HAND INJURIES

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PREFACE

Surgery of the hand is a regional specialty. Training leading to competence must draw on many areas of traditional medical disciplines as well as on engineering and other allied fields. Is it not better, then, that a textbook on managing injuries of the hand be the composite work of multiple authors, each recognized as the pre-eminent authority on the specific subject assigned to him? Without a doubt, the proliferating mass of detailed information related in one way or another to surgery of the hand today far exceeds the ability of a single author to keep absolutely abreast. Therefore, definitive reference books of an encyclopedic nature can no longer be written by a single hand. In fact, there is serious doubt that any bound book can be fully up to date on factual material. Therefore, for details of specific topics, one surely must go to original articles in the current literature. In any event, books by multiple authors are one means of trying to compile reference material more conveniently. This, in conjunction with the obvious expediency of getting material into print, accounts for the pronounced trend toward multiauthored books.

If this is the modern trend, why should one be so bold as to offer a textbook that is essentially the labor of a single author? Gaining surgical competence requires a guiding philosophy and embraces numerous factors aside from a good fund of factual information. It involves learning to examine carefully and interpret observations accurately, decision-making based on an understanding of principles rather than an attempt to apply stereotyped procedures such as one finds in an atlas, and developing a constant perspective that relates the hand problem to the patient's total situation. Above all, one needs to develop an attitude and system of dealing with problems that consistently leads to the best clinical judgment and care for each patient. It is in developing one's "approach" that a multiauthored text cannot compete with that by a single author, which has a continuous thread of a single philosophy running through every chapter.

Books alone cannot equip anyone for surgical practice. Ultimately, the essential foundation must be developed in the guided experience of an apprenticeship, but the study of good books can eliminate much "trial and error" as maturation progresses. This book emphasizes the importance of careful evaluation of observations, the literature and our own results. One must not only come to understand reasons for selecting a particular course of action, but also measure this carefully against all alternatives and review constantly and critically the results of his efforts. Never confuse 20 years of experience with that of one year repeated 20 times!

This book, dealing chiefly with the management of injuries, is based on my

personal experience in practicing and teaching surgery of the hand. The synthesis of ideas began when I was asked to write a comprehensive chapter on managing hand injuries for *Reconstructive Plastic Surgery* (edited by John Marquis Converse, W. B. Saunders, 1977). A number of photographs from that chapter have been incorporated into this text. There is neither effort toward nor pretense of this book's being a definitive reference. It has been written not only to present a philosophy and give basic understanding and sound direction to surgical trainees, but also to contribute toward a comprehensive foundation and point of departure for those who decide to specialize in and master all aspects of surgery of the hand.

This is also a practical text with detailed explanations of many treatments. With these examples I have endeavored to analyze and present basic concepts to explain why procedures of proven value are successful, thus enabling the surgeon to apply these principles to other situations in a logical manner. The goal is to escape stereotyped procedures by attaining the understanding necessary to synthesize an optimal treatment plan for every situation encountered. Never are two exactly the same. Following stereotyped procedures as presented in surgical atlases can only lead to frustration, for one's first case will surely confront him with some factor different from the textbook model, and he is lost. The many specific procedures presented help to make stated principles meaningful.

Surgical procedures selected for presentation are techniques that have worked well for me, but this does not imply that the ones I have chosen are the only good solutions to the problem. I may at times be guilty of oversimplification in my zeal to digest things to their common denominators, but in general, if something is thoroughly understood, it can be stated in a simple and straightforward manner. Statements are made with confidence since the text is based essentially on my own experience. When I have drawn on others, I have weighed their recommendations carefully on the scales of my experience.

I lay no claim to originality. In fact, there is little really new if the search for precedence is sufficiently exhaustive. If I have failed to give due credit in some instance, it is an oversight for which I apologize. I owe a debt to other surgeons so great that paying individual tribute is impossible. The whole book is an expression of all I have learned from previous teachers, colleagues, students, hand surgery fellows and patients. If anyone is to be singled out as having dominant influence through the years, clearly it is my mentor and friend, J. William Littler of New York. If my opinions and presentation have correctly reflected his teaching and surgical philosophy, the book is a tribute to him, and all my labors by this alone will have been well rewarded.

