A BRIEF OUTLINE
OF
MODERN TREATMENT
OF
FRACTURES

BY
H. WALDO SPIERS, A.B., M.D.
Professor of Orthopaedic and Fracture Surgery
College of Medical Evangelists
Los Angeles, California

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PREFACE

This brief outline of the modern treatment of fractures aims to illustrate the fundamentals in bone surgery and to touch only the high spots in their practical application. Modern textbooks are so filled with illustrations and demonstrations of operative technique, with the discussion of so wide a variety of methods, that the average student or interne is frequently at a loss to know what it is all about.

If the discussions here have pointed out and impressed upon the reader some of the pitfalls and dangers of fracture surgery, have brought forward by brief discussion and simple illustration some of the more recent "tried and true" methods of treatment, and have brought out and to an extent fixed in his mind the fundamental principles of all fracture surgery, the result desired has been accomplished.

In this second edition the chapter on "Fractures and Dislocations of the Hip" has been changed to include the Watson-Jones approach. The chapter on "Fractures of the Ankle and Foot" has been extended to include a description of arch support for injured lower extremity. A few illustrations have been added, also a short chapter with illustrations on "Fractures of the Mandible and Maxillae."

The author wishes to acknowledge indebtedness for inspiration and kindly suggestions to both his former instructor Robert B. Osgood, M.D., and his friend Willis C. Campbell, M.D.

H. Waldo Spiers.

Los Angeles, California

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Chapter I

CONSIDERATION OF GENERAL FRACTURE PROBLEMS

MECHANICS AND TYPES OF FRACTURE

Fractures are produced by either direct or indirect violence depending on the amount and the direction of the force. If the force is direct, and is of great violence, the line of fracture will be transverse. If the force is direct and the violence is only moderate, the line of fracture will probably be oblique. If the force is indirect, such as a twist or a spinning force, the line of fracture will probably be spiral in nature. There are many types of fractures. Their names are largely descriptive of their particular characteristics.

Following are types of fractures:

Transverse fracture.
Oblique fracture.
Spiral fracture.
Comminuted fracture, (multiple fragments).
Compound fracture, (fracture with an open wound leading to the fracture).
Simple fracture, (where the skin is unbroken).
"T" fracture, as fracture of both condyles of lower end of humerus.
Stellate fracture, (fractures of the cranium).
Intra-articular fracture, (fractures within the capsule of the joint).
Extra-articular fractures, (fractures just outside the joint capsule).
Crush fracture, (such as a compression of a body of a vertebra).
Impacted fracture, (in which the fragments are telescoped into each other).
Greenstick fracture, (in which the bones are bent, but the ends are not completely separated), (a common fracture of childhood).
Epiphyseal fracture, (one through the epiphyseal line).
Pathological fracture, (fracture due to bony disease, etc.).
Ununited fracture, (fractures that fail to unite).
Malunited fracture, (fractures that unite with bad alignment and deformity).

EMERGENCY CARE OF SIMPLE FRACTURE

Immobilization is the key to the care of a simple fracture. "Splint them where they lie" is an excellent motto. An obvious deformity of an extremity following an accident is sufficient indication for emergency treatment. Many fractures occur without obvious deformity, but the painful nature of the injury justifies the assumption of a fracture. In these days of the X-ray, manipulation is not justified. It is not only painful but unnecessary. Muscle spasm is the invariable accompaniment of a fracture.

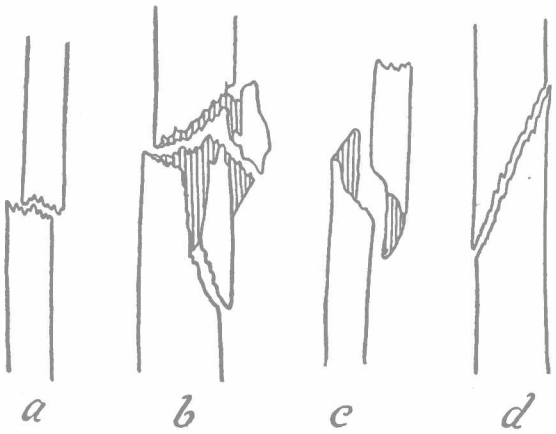

FIG. 1. Illustrating (*a*) transverse, (*b*) comminuted, (*c*) spiral, (*d*) oblique fracture of the long bones.

To handle a fracture, grasp the distal fragment gently, gradually increasing the traction on the extremity. This will tend to overcome muscle spasm and to realign the fragments, and should relieve, rather than increase pain. If no refined splints and pads are at hand, a pillow on a board bound firmly to the extremity is good emergency treatment. The extremity may be bound to the body, as in the case of an arm, or one leg may be bound to the other with a pillow or pad between.

