

*Second Edition*

# SURGERY of the ELBOW

By

FREDERICK M. SMITH, M.D.

*Second Edition*

# SURGERY of the ELBOW

By

FREDERICK M. SMITH, M.D.

*Former Associate Attending Orthopedic Surgeon,  
Presbyterian Hospital, New York Orthopedic  
Hospital, and Vanderbilt Clinic*

1972

W. B. SAUNDERS COMPANY

Philadelphia • London • Toronto

W B Saunders Company West Washington Square  
Philadelphia, Pa. 19105

12 Dyott Street  
London, WC1A 1DB

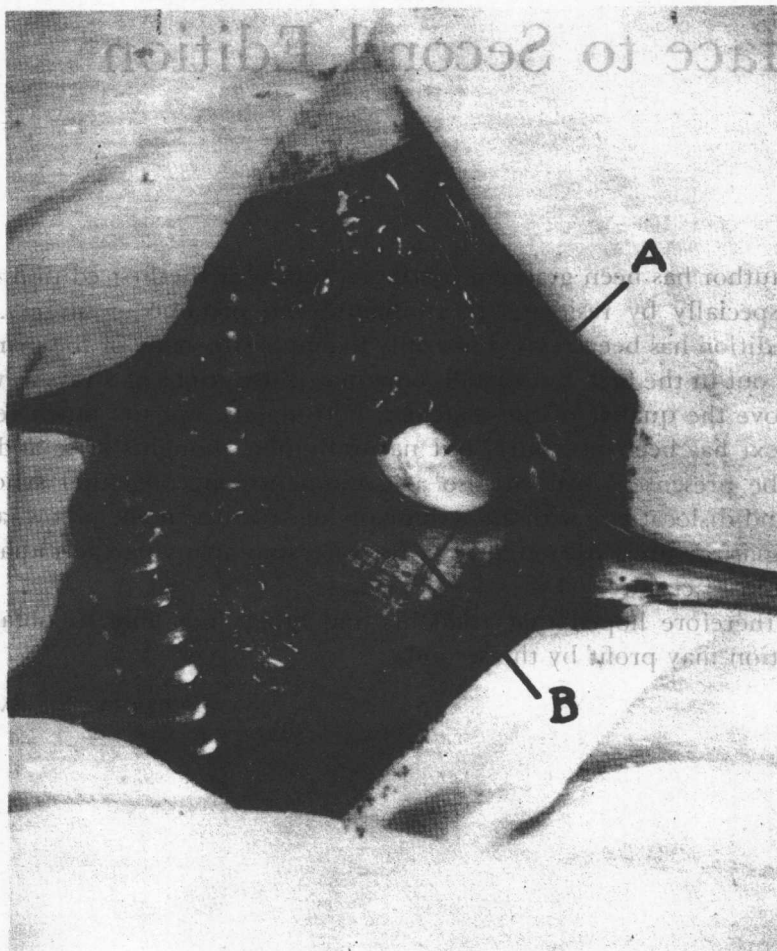
833 Oxford Street  
Toronto 18, Ontario

Surgery of the Elbow

ISBN 0-7216-8382-7

© 1972 by W. B. Saunders Company. Copyright 1954 by Charles C Thomas. Copyright under the International Copyright Union. All rights reserved. This book is protected by copyright. No part of it may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission from the publisher. Made in the United States of America. Press of W. B. Saunders Company. Library of Congress catalog card number 75-183457.

Print No: 9 8 7 6 5 4 3 2 1



### *Surgery of the Elbow*

*Medial epicondyle of humerus displaced into the dislocated elbow joint. Photograph shows operative exposure of the medial aspect of the joint. (A) Trochlear process of humerus. (B) Flexor-pronator group of muscles curling into the joint just distal to trochlea. The medial epicondylar fragment comes into view only when the muscles attached to it are pulled upon and withdrawn from the joint. (See Chapter X.)*

# Preface to Second Edition

The author has been gratified by the reception of the first edition of this book, especially by residents in traumatic and orthopedic surgery. The second edition has been revised not only to emphasize many of the principles brought out in the first, but to add some new illustrations of x-rays as well as to improve the quality of the sketches. Fortunately, not too much revision of the text has been necessary, but naturally new thoughts arise and these should be presented. Added also are comments on congenital synostosis, compound dislocations without accompanying fracture at the elbow, and on Monteggia fracture with radial neck fracture accompanying the radial head dislocation in children.