With appreciation I acknowledge indebtedness to the late Dr. John Converse, whose service I joined on founding of the Institute of Reconstructive Plastic Surgery at New York University. His unfaltering support in the early years was critical to developing surgery of the hand in this institution and the recognition it now enjoys.

It will be apparent that anatomy has been emphasized throughout this book. A thorough working knowledge of the surgical and functional anatomy of the hand is absolutely necessary to every aspect of managing hand problems, from diagnosis to formulation and successful execution of treatment plans. The initial chapter on functional anatomy contains little classic description, as this is readily available from numerous standard books, but it relates the anatomy specifically to function and repair.

I am greatly indebted to the Foundation for Hand Research, Inc., of New

York for permission to include their new and unique set of anatomical drawings, which present accurately and in fine detail the anatomy of the hand and forearm important to the hand surgeon. The illustrations were developed specifically to meet the needs of the hand surgeon rather than those of the anatomist. They are all original and were drawn from fresh cadaver dissections done by the surgeons to illustrate what is clinically important. The illustrations are finished in realistic natural color, rather than being stylized, to help one appreciate the normal life appearance of structures. They are presented as a special section in the center of the book for easy reference, not only in relation to this text but also for use with other studies.

After the introduction and the functional anatomy chapter, the organization of the book follows a logical pattern of progression. First is the section on basic principles. Although this is directed primarily at the requirements for managing injuries, the principles are equally applicable to most other areas of hand surgery.

Strong emphasis has been placed on the management of soft tissue injuries and tissue replacement. It is the surgeon's strength or weakness in this area that really separates good from consistently excellent care of the hand. A determined effort has been made to provide the background upon which one can, by thoughtful experience, develop the necessary competence in soft tissue management.

Following consideration of soft tissue injury, the next basic problem with which one must deal is that of restoring skeletal integrity. Again, principles have been emphasized in an effort to free one of enslaving stereotyped procedures.

The latter half of the book deals in detail with tendon, nerve and vascular problems as well as with some special subjects such as amputations and prostheses. For these topics it is difficult to clearly distinguish between acute and secondary care, as many of these procedures can be semielective when indicated.

The single most important theme throughout the text is that initial care determines to a very high degree the course of events and the ultimate outcome of hand injuries. The book is primarily concerned with acute injuries, but some secondary procedures have been discussed, chiefly to offer an insight into the future that may be essential to planning primary care. Basic planning for continuous care from wounding to optimal recovery is a concept that is strongly advocated.

Finally, a brief section on postoperative care is included, emphasizing that the operation is only one event on the road to recovery. In no other area of surgery is active participation by the patient in postoperative programs so critical to good recovery.

In style of writing I have striven for directness and clarity rather than effect. These efforts have been complemented by the generous use of photographs. Legends have been written carefully to tell a story in themselves. Although this is sometimes repetitious of the text, it is done to emphasize important points. It may also generate interest among students who initially only thumb through the book, stimulating their awareness of the importance, complexity, challenge, potential for repair and beauty of surgery of the hand. The many photographic series will serve also to project a standard of quality. The need is apparent, because too often in a consulting practice, situations are found in which the treating physician appears to be genuinely unaware that his efforts are suboptimal by today's standards. In many instances the text has been complemented by simple line drawings to demonstrate technical points more clearly. I hope to give the beginner a clear, basic understanding, while the more accomplished surgeon may appreciate and derive benefit from the details.

The recommended reading list is included to help those who may want some general amplification of a topic, but it is limited to articles that are particularly informative, stimulating or of special historic importance.

In the actual preparation of this text I am indebted to so many that, again, individual tribute to all cannot be made. Yet some have been so important that failure to acknowledge them specifically would belie my genuine appreciation. My associates in practice, Dr. Charles P. Melone, Jr., and Dr. David T. W. Chiu, have taught me much and have given candid advice from their own experience to reinforce my ideas or, in some instances, to cause me to re-examine a position before settling on a final conclusion. Other colleagues to whom I am especially indebted include Mr. Hugh Brown of Newcastle-upon-Tyne, Dr. Chen Zhong-wei of Shanghai, Dr. Jean Pillet of Paris and Dr. Viktor Meyer of Zurich. I also thank Ms. Dinorah Ruiz and Ms. Carolyn Verga for their infinite patience in typing and retyping much of the manuscript.