An anterior and posterior board splint in the case of the forearm, similar lateral splints in the case of the lower leg, bound firmly in place are satisfactory. In the fractured hip a board carried from the axilla to the ankle bound firmly to the trunk and to the affected extremity holds it temporarily very well. The injured spine is best handled on a firm stretcher. Pillows on a wide board answer the same requirement.

In the case of the injured neck support the head firmly, and transport as recommended for the injured lower spine.

Once the fracture is temporarily splinted, see that the patient is conveyed to a suitable place for X-ray examination. After films have been taken in both anteroposterior and lateral views, you are ready to consider the whole fracture problem before you.

EMERGENCY CARE OF COMPOUND FRACTURE

A compound fracture is one in which there is a wound which opens from the surface through the soft tissues to the fracture site. Prolonged

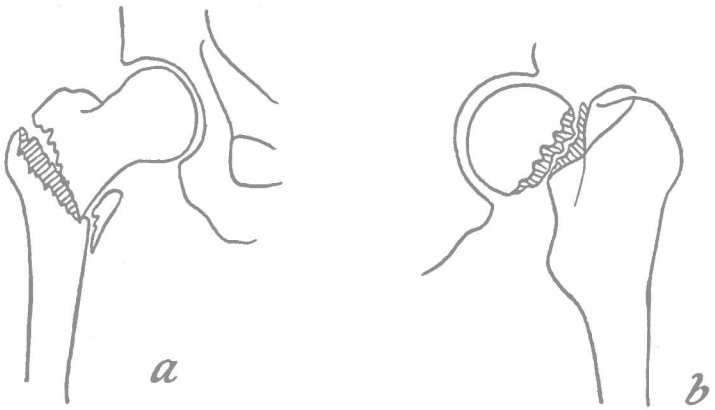

FIG. 2. *a*. Illustrating the typical extracapsular fracture of the femur at the hip.
b. Illustrating the typical intracapsular fracture of the neck of the femur.

and permanent disability is sometimes prevented, and often lives are saved by the intelligent handling of a compound fracture. There are two types in general.

1. The compound fracture in which the bone penetrates the skin from within outward.

2. One in which an object penetrates the skin from without inward.

It is self evident that the former is of less gravity than the latter.

Remove the clothing over the part and treat the wound at once with some strong antiseptic, preferably tincture of iodine, and apply a sterile pad of gauze and bind it on firmly. There are a good many things not to do at this time. Do not try to cleanse the wound with a watery solution. Do not try to prepare the parts by shaving or otherwise cleansing the wound. Leave this to a later time when it can be done

thoroughly. If the bones are protruding, do not reduce them by traction and countertraction until the whole raw area, bone, and wound have been treated with an antiseptic. Then gently replace the bones within the extremity by traction, and apply the sterile pad.

After the sterile pad and the antiseptic have been applied and the fragments placed in a reasonable position, you are then ready to treat the part as a simple fracture by applying emergency splints. Transport the patient at once to a hospital or clinic where adequate surgical technique is available. If an X-ray equipment is at hand, it is usually wise to have films made before taking the patient to the operating room.

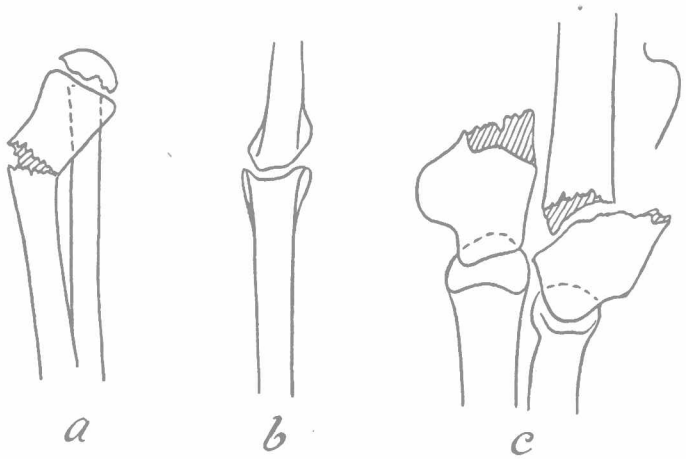

FIG. 3. *a*. Illustrating the "green stick" fracture common in children.
b. Illustrating the rounded, hardened edges of the ends of the fragments and the cupping and pointing characteristic of a nonunion.
c. Illustrating the "T" fracture of the lower end of the humerus.

