

Third Edition

DePalma's


THE MANAGEMENT OF FRACTURES AND DISLOCATIONS

an atlas

VOLUME 2

JOHN F. CONNOLLY, M.D., F.A.C.S.

Professor and Chairman
Department of Orthopedic Surgery
and Rehabilitation, The University of
Nebraska Medical Center, Omaha, Nebraska
and Chief of Orthopedic Surgery
Omaha Veterans' Administration Hospital,
Omaha, Nebraska



1981

W.B. SAUNDERS COMPANY

Philadelphia

London

Toronto

一九八三年八月廿九日

W. B. Saunders Company: West Washington Square
Philadelphia, PA 19105
1 St. Anne's Road
Eastbourne, East Sussex BN21 3UN, England
1 Goldthorne Avenue
Toronto, Ontario M8Z 5T9, Canada

Library of Congress Cataloging in Publication Data

De Palma, Anthony F.

De Palma's The management of fractures and dislocations.

Second ed. published in 1970 under title: The management of fractures and dislocations.

- I. Fractures—Atlases. 2. Dislocations—Atlases.
I. Connolly, John F. II. Title. III. Title: The
management of fractures and dislocations.

RD101.D29 1980 617'.15 79-64588

ISBN 0-7216-2666-1

Listed here is the latest translated edition of this book
together with the language of the translation and the publisher.

Spanish (*1st Edition*) (2 Volumes)—Atenco, Buenos Aires, Argentina

Japanese (*2nd Edition*) (2 Volumes)—Hirokawa Publishing Co., Tokyo, Japan

De Palma's the Management of Fractures
and Dislocations

Volume 1: ISBN 0-7216-2702-1
Volume 2: ISBN 0-7216-2703-X
Complete Set: ISBN 0-7216-2666-1

© 1981 by W. B. Saunders Company. Copyright 1970 and 1959 by W. B. Saunders Company. Copyright under the Uniform Copyright Convention. Simultaneously published in Canada. 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 79-64588.

Last digit is the print number: 9 8 7 6 5 4 3 2 1

CONTENTS

VOLUME I

Principles

DEFINITIONS AND CAUSES	2
TYPES OF FRACTURES.....	8
REPAIR OF FRACTURES.....	13
CONDITIONS INFLUENCING RATE OF HEALING	21
COMPLICATIONS OF FRACTURES.....	26
CLINICAL AND RADIOGRAPHIC FEATURES OF FRACTURES.....	100
GENERAL PRINCIPLES OF FRACTURE MANAGEMENT.....	106
REDUCTION OF FRACTURES.....	110
IMMOBILIZATION.....	115
MANAGEMENT OF OPEN FRACTURES	125
FUNCTIONAL REHABILITATION DURING AND AFTER FRACTURE HEALING	135

Injuries to Physes and Epiphyses

ANATOMIC FEATURES.....	144
MECHANISMS OF INJURIES (AFTER BRIGHT, BURSTEIN AND ELMORE)	149
SEPARATION OF THE UPPER EPIPHYSIS OF THE HUMERUS	156
FRACTURE OF THE EPIPHYSIS OF THE LATERAL CONDYLE OF THE HUMERUS (CAPITELLUM)	163
APOPHYSEAL SEPARATION OF THE MEDIAL EPICONDYLE OF THE HUMERUS.....	169
AVULSION OF THE LATERAL EPICONDYLE OF THE HUMERUS	179
EPIPHYSEAL SEPARATION OF THE LOWER END OF THE HUMERUS.....	184

SEPARATION OF THE UPPER RADIAL EPIPHYSIS	186
SEPARATION OF THE LOWER RADIAL EPIPHYSIS	190
SEPARATION OF THE PHALANGEAL EPIPHYSIS	193
AVULSION OF TRACTION APOPHYSES OF THE PELVIS.....	197
SEPARATION OF THE UPPER FEMORAL EPIPHYSIS.....	199
SLIPPED CAPITAL FEMORAL EPIPHYSIS	207
MALUNITED UPPER FEMORAL EPIPHYSEAL SLIPS GREATER THAN 60 DEGREES	213
SEPARATION OF THE EPIPHYSIS OF THE LESSER TROCHANTER	217
SEPARATION OF THE DISTAL FEMORAL EPIPHYSIS.....	219
FRACTURES OF THE TIBIAL SPINE	234
SEPARATION OF THE PROXIMAL TIBIAL EPIPHYSIS.....	237
COMPLETE AVULSION OF THE TIBIAL TUBERCLE.....	243
INJURIES OF THE DISTAL TIBIAL EPIPHYSIS	246
SUMMARY: PITFALLS IN MANAGING EPIPHYSEAL FRACTURES.....	257