Finally, I would be remiss if I did not express my awareness and appreciation of the contribution to this effort of Mr. Albert Meier and his fine staff at the W. B. Saunders Company. Only fellow authors of books published by this outstanding organization can fully appreciate the concern of this group for first-rateness, their openness to ideas and flexibility, and their constant giving of assistance by drawing upon vast publishing experience to help with every detail of the book.

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CONTENTS

INTRODUCTION

The history of all societies reflects a recognition of the special importance and appreciation of the exceptional capabilities of the hand of man.

"We ought to define a hand as belonging exclusively to man . . . corresponding in sensibility and motion with that ingenuity which converts the being who is the weakest in natural defenses to the ruler over all animated nature."

Sir Charles Bell
Bridgewater Thesis IV
London, 1834

It is with the combined functional perfection of the hand and brain that man has learned to manipulate and gain control over his environment. Aside from its prehensile excellence, the hand ranks with the eye as a prime mechanism of sensory perception. Its perfection of sensory perception, especially in the finger pads, is far greater than that of any other part. The infant uses his hands almost exclusively to learn about his environment. The hands are constantly exposed and express nonverbal communications and individual personality in a way exceeded only by the face. Like the face, the hands are a critical part of man's body image and self-concept. In some respects, disfigurement of the hands has more emotional impact than disfigurement of the face, since one sees his own face only in the mirror but constantly views his own hands. In today's mobile and competitive world, to ignore or deny the importance of aesthetic aspects of the hand to one's socioeconomic well-being is unrealistic and outdated. Considering the premium society places on youthfulness, appearance and performance, the prejudice and intolerance associated with damaged hands are evident and devastating to the affected individual. Too often, society will summarily ostracize those who have conspicuous hand disorders. The man who will not take his hand from his pocket is almost as handicapped as one with a major physical impairment. It is incumbent upon every surgeon dealing with problems of the hand to be keenly aware of the importance of aesthetic considerations to global function — our goal — and not to think of function only in a simple prehensile sense.

Thus, the hand is essential to almost every personal, economic or pleasurable endeavor of every individual regardless of status. For the working man it is his only capital, but no element of society escapes from impairments of the hands.

Our hands may be affected by many disorders ranging from congenital mishaps to tumors, but by far the greatest cause of functional impairment is injury, the basic subject of this text. Despite awareness of the problem and ever-increasing accident prevention efforts, in 1979 more than 16 million Americans injured their hands sufficiently to seek treatment by a physician or to interrupt their regular activities. This does not take into account the innumerable less serious injuries that reduced productivity but required no formal treatment. In fact, fully one third of all injuries requiring treatment involved the upper

extremities. The number of injuries to the hand occurring in the home was about the same as the number of industrial and farm-related injuries, but the former were generally less severe. About 20 per cent of sports injuries also involved the upper extremities. In 1979, upper extremity injuries collectively accounted for about 95 million days of restricted activity and 16 million days of absence from work. It has been estimated that the direct and indirect cost to the national economy of the industrial injuries alone was more than $5 billion in 1979. The vast majority of hand disorders occur in young and productive persons, so the total economic impact is enormous. The treatment of hand injuries is truly a major area of health care.

The social, economic and humanistic importance of our hands is so enormous to every individual and to society collectively that the greatest of efforts to improve the care of persons with hand injuries is fully justified.

ORGANIZATION FOR CARE OF THE HAND

Initial care determines to a great extent the ultimate outcome of an injury to the hand. The value of specialized care beginning as promptly as possible after injury is thoroughly established. The increasing availability of specialized care from the time of injury is a development that has evolved from experience, recognition of the socioeconomic importance of the hand, improved surgical techniques, better biological understanding and the demands of the public. The specialist in hand surgery must master and then combine the appropriate aspects of traditional general, plastic, orthopedic and neurological surgery with postoperative physical medicine if he is to give optimal care. Present training within one of these currently recognized specialties is invariably weighted toward traditions of that particular specialty at the expense of the other essential ingredients of ideal and balanced training. The need to develop more logical training programs that will produce in a reasonable period of time the large number of well-prepared hand surgeons necessary to deliver the care now possible is a prime force in the movement toward recognition of hand surgery as an area of regional specialization. Ultimately, this will result in better care of this enormous group of patients.