It is therefore hoped that residents and others not able to obtain the first edition may profit by the second.

FREDERICK M. SMITH



## Preface to First Edition

**T**HERE HAS long existed need for a book dealing with surgical conditions of the elbow. This region is subject to severe types of trauma (fractures, dislocations, lacerations, gunshot wounds, crushes, etc.) or to milder forms of trauma such as constant usage (occupation), sports (baseball pitching), or to irritation from mal-union after previous fractures or from post-traumatic arthritis. The joint may become the site of sepsis or tuberculosis and thus require operative surgery. Arthritis (gonorrheal or rheumatoid) does not require surgery in the early stage, but fibrous or bony ankylosis, the late result of either of these infections, may require surgery to increase joint motion. Other non-traumatic conditions of the elbow such as congenital deformities, neoplasms, osteomyelitis, paralyses, loose bodies, and bursitis often call for relief by operative surgery.

Although numerous monographs have been written upon such subjects as the shoulder, hand, hip and foot, the student must search through one or more of these or other text-books in order to cover the elbow region thoroughly. He must consult a text-book on fractures for traumatic lesions, many of which fail to warn against important associated soft part lesions, or fail to advise how to avoid incurring their complications. For late deformities or for tuberculosis of the joint, he must consult a text-book on operative orthopedics. In this is described one or more methods of treating such a lesion, usually stressing the particular method of the author, the latter well illustrated. Not only the medical student, but the resident or the younger surgeon may become utterly confused by the number of plausible methods of treatment suggested for a given condition. He is not in a position to decide for himself which method to choose from the information presented. He may recall the principles of treatment for fresh injuries; but for late deformities—this is something entirely different. It is just as important for the writer to inform his reader how a certain deformity might be avoided as it is to tell him how to correct it when present.

The purpose of this book is to deal with the various conditions in the region of the elbow that are amenable to surgical treatment or to a combination of surgical plus physiotherapeutic or radiotherapeutic measures. Inasmuch as trauma and the results of trauma make up a large part, the book will stress the principles of treatment, point out the danger spots, try to predict what can or may happen with good or bad treatment and thereby help the younger surgeon avoid the pitfalls that his predecessors have learned via "the hard way." For the purpose of impressing upon the reader the main

principles of treatment and the importance of careful attention to details so necessary in the successful care not only of a particular patient, but of all patients coming under his attention, reiteration in the text is employed solely as a means of emphasis.

FREDERICK M. SMITH

# Contents

	<i>Page</i>
Chapter I	
TRAUMATIC LESIONS OF THE ELBOW REGION .....	1
General Considerations .....	1
Fractures .....	5
Traumatic Etiology .....	5
Spontaneous .....	6
Epiphyseal Separation and Epiphyseal Trauma .....	7
Dislocations .....	7
Combined Fractures and Dislocations .....	8
Definitions .....	8
Fractures .....	8
Dislocations .....	9
Displacements .....	9
Other Traumatic Lesions .....	10
Chapter II	
PATHOLOGY OF FRACTURES .....	11
Acute Pathology .....	11
Late Pathology .....	12
Repair of Fractures .....	13
Repair of Soft Parts .....	17
Chapter III	
ANATOMY OF THE ELBOW REGION .....	18
Chapter IV	
SYMPTOMS AND SIGNS OF FRACTURES AND DISLOCATIONS .....	33
Chapter V	
PHYSICAL EXAMINATION OF THE ELBOW .....	37
Diagnosis .....	38
A. Clinical Diagnosis .....	38
B. Roentgenologic Diagnosis .....	39