Injuries of the Cervical Spine

EPIDEMIOLOGY	260
PERTINENT ANATOMIC FEATURES	261
MECHANISMS OF INJURY	267
EMERGENCY TREATMENT OF CERVICAL SPINE INJURIES	290
MANAGEMENT OF SUBLUXATIONS, DISLOCATIONS, AND FRACTURE-DISLOCATIONS.....	303
OCCIPITO-ATLANTAL DISLOCATIONS	306
FRACTURE OF THE ATLAS (BURSTING OR JEFFERSON'S FRACTURE).....	310
FRACTURE OF THE NEURAL ARCH OF C2 (HANGMAN'S FRACTURE).....	312
UNILATERAL ATLANTO-AXIAL SUBLUXATION	315
TRAUMATIC FORWARD DISLOCATION OF THE ATLAS	319
TRAUMATIC POSTERIOR DISLOCATION OF THE ATLAS.....	323
LESIONS OF THE ODONTOID PROCESS	326
SUPERIOR SUBLUXATION OF ODONTOID.....	328

UNILATERAL AND BILATERAL DISLOCATION OF A CERVICAL VERTEBRA.....	334
MANAGEMENT OF FLEXION INJURIES.....	345
MANAGEMENT OF EXTENSION INJURIES	363
POSTERIOR FUSION FOR INSTABILITY FOLLOWING LAMINECTOMIES (ROBINSON AND SOUTHWICK).....	370
MANAGEMENT OF INJURIES OF THE CERVICAL DISCS AND SOFT TISSUES.....	373
REHABILITATIVE MANAGEMENT OF THE PATIENT WITH SPINAL CORD INJURY	393
SUMMARY: THE PITFALLS OF CERVICAL SPINE FRACTURES AND DISLOCATIONS.....	397

Dislocations, Fractures, and Fracture-Dislocations of the Thoracic and Lumbar Spine

ANATOMIC FEATURES AND MECHANISMS OF INJURIES.....	400
EVALUATION AND MANAGEMENT OF INJURIES TO THE THORACIC AND LUMBAR SPINE	416
REHABILITATION OF THE PATIENT WITH TRAUMATIC PARAPLEGIA.....	453

Fractures and Dislocations of the Pelvis

PERTINENT ANATOMIC FEATURES AND MECHANISMS OF INJURY	460
GENERAL PRINCIPLES OF TREATMENT FOR PELVIC INJURIES.....	468
MANAGEMENT OF MINOR PELVIC FRACTURES	471
MANAGEMENT OF MAJOR PELVIC FRACTURES AND DISLOCATIONS	478
SUMMARY: PITFALLS IN MANAGING PELVIC FRACTURES AND DISLOCATIONS.....	496

Injuries to the Thoracic Cage

GENERAL CONSIDERATIONS.....	500
FRACTURES AND DISLOCATIONS OF THE RIBS	502
FRACTURES AND DISLOCATIONS OF COSTAL CARTILAGES.....	506
EMERGENCY MANAGEMENT OF COMPLICATIONS FROM RIB FRACTURES	509
DOUBLE FRACTURES OF THE RIBS (STEERING WHEEL INJURY, FLAIL CHEST, STOVE-IN CHEST).....	513