A brief review of the development of reparative hand surgery is useful to an appreciation of both the present situation and the changes that are occurring. It is difficult to realize that significant general interest in reparative surgery of the hand dates back only to World War II, there having been only isolated efforts at repair prior to that time. Until then, surgery of the hand had consisted essentially of drainage of infections, amputation and wound closure. World War II brought great advances in the management of shock with extensive use of blood transfusions, generally better anesthesia and wound care, introduction of antibiotic therapy and, above all, vastly improved systems of transport. The result was that for the first time, significant numbers of young men survived major battle injuries and recovered good health but remained badly handicapped. The relation of hand injuries to one's socioeconomic well-being rapidly became apparent, as did the need for improved care to minimize the resulting handicaps. However, at that time there were only a dozen or so surgeons in the entire country who possessed the special interest, knowledge, skills and experience to deal optimally with these nonlethal but complex injuries. Out of pragmatic necessity, there

evolved in those circumstances a two-phased concept of managing upper extremity injuries. The first phase was the primary or emergency treatment, which was to be followed later by a distinct and separate second phase of reconstructive procedures. It was hoped that the first phase would include not only the control of hemorrhage but also debridement of the wounds and all possible steps to minimize the disastrous complication of infection. Generally, the first phase of treatment was completed with secondary wound closures. It was envisioned that the repair of severed tendons, nerves, malaligned fractures and other injuries would be undertaken as elective procedures at a later time after wounds had healed. Such a two-phased program of managing hand injuries clearly is counter to a logical scheme of optimal care in light of present understanding, but it is useful to understand why the concept was introduced during World War II, which was the beginning of the modern era of hand surgery.

The two-phased plan of management of military hand injuries was implemented through instructional courses and technical manuals outlining for the field surgeons simplistic but widely applicable steps that were to be taken in primary care and preparation of the patient for transport. Provisions for the second, or reconstructive, phase of this system were made by establishment of specific hand surgery centers in selected military hospitals across the country. This remarkably successful program was devised under the guidance of Dr. Sterling Bunnell of San Francisco, civilian special consultant to the Surgeon General. Dr. Bunnell's forward vision, organizational skills, remarkable energies and, above all, forceful personality led to his pre-eminence in the field. However, we should not forget that credit for a major portion of the essential groundwork for reparative hand surgery must be given to many, including the quieter group of Koch, Allen and Mason in Chicago, where Kanavel had worked earlier.

Of course, concentrated efforts in the military's secondary repair hand units brought progress in the care of the hand at a far greater rate than ever before. Almost without exception, the great names we associate with the first generation of hand surgeons in America developed their skills and reputations working in these military centers. Despite the significant improvement of care that evolved from this practical two-phased system of management, it became glaringly apparent to those working in the hand surgery units that *a single continuous plan of treatment from the time of injury to maximal recovery was essential if ideal standards of treatment were ever to be realized.*

This small nucleus of pioneering hand surgeons came to appreciate fully the problems of implementing a total care approach and, at the same time, the advantages that such a treatment plan would provide. Yet, as a practical matter, the number of hand surgery specialists spawned by the war was so limited that the two-phased system of treatment was carried over into postwar civilian practice with only rare exceptions. However, during the subsequent years, several fundamental changes have occurred. There has been tremendous progress in reparative surgical techniques as well as better biological understanding. This has not only resulted in successful repairs, such as reattachment of amputated parts by microvascular technique, but also attracted the interest, imagination and efforts of an ever-increasing number of gifted and highly trained young surgeons. At the same time, both the profession and the public have become aware that early specialized care makes a great difference in the outcome of an injury and that such care is increasingly available in most communities.

All changes, even for the better, usually are accompanied by some problems. In the current transition toward the more rational concept of total and continuous

care from injury to maximal recovery, there has too frequently been a disastrous extension of efforts by ill-prepared surgeons to give definitive care beyond their level of competence. A little knowledge is worse than a candid admission of having basically no knowledge. When a qualified hand surgeon is not available, at least to advise on the initial treatment, primary care should be limited to general supportive measures, debridement and simple wound closure, appropriate splinting and prompt transport of the patient to a facility where definitive care can be given. It is a serious error for unqualified surgeons who fail to appreciate the problem fully and who do not recognize their own limitations to undertake definitive repairs. Such repairs not only generally fail but also compromise the patient's ultimate recovery potential. Currently, overzealous attempts at repair are much more commonly the cause of increased problems and complications than is undertreatment. Vascular injuries with tissue-threatening ischemia are the only absolute hand emergencies. In all other cases there is time to arrange appropriate care for the patient.