Chapter VI

GENERAL PRINCIPLES OF FRACTURE TREATMENT .....	42
--	----

Chapter VII

ANESTHESIA .....	48
------------------	----

Chapter VIII

GENERAL CONSIDERATIONS OF THE PATIENT .....	52
---	----

Chapter IX

CLASSIFICATION OF FRACTURES AND DISLOCATIONS .....	58
--	----

Chapter X

FRACTURE OF LOWER EXTREMITY OF HUMERUS .....	60
Dicondylar (Intercondylar) Y and T Fractures .....	60
Supracondylar (Transcondylar) Fracture in Children .....	69
Fracture (Separation) of Medial Epicondyle (Epiphysis) of Humerus .....	102
Fracture of the Medial Condyle of Humerus .....	108
Fracture (Separation) of the Lower Epiphysis of the Humerus .....	111
Fracture of the Trochlear Process of Humerus .....	114
Fracture of the Capitellum of Humerus in Adults .....	115
Fracture of the Lateral Condyle of Humerus in Adults .....	118
Fracture of the Lateral Condyle or Separation of the Epiphysis of the Capitellum in Children .....	123
"Side-Swipe" Fracture of Lower Extremity of the Humerus .....	132
Gun-Shot Wounds of the Elbow .....	135
Door-Handle Injuries .....	136

Chapter XI

FRACTURE OF UPPER EXTREMITY OF ULNA .....	137
Fractures of the Olecranon .....	137
Fracture of the Coronoid Process .....	150
Monteggia Fracture .....	154

Chapter XII

FRACTURE OF UPPER EXTREMITY OF RADIUS .....	166
Fractures of the Head and Neck .....	166
Fracture (Avulsion) of Bicipital Tuberosity of Radius .....	175

Chapter XIII

ASPIRATION OF THE ELBOW JOINT .....	176
-------------------------------------	-----

Chapter XIV

COMPLICATIONS FOLLOWING ELBOW INJURIES .....	179
General .....	179
Vascular Injuries Complicating Fracture and Dislocations .....	180
Nerve Injuries Complicating Fracture and Dislocation .....	181
Median Nerve .....	182
Ulnar Nerve .....	182
Radial Nerve .....	183
Myositis Ossificans .....	185
Volkmann's Ischaemic Contracture .....	187

Chapter XV

OPERATIVE TREATMENT OF FRACTURES .....	193
--	-----

Chapter XVI

OPERATIONS ON THE SOFT PARTS ASSOCIATED WITH FRACTURE OR DISLOCATION	206
--	-----

Chapter XVII

SURGICAL APPROACHES TO THE ELBOW REGION .....	210
---	-----

Chapter XVIII

EARLY TREATMENT AIDS FOLLOWING INJURY .....	221
---	-----

Chapter XIX

DISLOCATIONS AT THE ELBOW JOINT .....	222
Types of Dislocation at the Elbow Joint .....	226
Treatment of Specific Dislocations at the Elbow .....	227
Unreduced (Old) Dislocation at Elbow .....	236
Technique of Open Reduction (Campbell) .....	237
Divergent Dislocation .....	239
Dislocation of Radius Alone .....	241
Dislocation of Radius with Ulnar Fracture (Monteggia Type) .....	244
Dislocation of Ulna Alone .....	244
Subluxation of Head of Radius in Child ("Pulled Elbow") .....	245
Congenital Dislocation of Head of Radius .....	246
Delayed Dislocation of Head of Radius Following Injury .....	247

Chapter XX

REHABILITATION .....	249
----------------------	-----

Chapter XXI

THE TREATMENT OF LATE DEFORMITIES AND DISABILITIES RESULTING FROM FRACTURE OR DISLOCATION .....	254
Malunion .....	254
Non-Union .....	259
Cubitus Varus (Gun-Stock) Deformity .....	261
Cubitus Valgus Deformity .....	261
Late Ulnar Nerve Neuritis .....	262
Growth Disturbance .....	264
Flexion Block .....	264
Myositis Ossificans .....	264
Excess Callus Formation .....	265
Periarticular Fibrosis and Capsular Contracture .....	265
Synostosis .....	265
Ankylosis .....	267
Osteochondritis Dissecans .....	269
Traumatic Arthritis .....	269
Volkmann's Contracture .....	270

Chapter XXII

CONDITIONS IN THE ELBOW REGION OR JOINT DUE TO TRAUMA OTHER THAN FRACTURE OR DISLOCATION .....	271
Loose Bodies .....	271
Chronic Synovitis .....	271
Chronic Bursitis of Olecranon Bursa (Miner's Elbow) .....	272
Epicondylitis (Tennis Elbow) .....	274
Radio-Humeral Bursitis .....	275
Medial Epicondyle Bursitis .....	276
Rupture of Biceps Tendon .....	277
Sprain of Elbow Joint .....	277