FRACTURES OF THE STERNUM.....	519
SUMMARY: PITFALLS OF MANAGING INJURIES TO THE THORACIC CAGE	522

Fractures and Dislocations of the Shoulder Girdle

FRACTURES OF THE CLAVICLE	524
LIGAMENTOUS INJURIES OF THE ARTICULATIONS OF THE CLAVICLE.....	545
FRACTURES OF THE SCAPULA	566
FRACTURES OF THE GLENOID	570
DISLOCATION OF THE SCAPULA.....	583
SUMMARY: THE PITFALLS OF FRACTURES AND DISLOCATIONS OF THE SHOULDER GIRDLE	585

Injuries of the Ligaments and Capsule of the Glenohumeral Joint (Subluxations and Dislocations)

ANATOMIC FEATURES AND MECHANISMS OF INJURY.....	588
MANAGEMENT OF SPRAINS AND SUBLUXATIONS OF THE GLENOHUMERAL JOINT	602
MANAGEMENT OF GLENOHUMERAL DISLOCATIONS	616
MANAGEMENT OF COMPLICATIONS OF GLENOHUMERAL DISLOCATION	642
SUMMARY: PITFALLS OF MANAGING SUBLUXATIONS AND DISLOCATIONS OF THE SHOULDER.....	682

Fractures of the Humerus

FRACTURES OF THE UPPER END OF THE HUMERUS	686
FRACTURES OF THE SHAFT OF THE HUMERUS	718
SUMMARY: COMPLICATIONS AND PITFALLS OF FRACTURES OF THE HUMERUS.....	737

Fractures and Dislocations in the Region of the Elbow

FRACTURES OF THE LOWER END OF THE HUMERUS.....	740
DISLOCATIONS OF THE ELBOW JOINT	791
FRACTURES ASSOCIATED WITH DISLOCATION OF THE ELBOW JOINT	806
VASCULAR AND NEURAL COMPLICATIONS ASSOCIATED WITH FRACTURES AND DISLOCATIONS OF THE ELBOW JOINT.....	826
RECURRENT DISLOCATION OF THE ELBOW JOINT.....	837
OLD UNREDUCED DISLOCATIONS OF THE ELBOW JOINT.....	839

TRAUMATIC MYOSITIS OSSIFICANS.....	848
OTHER FRACTURES, DISLOCATIONS, AND INJURIES ABOUT THE ELBOW	851
SUMMARY: COMPLICATIONS AND PITFALLS OF FRACTURES AND DISLOCATIONS OF THE ELBOW	883
Fractures of the Shafts of the Bones of the Forearm	
ANATOMIC CONSIDERATIONS	888
GENERAL CONSIDERATIONS IN TREATMENT.....	901
CLOSED REDUCTION AND FUNCTIONAL TREATMENT OF FOREARM FRACTURES (SARMIENTO).....	910
OPERATIVE MANAGEMENT OF FOREARM FRACTURES.....	918
MANAGEMENT OF OPEN FRACTURES OF THE BONES OF THE FOREARM.....	954
FRACTURE OF THE ULNA WITH DISLOCATION OF THE RADIAL HEAD (MONTEGGIA FRACTURE).....	959
FRACTURES OF THE BONES OF THE FOREARM IN CHILDREN	979
SUMMARY: COMPLICATIONS AND PITFALLS OF FOREARM FRACTURES.....	1003
Index	i-xxxiii

VOLUME 2

Fractures and Dislocations in the Region of the Wrist

FRACTURES OF THE LOWER END OF THE RADIUS: COLLES', SMITH'S AND BARTON'S FRACTURES.....	1008
FRACTURE OF THE RADIAL STYLOID PROCESS	1033
TRAUMATIC DISLOCATION AND SUBLUXATION OF THE DISTAL END OF THE ULNA (WITH AND WITHOUT FRACTURE).....	1036
COMPLICATIONS OF DISTAL RADIAL FRACTURES.....	1043
FRACTURES AND DISLOCATIONS OF THE CARPAL BONES: GENERAL PRINCIPLES	1052
FRACTURES OF THE SCAPHOID.....	1059
LUNATE AND PERILUNATE DISLOCATIONS AND SUBLUXATIONS	1084
OTHER DISLOCATIONS AND SUBLUXATIONS OF THE CARPUS	1103
FRACTURES OF THE CARPAL BONES	1115
NEUROLOGIC COMPLICATIONS OF CARPAL INJURIES.....	1130
SUMMARY: COMPLICATIONS AND PITFALLS OF FRACTURES AND DISLOCATIONS OF THE WRIST	1134