It is now widely recognized that the socioeconomic importance of hand disorders is so great for the affected individual and for society as a whole that concerted efforts to improve care will receive more and more support. In addition, it is universally recognized that improved care comes with concentrated efforts or specialization. The individual surgeon can no longer be equally proficient in all areas, so specialization is essential. The argument lies only in exactly how medical reorganization is to accommodate and integrate specialization. It has been conclusively demonstrated that optimal care of the complex hand requires recognition of surgery of the hand as an area of regional specialization, with total care from injury to recovery being the responsibility of one highly trained regional specialist. His responsibility must include the critical postoperative care, which cannot be delegated in a detached manner. This does not preclude the organization of closely coordinated medical-surgical teams including therapists and others, but it demands that each case be the surgeon's ongoing responsibility and that all delegated treatment be under his continuing supervision.

Even the logical organization of surgical training programs to prepare the large number of hand surgeons needed requires recognition of the hand as a regional specialty. Current hand surgery training is offered within a department of general, plastic or orthopedic surgery. Yet, not one of these existing medical specialties covers adequately the multiple disciplines on which fully comprehensive and balanced training must draw. Only when the hand is recognized as a regional specialty, as has been done in Sweden, will it be possible to plan completely satisfactory training programs, unencumbered by the restraints of traditional organization and political considerations so deeply entrenched and jealously guarded by currently recognized specialties in every medical center.

Most important of all, optimal patient care clearly demands that the current fragmentation of care be superseded by management within a framework of regional specialization. The situation is remarkably similar to that of the recognized regional specialty of ophthalmology. One would not now consider for even a moment calling in an orthopedic surgeon to adjust the eye muscles of a child with strabismus and then a physiatrist to instruct a therapist on the postoperative muscle exercise program required for the child's recovery. Yet, such illogical fragmentation of care continues too frequently to be imposed upon the management of hand injuries. Better organization for care of the hand must cut through these traditional system-based divisions of medicine as it has with ophthalmology. *Optimal care demands that hand surgery be recognized as a regional specialty*

integrating in a logical way appropriate aspects of many traditional medical specialties. The advantages are so great for minimizing the consequences of injuries to the hand that this inevitably will become the accepted pattern of care in the future.

REACTION OF THE PATIENT TO INJURY

We must constantly recognize that the justification for our endeavors is the help we give our patients. *Success of treatment can be measured only in terms of how fully the patient resumes a normal life*. It is therefore incumbent upon all who provide care to ascertain the patient's wishes and give due respect to them. It is important to listen to the patient. Listening not only gives you an opportunity to learn much about him, which must be considered in any decision making, but also goes a long way toward establishing rapport and convincing him of genuine concern. The patient who is hostile and unreasonably angry about the incident of injury most probably is going to follow this same pattern of transferring responsibilities throughout his program of treatment. Few moments are more productive than those spent listening carefully to the patient's account of his injury as well as his anxieties and expectations. All these factors must be considered along with the actual physical damage when formulating the best course of action.

It is important to be constantly mindful that the problem belongs to the patient; do not accept its transfer. At the same time, we must appreciate our responsibility to inform the patient appropriately of the medical factors as best we can so that he and his family can make reasonable decisions. Such information must be carefully individualized. The unskilled worker needs simplistic information in terms that he clearly grasps, whereas the erudite professional or business executive needs much more detailed information about the injury, the outlook for recovery and what is involved in the proposed treatment. The patient is entitled to reasonable explanations, and they will foster his better participation in the treatment. *No other area of surgery requires as great a degree of patient participation in getting well as does surgery of the hand.* A frank discussion and understandable explanations can also do much to keep expectations realistic. This is a problem today, when unrealistic demands and expectations are being kindled all too frequently by an exuberant press and media thriving on sensationalism rather than factual reporting of events.

