouth type.

The most significant result of preventive dentistry has been communal fluoridation. Extensive research and experimentation have clearly shown that trace amounts of systemic fluoride, tested mostly as an additive to the water supply,

significantly reduce the incidence of dental caries. Reductions of caries for all age groups for the period during which the teeth were exposed to fluoride range from 40% to 60%. This significant reduction has been a factor in changing dental practices. It is encouraging that fluoridation has resulted in the need for fewer restorations and an increase in the preventive services of prophylaxis and examination. The loss of teeth and the number of edentulous patients are reduced also. Communal fluoridation reduces from 55% to 60% the decayed, missing, or filled teeth in children when they are continuously subjected to the application of fluoride from birth. Some states have laws requiring fluoridation of the water supplies, whereas in others such laws are not necessary because of the efforts of the public health departments.

The dental team has several methods of preventing caries, such as applying fluorides on the teeth of individuals in dental offices, institutions, or schools or recommending products such as dentifrice or mouthwashes for home consumption. It is estimated that with motivation, 90% of dental disease can be eliminated, and a large part of this would be by means of fluoride therapy.³³ A survey reported that 33% of the people who made dental visits were motivated by prevention, a result that reveals part of the challenge in dental health education.³⁴ Such a low percentage indicates that the value of preventive service is not well recognized and that many people are missing the benefits preventive services offer.

The effects of fluoridation programs have been studied.³⁵ Fluoridation remains the greatest contribution to dental health ever made to civilization.

The changes in the incidence and characteristics of dental disease influence the need figures. The effects of prevention for this reason should be constantly monitored by the health planners. Conversely, it can be demonstrated that preventive dentistry increases the number of restorative treatments needed because the natural teeth are saved and protected by the fluoride therapy. With the increase in the use of preventive measures more time will be available and focused on treating the well patient.

Preventive techniques for the dental office are not as clearly defined as in medical practice. Vaccination and the prevention of specific prob-

lems can often be done in medicine. Because of the chronicity and multiple etiological factors of dental problems, the treatments for oral prevention are not as fragmented. Preventive techniques require objective evaluation of the patient by the dentist. The influence of this philosophy should not downgrade the traditional services of general practice but should encourage a combination of the better methods. The objective should be to select the services with the long-term advantages. Good operative dentistry is preventive in nature.

Motivation of the patient is essential and is often an unknown quantity; it is difficult to determine which patients will practice acceptable oral health habits. Acceptable oral health habits are important because the removal of plaque is essential to control most of the caries and periodontal problems. With the adult this cannot be done by toothbrushing alone. Good oral hygiene requires the discipline of cleaning the interproximal surface. The bacterial toxins found in plaque resulting from degrading carbohydrates lead to the destruction of the gingiva and supporting tissues. How harmful plaque affects tooth structure is well known. However, motivation of the patient is shown only by behavior change, which indicates that some learning has occurred in order for the individual to become a dedicated dental patient. Achievement of behavioral change, along with the related change in psychology, occupies much time for the dental team. Such change is the foundation of the control program and a valuable preventive service for the office.

ESSENTIAL FACTORS FOR DENTAL PRACTICE

Certain factors are essential for successful dental practice. It is not possible to include these factors in every case, but they should be kept in mind. Application of the rules will become second nature when experience is gained. An attempt should be made to understand these factors, because they not only are elemental, but are the key to an enjoyable professional life.

Professional attitude

A profession is characterized by additional study over regular schooling. For a group to be called a profession, continuous study and learn-

ing are required. The dental profession is worthy of such a name and is recognized by the active programs in continuing education. The attitude of those in a profession determines the success of the group, and certainly dentistry has strived for the highest goals that can be attained.

Motivation and learning have been discussed for centuries. Because of the great amount of knowledge that is acquired and the manual skills that must be mastered, there is a great need for motivation in dental education. The student must be willing to put in many hours in the library and in training. It is also necessary to be motivated for service because dentists, as members of a health profession, must put the patient's welfare first. High quality and efficiency are the guideposts in health-oriented professions.