Fractures and Dislocations of the Hand

APPLIED ANATOMY..... 1138

COMMON MECHANISMS OF INJURY TO EXTRINSIC AND INTRINSIC
TENDON AND JOINT FUNCTION—THE “JAMMED” FINGER OR THUMB 1148

BASIC PRINCIPLES IN MANAGING HAND INJURIES..... 1153

DISLOCATIONS AND FRACTURE-DISLOCATIONS OF THE THUMB..... 1158

FRACTURES, DISLOCATIONS, AND FRACTURE-DISLOCATIONS
OF THE FINGERS..... 1190

SUMMARY: PITFALLS OF FRACTURES AND DISLOCATIONS OF THE HAND..... 1258

**Dislocations and Fracture-Dislocations of the Hip
and Acetabulum**

ANATOMIC FEATURES AND CLASSIFICATION OF INJURIES..... 1262

POSTERIOR DISLOCATIONS OF THE HIP 1268

ANTERIOR DISLOCATIONS OF THE HIP 1315

TRAUMATIC DISLOCATION OF THE HIP IN CHILDREN 1331

FRACTURES OF THE ACETABULUM 1335

SUMMARY: COMPLICATIONS AND PITFALLS IN MANAGING HIP
DISLOCATIONS AND FRACTURE OF THE ACETABULUM 1361

Fractures of the Femur

FRACTURES OF THE UPPER END OF THE FEMUR 1366

FRACTURES OF THE NECK OF THE FEMUR 1407

FRACTURES OF THE FEMORAL SHAFT 1456

FRACTURES OF THE LOWER END OF THE FEMUR..... 1511

SUMMARY: PITFALLS OF MANAGING FEMORAL FRACTURES..... 1537

Injuries of the Soft Tissues and Bony Elements of the Knee Joint

ANATOMIC FEATURES..... 1542

INJURIES TO THE LIGAMENTS OF THE KNEE JOINT..... 1548

DISLOCATIONS AND FRACTURE-DISLOCATIONS OF THE KNEE JOINT 1620

FRACTURES OF THE PATELLA..... 1631

RUPTURE OF THE EXTENSOR APPARATUS OF THE KNEE JOINT..... 1649

DISLOCATIONS OF THE PATELLA	1663
SUBLUXATION AND DISLOCATION OF THE PROXIMAL TIBIOFIBULAR JOINT	1688
ACUTE TRAUMATIC HEMARTHROSIS	1691
OPEN JOINT INJURIES.....	1693
FRACTURES OF THE CONDYLES OF THE TIBIA	1696
SUMMARY: PITFALLS AND COMPLICATIONS OF KNEE INJURIES	1719

Fractures of the Tibia and Fibula

FRACTURES OF THE SHAFT OF THE TIBIA.....	1724
OPEN TIBIAL FRACTURES.....	1749
OTHER PROBLEMS IN TIBIAL FRACTURE.....	1767
FRACTURES OF THE SHAFT OF THE FIBULA ALONE.....	1797
SUMMARY: COMPLICATIONS AND PITFALLS OF MANAGING TIBIAL FRACTURES	1798

Injuries of the Ankle: Sprains, Dislocations, and Fractures

ANATOMIC FEATURES AND MECHANISMS OF INJURIES.....	1802
EVALUATION AND MANAGEMENT OF ACUTE ANKLE SPRAINS	1809
FRACTURES OF THE ANKLE	1835
POSTERIOR DISLOCATION OF THE FOOT WITH POSTERIOR MARGINAL FRACTURE OF THE TIBIA.....	1887
PRONATION-DORSIFLEXION INJURIES	1898
DISLOCATIONS OF THE ANKLE JOINT	1916
OPEN FRACTURES AND FRACTURE-DISLOCATIONS OF THE ANKLE JOINT.....	1931
MALUNITED FRACTURE-- DISLOCATIONS OF THE ANKLE.....	1939
SUMMARY: PITFALLS IN MANAGING ANKLE INJURIES.....	1947