Chapter XXIII

NON-TRAUMATIC CONDITIONS OF THE ELBOW REGION OR JOINT .....	279
Infections .....	279
Rheumatoid Arthritis .....	281
Osteoarthritis .....	283
Post-traumatic Arthritis .....	283
Non-specific Arthritis .....	283
Osteochondritis Dissecans .....	284
Neurotrophic Joint .....	284

Osteomyelitis .....	285
Osteoid Osteoma .....	286
Neoplasms .....	287
Metabolic Disorders .....	288
Hemophilia .....	291
Affections of the Nervous System .....	292
Flexor Power .....	292
(Operative Correction) Steindler; Bunnell .....	292
(Operative Correction) Clark .....	293
(Operative Correction) Putti & Scaglietti .....	294
Extensor Power .....	294
(Operative Correction) Ober & Barr .....	295

## Chapter XXIV

SPECIAL OPERATIONS UPON THE ELBOW JOINT .....	296
Arthrodesis .....	296
Techniques of Campbell, Hallock .....	296
Technique of Steindler .....	298
Technique of Scuderi .....	298
Arthroplasty .....	299
Types—Functional (Haas) .....	301
Anatomic (MacAusland) .....	302
Articular Replacement (Hudack) .....	304
Resection (Excision) of the Elbow Joint .....	304
Erosion of the Elbow Joint .....	307
Arthrotomy of the Elbow Joint .....	307
Amputation .....	307
BIBLIOGRAPHY .....	309
INDEX .....	321

# Traumatic Lesions of the Elbow Region

## GENERAL CONSIDERATIONS

**T**HE ELBOW JOINT is an instrument of precision and one of complex mechanism. It is made up of three joints which, working together, give the function of one: the ulnar-humeral, the radio-humeral, and the (superior) radio-ulnar joints. The first two allow hinge-joint motion (flexion and extension); the latter two allow rotary motion of the forearm and hand (pronation and supination). It requires no intricate knowledge of anatomy and only a little common sense to realize that slight alterations in the joint structure may cause profound disturbances in its function. For example, a dicondylar fracture of the humerus with the condyles displaced in relation to the shaft and to each other may be compared to an ordinary door with its two hinges improperly aligned. Just as the door may be partially closed or opened, the elbow joint may be partially flexed and extended; but neither motion can be performed freely or completely. If one uses force to open or close this door beyond its free arc, the hinges may bind and squeak; if enough force is used one hinge may pull away from the door or wall or a portion of the hinge may break. If one uses force (passive motion or manipulation) to increase motion similarly following a fracture into an elbow joint, it also may bind, and if enough force is used, something must give way, i.e., a bone fragment, ligaments, or muscle.

Besides the importance per se of free flexion, extension and rotation in the elbow joint, it is important to remember that loss of one or more of these motions may seriously interfere with use of the hand. In many occupations complete pronation and supination are not absolutely essential and slight loss of either or both may not handicap the individual seriously since he can often compensate (sometimes imperceptibly) for this loss by rotation of the humerus at the shoulder joint. Other individuals may be very greatly handicapped by the loss of only twenty or thirty degrees of one of these rotations. Consider the pianist who loses this amount of full pronation. For fifteen to twenty minutes he may compensate by abducting his humerus, but this becomes so tiring he has to stop playing, when formerly he was able to play the piano for two to three hours at a time. A violinist, should he lose thirty degrees of full supination in his left hand, may have his career come to a rather abrupt termination.

There are many reasons why pronation and supination may be interfered

with following injury. Among these are development of irregularity or enlargement in the radial head, adhesions within the joint, loose bone fragments in the joint, and post-traumatic arthritis. These are but a few of the mechanical reasons for difficulty following injury. Pain and swelling are additional reasons for loss of function and use. (These disabilities, their etiology and treatment will be dealt with later in more detail in their proper chapters.)

So far nothing has been said of injuries to the surrounding soft tissues in the region of the elbow. Physicians with limited experience may forget that the soft tissues surrounding the bones and joints often exhibit more important pathology than the fracture or dislocation itself. The muscles, arteries, veins, lymphatics and nerves may be of much greater importance than the bone or the joint. For example, what good is an extremity which shows a well healed fracture, but also shows a Volkmann's ischemic contracture?