The emotional impact of injury is highly variable, determined not so much by the extent of physical damage as by the patient's personality, intelligence, motivation, past experience and established patterns of problem solving. It is not uncommon to observe a person with a moderate physical injury long remaining on the nonproductive roster while another patient with a major physical loss can hardly be detained long enough for wound healing to occur. Because such occurrences are so common, the conclusion is inescapable that far too little interest and concern have been given to the emotional aspects of the injury, which often are the greatest problem. This is especially true of hand injuries, as they are not easily disguised. Problems of the hand are conspicuous because they involve either disfigurement or physical impairment. *We must expand our concept of function to encompass reintegration into the mainstream of life and not think of function only in terms of prehension*. The surgeon and his team are in the best position to observe and deal with the majority of nonpsychopathic emotional problems related to injury, and they should accept this responsibility as part of

providing the best for the patient. *The magnitude of emotional response bears little relation to the actual physical damage, but it can be just as disabling and deserves careful attention.*

Overlapping but definite phases of emotional response have long been recognized. Basically, the first phase is characterized by disbelief, the second by realization and the third by accommodation for the majority or fixed maladjustment for a few.

Typically, at the instant of injury there is disbelief that it could have happened. The unexpected and previously unexperienced incident is such that the nervous system is not prepared to make an accurate assessment of the stimuli suddenly flooding it, so the response is either nil or one of denial. "Shock" may be instantaneous or protracted for as long as several days in extreme situations.

From the standpoint of treatment, the second phase of emotional response is of primary concern. The second phase of response to injury is a period of emotional turmoil during which guidance and other external influences have the greatest opportunity for effectiveness. During this period the patient makes a conscious evaluation of the extent of the injury with all its implications. The process provokes innumerable responses, which may include anxiety, anger, hostility, paranoia, depression, despair or persistent denial. The duration of this phase is highly variable, but those who are to make a good accommodation — and fortunately this is the vast majority — will begin to appreciate their remaining assets more fully and to make a realistic evaluation of that which they cannot expect to recover. Those who are destined to remain invalid continue to cling to their former body image, maximize their problem and persist in nonadaptive problem-solving behavior.

Patients evolve from the formative second phase in one of two directions. The great majority enter the third phase having begun to develop healthy accommodations, and the impairments simply become their new norms with which they are increasingly comfortable. The minority cling to nonadaptive behavioral patterns. The third phase is one of rigidity in which changes are difficult to effect. The patient who enters the third phase without having made progress toward realistic accommodations is very resistant to motivation or any help, and his future is discouraging despite all efforts.

Since there is an inverse relation between the duration of disability and the ultimate prognosis for vocational and social reintegration, protracted treatment programs that are not producing obvious progress should be avoided. The most common example is subjecting a patient to weeks of whirlpool or other homeopathic treatment when in fact anything short of appropriate surgical repair has no chance of resolving the problem satisfactorily. Early and accurate assessment of injury with projection of at least a general but realistic plan of management is of greatest importance in minimizing the number of patients who evolve from the second phase of emotional turmoil with fixed, nonadaptive attitudes. Of course, there are patients whose pre-existing behavioral patterns are such that no amount of enlightenment and early guidance is going to change their course, but fortunately these are the small minority. The opportunity to guide the patient's emotional response during that formative period must not be allowed to slip away. Early, high-quality comprehensive care, which must include awareness of and attention to the emotional response to injury, can go far to minimize the losses for this enormous group of patients with hand injuries.

CHAPTER 1

SURGICAL ANATOMY OF THE HAND

The serious student of surgery of the hand must of necessity become a lifelong student of the intricate and fascinating anatomy of the hand, the mastery of which is absolutely essential to accurate diagnosis, development of logical treatment plans and, of course, skillful execution of surgical repairs. Fortunately, as one begins to understand the hand, he will find it so beautiful and interesting that mastering the complex anatomy becomes a pleasure rather than a task.

Anatomical principles and basic patterns significant to surgical management are stressed here with no pretense of providing detailed descriptions, which can be found in the numerous anatomy texts available. It is recognized that small and sometimes large variations are innumerable. In fact, differences in small detail are so frequent as to be the rule rather than the exception. Knowing the incidence of even major variations is of little help with the individual case, for the surgeon must be constantly aware that such variations exist and must watch for them in every case.