Fractures and Fracture-Dislocations of the Bones of the Foot

FRACTURES AND DISLOCATIONS OF THE TALUS	1952
COMPLICATIONS OF FRACTURES AND FRACTURE-DISLOCATIONS OF THE TALUS	1993

FRACTURES OF THE CALCANEUS.....	2005
FRACTURES AND FRACTURE-DISLOCATIONS OF THE TARSAL NAVICULAR.....	2031
FRACTURES OF THE CUBOID AND CUNEIFORM BONES	2039
DISLOCATIONS AND FRACTURE-DISLOCATIONS OF THE MIDTARSAL JOINT	2045
DISLOCATIONS AND FRACTURE-DISLOCATIONS OF THE TARSOMETATARSAL JOINT	2051
FRACTURES OF THE METATARSAL BONES	2058
DISLOCATIONS OF THE METATARSOPHALANGEAL JOINTS	2070
FRACTURES OF THE TOES	2073
SUMMARY: PITFALLS AND COMPLICATIONS OF FRACTURES AND DISLOCATIONS OF THE FOOT.....	2078

Birth Fractures and Pathologic Fractures

BIRTH FRACTURES OF LONG BONES	2083
PATHOLOGIC FRACTURES	2088
SUMMARY: PITFALLS AND COMPLICATIONS OF BIRTH FRACTURES AND PATHOLOGIC FRACTURES	2134

Appendix

MULTIPLE TRAUMA: EARLY MANAGEMENT IN THE EMERGENCY DEPARTMENT.....	2138
TREATMENT PROTOCOL FOR PREHOSPITAL MANAGEMENT OF THE TRAUMA PATIENT.....	2140
PNEUMATIC COUNTER-PRESSURE DEVICE	2146
Index	i-xxxiii

FRACTURES AND
DISLOCATIONS IN
THE REGION OF
THE WRIST

FRACTURES OF THE LOWER END OF THE RADIUS: COLLES', SMITH'S AND BARTON'S FRACTURES

REMARKS

Like most fractures of the upper limb, these eponymic fractures result from a fall on the outstretched hand. Varying force vectors produced by the fall, the position of the wrist, and the differing structural properties of bones account for the differences in fracture types.

Forceful hyperextension with the forearm and wrist pronated drives the carpals into the distal radius and produces a bending and compressive failure of the cancellous subchondral bone.

Colles' fracture is a typical fracture of weakened osteoporotic bone; 60 to 70 per cent of these fractures occur in postmenopausal women.

The same hyperextension mechanism in the young adult male is more likely to produce a fracture of the scaphoid.

The hyperextension injury to the child's wrist usually results in failure through the physis or produces a distal greenstick fracture.

Occasionally, the force vector of the injury drives the carpal bones in a volar direction. This results in a fracture that angulates volarly instead of dorsally, i.e., Smith's fracture.

The same force vectors with volar direction in a young adult male shear off the articular surface of the distal radius and produce a Barton's fracture with volar dislocation of the carpus.

Each of these fracture types carries different implications regarding stability of reduction and prognosis; however, each is managed with the same ultimate objective — restoration of painless function.

Colles' Fracture

REMARKS

Colles' fracture with its dinner-fork deformity is among the most common fractures seen in emergency rooms.

The force vectors of injury produce the characteristic fork deformity of the patient's wrist. This consists of three components: radial shortening, dorsal tilt, and radial deviation of the distal radial fragment.

Correcting the dinner-fork deformity is done by pulling the radius out to length and then restoring the normal volar and radial tilt of its distal end.

The reduction must be maintained until the weak subchondral bone heals sufficiently to prevent redisplacement. This is the difficult aspect. In actual practice, recurrence of deformity, particularly radial shortening, is common because of the eggshell structural properties of the fractured bone in this region.

A good reduction is important for the patient's subjective opinion about the result, which is based primarily on the appearance of the wrist and the range of rotation after healing.

Avoid overtreating these injuries in the elderly patient. Particularly avoid extreme positions of forced flexion, pronation, and ulnar deviation (Cotton-Loder position), which add to the likelihood of postreduction neuropathy and disuse hand-shoulder syndrome.