In general, injuries about the elbow give fairly successful results if treated with average consideration and intelligence. On the other hand there are many elbow fractures of a complicated nature which require some special knowledge and skill to be able to handle properly if the patient is to obtain a good functioning joint. Thirty or 40 years ago the treatment recommended for dicondylar fractures of the humerus in adults was reduction and immobilization for six to eight weeks in plaster casts or splints in such position as was considered optimum for the individual *should the joint become ankylosed*. The majority of them did ankylose after such prolonged immobilization. This is a peculiarity of elbow joints following severe injury when subjected to prolonged immobilization. The idea, however, was purely defeatist from the beginning. It is now encouraging that more and more surgeons who treat such injuries are beginning to be enlightened and are now getting these patients on early active motion in order to allow them to regain as much function as possible in this very important joint. It takes courage to sacrifice an excellent appearing elbow or a nice x-ray film of a perfect (?) reduction, if a sacrifice has to be made either in anatomy or function, and strive to restore joint function as fully as possible.

Furthermore, many of the commoner and less serious elbow injuries are often missed in respect to proper diagnosis and consequently are given improper treatment. The position of acute flexion is *not* the routine and proper position of immobilization in all elbow injuries. There should be no routine treatment of a particular type of fracture. Each patient should be examined and treated as an individual and the best method of treatment selected for him. It is better to vary or adjust the method to the individual than vice versa. Routine flexion, routine circular plaster and, what is worse, a routine surgical mind are probably responsible for more Volkmann's contractures than anything else. Too many times have we seen a child brought to the clinic or office months following injury and demonstrating little or no motion in the elbow joint, seeking help after his original doctor

has mistaken a serious lateral condyle fracture for a "chip off the bone" and had resorted to forced stretching manipulations.

### **HIGH INCIDENCE OF ELBOW INJURIES**

The elbow region is one of the common sites of injury both in the child and adult, being injured in the traumas of ordinary life (falls), sports, and in farm and automobile accidents. In large cities roller skating and traffic accidents become frequent causative agents of these injuries. At the Presbyterian Hospital, New York City, from 1929 to 1945 inclusive, fractures and dislocations of the elbow made up 9.9 percent and 18.8 percent of the total fractures and dislocations respectively treated on the Fracture Service. Omitting the dislocations, this amounts to more than twenty-one thousand fractures treated during this seventeen-year period.

### **WHAT ARE WE TRYING TO ACCOMPLISH?**

The above question may best be answered in the words of Murray,<sup>1</sup> who said:

In traumatic injuries what we as surgeons are trying to accomplish is the restoration, insofar as possible, of the individual to his former usefulness, in the shortest possible time, with as complete restoration of normal anatomy as can be accomplished under those circumstances.

**From the Standpoint of the Patient.** The writer has been taught in medical school and had impressed upon him thoroughly during his subsequent surgical training that the patient's welfare takes precedence over all else. This is a fundamental principle and as such deserves our immediate attention. All else, including teaching, research, etc., is of secondary importance. In other words, given an injured or ill patient, one must turn and devote all his attention, skill, and facilities within reason to relieve his suffering and to mend his injury.

This is an excellent principle and one that can and should be adhered to strictly in civilian practice. In the treatment of large numbers of war casualties it may be necessary and wise to forego the individual patient and to follow a method of treatment shown to be better for the entire group of injured, otherwise a few would be adequately treated at the expense of many. It is hoped that civilian surgery, however, will occupy the greater part of our future experience, and to this end is the majority of this book written.

We hope, therefore, to give the patient the best possible advantage anatomically, functionally, economically, and psychologically that can be furnished him.

**From the Standpoint of the Insurance Company.** Rarely is anyone sorry

<sup>1</sup> Murray, Dr. Clay Ray.



because an insurance company has to reimburse a patient for damages or time lost. Actually this is beside the point. The honest surgeon with a conscience will treat and take care of the injured patient with the best of his skill and knowledge which means that he will not prolong the treatment unnecessarily. In the end the insurance companies should not be long in recognizing that good surgical care does not consist solely of keeping the "paper work" up to date. Good surgical care costs money, but if it is good, it will in the long run result in an actual saving of money.