A receptiveness to learning creates a favorable attitude. A professional must have a desire for knowledge and must strive to learn new concepts. The influence of research on treatment makes it necessary to be open-minded to and accepting of change. The best treatment procedure should always be used when what is the "best" can be defined. Continuous education is the key to a successful practice of dentistry. Since lifetime learning is considered a necessity in professions, it is advisable for the dentist to follow organized postgraduate activities.

There are many extracurricular activities that should be supported for the welfare of both the individual and the profession. An active part should be taken in dental organizations. Other allied organizations in the community need to be supported, and professionals should assume many civic and political responsibilities. The role of the professional widens when all these responsibilities are fulfilled.

Knowledge of the subject

During undergraduate training it is advisable to learn all that is possible in the curriculum. Dental education is recognized for a well-planned and time-consuming curriculum. All available time for the classroom and clinic must be utilized because after graduation it is impossible to learn under the same efficient conditions. The information presented in the dental curriculum produces basic knowledge and develops the initial judgment in each stu-

dent. The doctrines taught will be used for treating patients or conducting research throughout the candidate's lifetime. In the undergraduate program the student's choices are usually limited between the biological and clinical courses and those of an elective nature. To develop the fundamentals, all areas in the curriculum must be studied. Dentistry is founded on scientific principles that are broadened by research; research influences the clinical procedures that will be used and improves delivery of dental care.

A planned program of continuing education should be organized following graduation. This involves collecting a personal library and attending postgraduate courses. Regular weekly time should be allotted for these projects to remain abreast of current developments in the profession. The dentist who does not participate in planned programs of continuing education becomes outdated and dissatisfied with the way he is practicing.

Study clubs are useful and sometimes the best answer for continuing education. Such groups meet on a regular basis and can be either clinical or discussion clubs. At any rate, it is possible to discuss problems with associates and to evaluate the results of other dentists. A valuable appraisal of skill occurs when the participant subjects himself to the criticism of his peers. Skill analysis and evaluation of new materials and procedures are good topics for the clinical study clubs. Learning should be an enjoyable experience all during the professional life of the practitioner.

Vision

In order for one to perform dental operations, vision and access to the surgical field must be provided. It is a burden to work in the oral cavity when the patient's lips, cheek, or tongue is in the path of the instruments and the operator's vision. These tissues must be retracted and the teeth made available to the light source. The light can be applied directly or reflected and the tissues retracted with different types of instruments. The devices that can be used are the mirror, rubber dam, cotton holders, retractors, and bite blocks. Access and vision must be provided without injury or discomfort to the patient.

Of equal importance is the type of illumination that is directed toward the teeth. The light source should come from the dental unit and illuminate the established field. Again, a direct

path is provided, or the light can be reflected by the mirror to the specific working area. Eye damage results from too much contrast in the illuminations or inadequate intensity in the working area.

The visual acuity of the operator is another important consideration. Vision must either be naturally good or corrected by glasses; magnification is also necessary beyond the corrected vision. For safety reasons, glasses should be worn at all times in the operatory and laboratory. They are necessary to deflect fragments of tooth and debris that are removed in cavity preparation and other procedures. A factor related to acuity is depth perception, and the two factors must be coordinated to make the proper image.

Surgical environment

The cleanliness and control of the operating field contribute to the effectiveness of the procedure. Tooth reduction for cavity preparation is a surgical procedure, and an aseptic and protected environment should be established for the teeth. An ideal dental field maintains dryness and is free or can be cleaned of debris. It is necessary to completely isolate the teeth from saliva to produce such a condition.

The best method of producing the surgical field is with the rubber dam. Regular latex rubber sheets are used for this purpose. Holes are punched in the rubber sheet and placed around the teeth. Once it is adapted, the rubber dam blocks the saliva and produces a good surgical environment for operative procedures. When the dark-colored rubber dam is used, vision is also improved because of the color contrast with the teeth. An ideal surgical environment is necessary by use of the rubber dam or by careful retraction of the tissues by the dentist and the auxiliary.

Instrumentation

Because many types of instruments are required for specific dental treatments, different shapes and sizes of instruments are available. Access and efficiency provided by the design of the instrument aid the treatment; thus the location and type of problem in the mouth dictate the use of one instrument over another. An orderly, sequential procedure is advocated for all techniques. The tooth structure is very hard and brittle, making the maintenance of sharp