The deformity may actually be worsened by forced pronation, which accentuates the deforming pull of the brachioradialis on the distal fragment.

For unstable fractures use pin fixation through the distal radius. This technique is particularly useful to correct the disruption of the radioulnar joint and radial shortening that commonly cause the unsatisfactory appearance and rotational limitation after Colles' fracture.

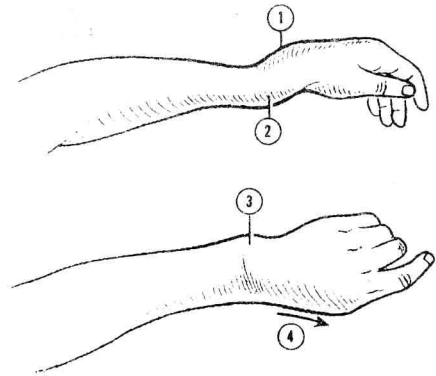
Avoid pins through the hand, which can produce extremely recalcitrant disuse hand-shoulder or ocular-palmar syndrome. The latter syndrome occurs in the patient who has become so intimidated by the injury or, more often, by its treatment that whenever he looks at the hand it hurts.

The hand-shoulder disuse syndrome after fracture can be virtually eliminated by treating the fracture with emphasis on early active range of motion to the fingers and shoulder, and by avoiding the use of a support sling.

COLLES' FRACTURE WITHOUT COMMINUTION

Dinner-Fork Deformity

1. Abrupt dorsal prominence.
2. Gently rounded volar prominence.
3. The wrist is broadened.
4. The hand is deviated radially.

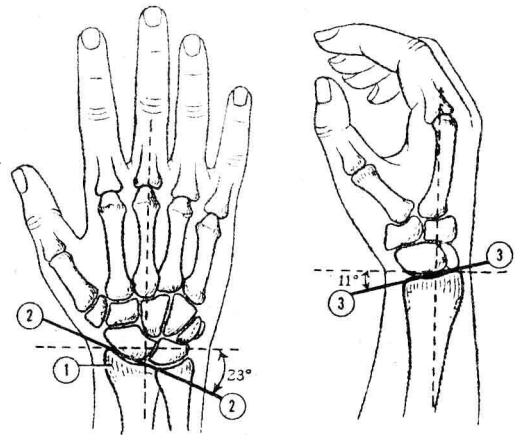


Appearance on X-Ray

NORMAL WRIST

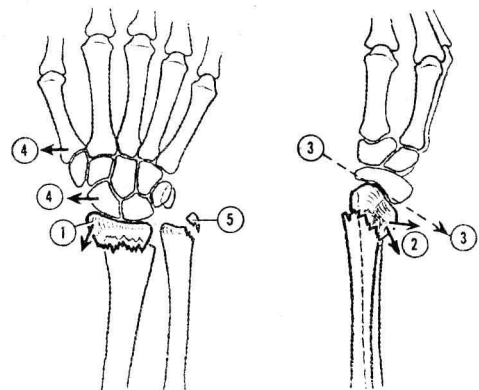
1. The styloid process of the radius extends 1 cm beyond that of the ulna.
2. The articular surface of the radius projects toward the ulna 15 to 30 degrees (average 23 degrees).
3. The plane of the radial articular surface slopes downward and forward 1 to 23 degrees (average 11 degrees).

Note: Compare these anatomic features with those seen in a Colles' fracture.



COLLES' FRACTURE

1. The distal radial fragment is displaced proximally. (The radial styloid may be on the same plane as the ulnar styloid or proximal to it.)
2. The distal radial fragment displaces dorsally and proximally.
3. The plane of the articular surface of the radial fragment tilts dorsally. (This angle varies greatly in different patients.)
4. The carpus and the hand deviate toward the radius.
5. The ulnar styloid may or may not be fractured.



Preferred Method of Anesthesia: Regional Intravenous Anesthetic

1. Mix 15 cc. of 1% lidocaine and 30 cc. of normal saline to make a 0.33% solution. The dosage should be 0.5 cc. of this solution per kg. of body weight.