**From the Standpoint of Improving the Treatment of Trauma.** Through being alert a constant search will be made for new methods of treatment and the management of traumatic injuries will be made clearer and less difficult. The surgeon, who is to be successful, must never hesitate to learn from others. He will do well to attend scientific meetings and enter into discussions. He must keep up with the current literature to be aware of the progress in his field. To think over the new methods of treatment and try to reason why these may or may not fit into the scheme of general principles of treatment is time well spent. It will stress the importance of these and will make him a better surgeon, because good surgical judgment improves from years of experience in following sound principles.

**From the Standpoint of Teaching.** There is no question but that medical students are molded by the type of teachers with whom they come in contact and the teaching which they receive. This cannot begin too early in their careers. They must be honest with themselves; they must seek the truth; they must face facts. They must be taught the importance of "giving the patient a break" first, and being purely scientific later. If this can be instilled into them, they in turn may be entrusted with the future of surgery.

The teaching of undergraduate students should be limited largely to the principles of treatment and should not take into consideration the various methods of treatment. Only those methods should be mentioned which help to illustrate a particular principle. Students are only human and look for short cuts, tending to classify a certain "cure" with a certain disease (or injury). They must be given enough ground work such as anatomy and physiology and be made to understand the pathology of injury as well as that of disease. They must be advised when, where and how to look for various types of complications and be taught their implications. None of this should be done solely with didactic lectures. These must be curtailed to a minimum merely to give a general survey of the particular subject at hand. The main part of his teaching in this type of clinical work should consist of demonstrations of actual clinical cases, roentgenologic examination, discussion of cases, observation over a period of time and actual participation in the care of the patient. This can be carried out with small groups of students studying cases in the out-patient clinic or on the surgical ward. In this way the student gets to see the actual management of a case and if he gets to discuss its possibilities, this form

of teaching is infinitely more valuable to him than a dry lecture on the same subject.

The teaching of graduate students should augment this same teaching of sound principles by going into more detail as to various methods of treatment and the reasons for the choice of particular methods. It should also, if possible, permit them to participate in the actual treatment. In this fashion, they will learn refinements of diagnosis and technique that they had not previously acquired. Graduate students will benefit also if given an opportunity to carry out either a scientific or clinical research problem and in turn may help the professional staff or the institution under which they are working.

## FRACTURES

### Traumatic Etiology

Fractures in the region of the elbow are usually due to trauma, but they may have a spontaneous origin. Trauma may be divided into the direct and indirect types. Without identifying each and every variety it might be mentioned that of the slow-speed objects causing fractures by direct contact we have a pitched baseball, a club, a knife, pistol butt, falling glass, and other falling debris. High speed etiological agents consist of pistol or rifle bullets, shrapnel, shell, bomb or mine fragments. Then there are crushing injuries such as result from a window falling on the elbow, or a crush from a door, automobile or airplane accident. The elbow may be occasionally run over by a pneumatic tire of a car, or by the flanged wheel of a street car or train (in the latter case traumatic amputation usually resulting). Both the elbow and the object with which it comes in contact may be moving, and the combined speed of the two plus the mass result in a shattering, almost explosive injury to the elbow such as seen in the so-called "truck-swipe" or "side-swipe" injury sustained not infrequently by drivers of cars who insist on resting their forearm and elbow on the window sill while driving along the highway. Probably the commonest cause of elbow fractures comes from falls sustained by the patient in the home, at work, at play or on icy streets. Although many of these fractures come from hitting the elbow directly, many more come from a fall upon the hand, the force being transmitted indirectly to the elbow through the radius and ulna, but eventually knocking off the capitellum or radial head. Fractures resulting from pure indirect trauma are usually those caused by an avulsion mechanism as is sometimes seen in the olecranon after forcefully throwing a baseball; or in a dislocated elbow where the medial epicondyle epiphysis has been avulsed by the pull of the medial collateral ligament; or the bicipital tuberosity avulsed by a sudden violent pull of the biceps tendon.

### Spontaneous

Spontaneous fractures in the elbow region are usually due to some localized bone pathology, the commonest of which is a metastasis from a malig-