Our discussions here are directed toward the most frequently encountered anatomical arrangements. No attempt is made in this presentation to discuss the variations. *The surgeon must appreciate that anatomical variations are common and must constantly consider their possible existence in his observations and treatment.*

Terminology is important and warrants a brief discussion. We should constantly strive to adopt a common terminology to be used by those interested in the hand. This has been one of the major efforts of the International Federation of Societies for Surgery of the Hand, and it is critical for clarity and precision of communications. We favor simple terms that are readily understood and used rather than grandiose and complex schemes. For example, to obviate confusion, we should refer to the five digits by name as the thumb, index, middle, ring and small fingers rather than by numbers. Borders of the hand generally should be referred to as radial and ulnar rather than lateral and medial. (The latter terms are derived from the classic anatomical position and are applicable only when the forearm is fully supinated.)

BASIC ARCHITECTURE OF THE HAND

A complex of 27 bones arranged in four units constitutes the basic structural foundation of the hand and wrist. There are three mobile, or adaptive, units

projecting from a single fixed unit that serves as a stable foundation for them. The wrist bones are called carpals; there is minimal motion between them. The eight-bone carpal complex is strongly bonded to the base of the second and third metacarpals, collectively constituting the **fixed unit** of the hand. The most mobile unit is the thumb, whose importance needs no elaboration. It is attached to the fixed unit at the extremely mobile first metacarpotrapezial joint. The second adaptive (mobile) unit is the index finger, which enjoys a substantially greater degree of functional independence than do the other fingers. This favors its participation in fine manipulations. The third adaptive unit is concerned principally with power grasp and is composed of the middle, ring and small fingers along with the somewhat mobile fourth and fifth metacarpals. Mobility of the latter permits convergence of the fingers with flexion and better pulp-to-pulp apposition of the ring and small fingers to the thumb as the palm is cupped (Fig. 1–1).

The carpals are divided into two rows, a proximal and a distal (see Color Plate 4). The scaphoid is unique in that it is a link between the proximal and distal rows of carpals and thus vulnerable to fractures through it (Fig. 1–2). As there is a very restricted range of motion between the carpal bones, positioning of the hand is achieved primarily by the enormous range of motion in all planes that is possible at the radiocarpal (wrist) joint, where the broad, convex cartilaginous surfaces of the scaphoid and lunate articulate with the cuplike distal radius as a greatly flattened ball-socket arrangement. Positioning achieved by the wrist is, of course, in conjunction with forearm rotation and elbow-shoulder motion. Pronation, or turning the palm downward, is accomplished by rotation of the radius around the fixed ulna by the median-innervated pronator teres and pronator quadratus muscles. This is countered by supination of the forearm (turning the palm upward)

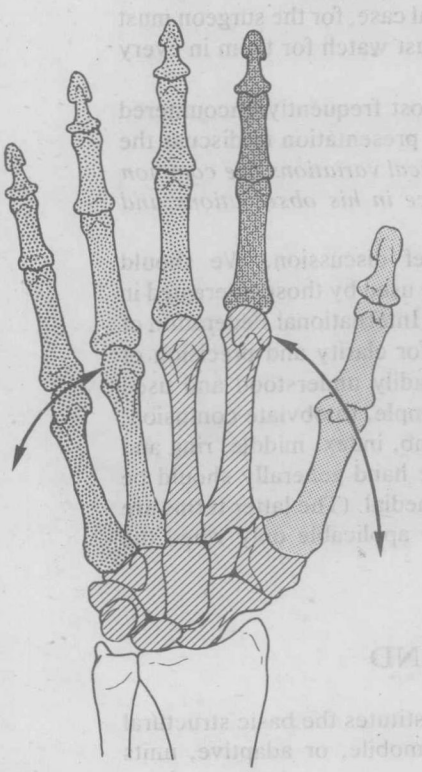

Figure 1–1 Basic architectural units of the hand. The fixed unit, comprising the second and third metacarpals, is rigidly bonded to the carpal wrist complex. The mobile, or adaptive, elements move about the fixed unit. The thumb is the most adaptive, followed by the index finger, which makes the two highly effective for fine, precision manipulations. The other mobile parts are concerned primarily with power grasp, and they function together basically as a unit. They are the fourth and fifth metacarpals with the middle, ring and small fingers.