2. Insert a small butterfly needle into the hand on the fractured side, which is immobilized in a splint.

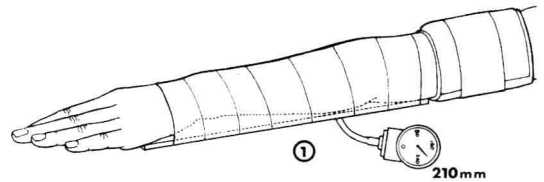
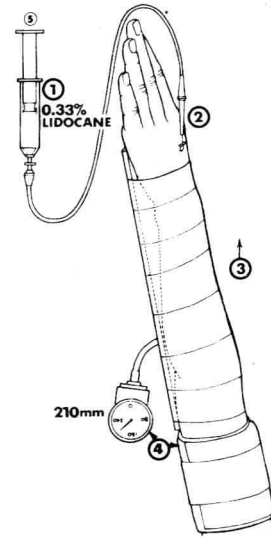
3. Elevate the limb for at least 3 minutes to diminish edema.

4. Using a pretested and securely taped blood pressure cuff, stop circulation by rapid inflation to at least 210 mm Hg.

Note: Specially designed double tourniquets may also be used.

5. Lower the arm and inject the lidocaine solution in appropriate dose.

1. The needle is removed, and after 10 minutes the fracture is reduced. Always keep the cuff inflated for at least 15 minutes.



Reduction by Traction and Manipulation

The patient assumes the supine position on the fracture table.

1. Finger traction is applied.

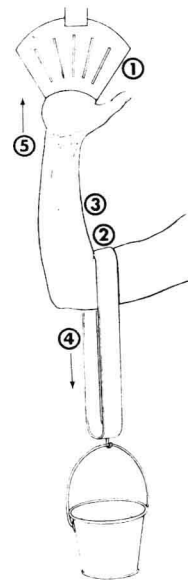
2. The elbow is flexed to a right angle.

3. The forearm is in neutral rotation.

4. Counter traction is made using a muslin sling with a water bucket for traction.

5. Traction is maintained for approximately 5 minutes to pull the radial styloid distal to the ulnar styloid.

Note: The tourniquet for intravenous anesthesia is maintained during reduction.



Reduction by Traction and Manipulation (Continued)

1. With the fingers of both hands on the volar side of the forearm, use both thumbs to push the distal fragment forward and toward the ulna.



Application of Sugar-Tong Splint (Miller Method)

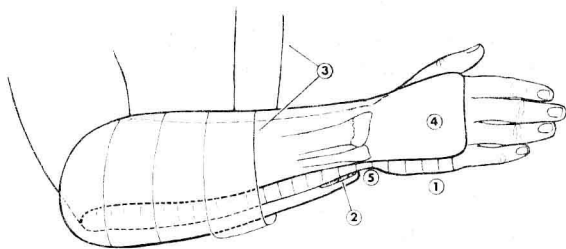
1. Apply cast padding from the metacarpal heads to above the elbow.

2. Add a felt pad to the volar surface of the proximal fragment.

3. Wrap a 10-cm sugar-tong plaster splint with circumferential gauze bandage.

4. The dorsal half of the splint ends at the metacarpal heads and is molded over the distal fragments.

5. The volar half ends 1 to 2 cm proximal to the fracture.



1. The wrist is in neutral rotation and slight flexion. Forced flexion or pronation accentuates the deforming pull of the brachioradialis and should be avoided.

2. The sugar tong splint allows slight wrist flexion and

3. Limited elbow motion without forearm rotation.

Note: If reduction is satisfactory, deflate the tourniquet for intravenous anesthetic to 80 mm Hg and after 10 seconds reinflate it to 210 mm Hg. Monitor vital signs and mental status; if they are unchanged, remove the tourniquet completely. Continue monitoring vital signs and mental status for 10 minutes following release of tourniquet. The entire procedure requires two assistants, one to monitor the pressure of the cuff during the block and the other to assist in reduction. Minimum tourniquet time should always exceed 15 minutes. Resuscitation equipment should be immediately available when administering anesthetic of any type.