This gives one valuable information in planning the treatment and carrying out subsequent procedures in the operating room. Keep in mind where a great deal of blood has been lost that transfusions are often life saving.

DEBRIDEMENT OF COMPOUND FRACTURE

By debridement is meant the removal of all foreign substances, such as clothing, sand, dirt, splinters, glass, etc., the removal of all dead or macerated tissue either soft or bony, the removal of the wound edges, and a thorough cleansing of the wound. Ether dissolves oils and fats, removes dirt, and is an excellent cleanser. This should be followed by

iodine and alcohol. It is good practice in the debridement of a wound to do the preliminary cleansing and removal of the macerated or dead tissue with one set of instruments, discarding them and the gloves, and then proceed with another fresh sterile set to re-cleanse the wound. After this procedure has been followed out in its entirety, then only is one justified in suturing the skin edges together tightly without drainage, and proceeding to a reduction of the fracture by the method indicated in the type of fracture with which one is dealing.

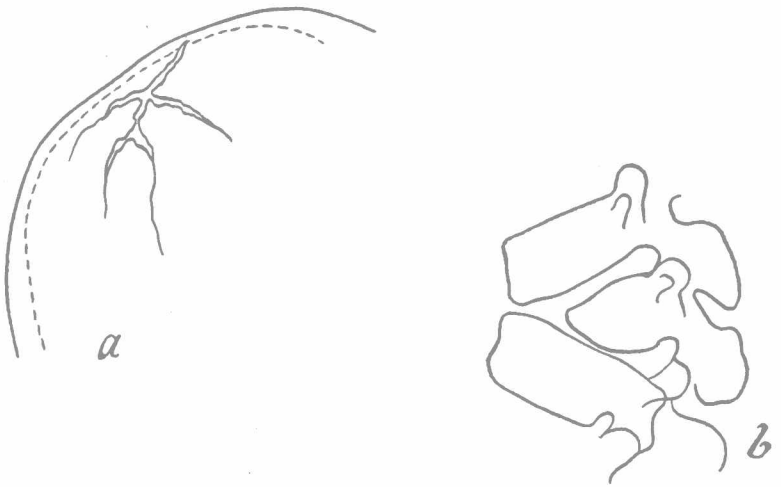

FIG. 4. *a*. Illustrating the stellate fracture seen most characteristically in fractures of the skull.
b. Illustrating a compression fracture of a vertebral body.

To be successful, debridement must be carried out within a few hours from the time of the accident. Eight hours is probably the outside limit—better within an hour or so. The secret of the care of a compound wound lies in a thorough cleansing, the tight suturing, and the complete immobilization of the parts.

In many types of compound wounds debridement is not justified or is impossible in its entirety. Gunshot wounds are one type; wounds in which the skin edges cannot be approximated without undue tension, or wounds which have arrived too late at the operating room are other such types. These must be treated as probably infected wounds, leaving adequate preparation for drainage.

Debridement is effective only in first few hours.

1. Remove all foreign material.
2. Remove all dead or macerated tissue and wound edges.
3. Suture tightly without skin tension.
4. Immobilize part completely.

SERUM IN TETANUS AND GAS BACILLUS INFECTION

Every compound fracture should be considered potentially infected. When the bones penetrate from within outward, the percentage of danger of infection from the gas bacillus and tetanus bacillus is slight. All should be given tetanus antitoxin within a few hours after the injury. It is now customary to give the immunizing dose of tetanus-perfringens antitoxin together. Tetanus antitoxin is definitely prophylactic. The consensus of opinion is that the use of the perfringens antitoxin is also of value. Where the opportunity for infection is quite evident, as in a very dirty compound wound with foreign particles in it, it is recommended that immunizing doses of both antitoxins be again repeated in three to five days. Once the general symptoms of tetanus develop, the prognosis is very bad. Heroic treatment of the disease by tetanus antitoxin will sometimes, but not often, be life saving. Late treatment of the focus of infection because of the nature of the disease is of little avail.

GAS BACILLUS INFECTIONS

All wounds that are compound, and all wounds that have been delayed in coming to surgery, or have had emergency treatment elsewhere should be cultured. There is no difficulty in taking a culture from the average wound with an applicator. This should be routine at the first examination.

Gas bacillus infections show themselves promptly. The odor is characteristic; once one has been at all familiar with it, it is unmistakable. The gas in the tissues is readily felt. The tissues crepitate. The patient is extremely toxic. The increase in pulse rate is proportionately greater than the increase in temperature. The longer the patient lives following the infection, the better the prognosis. The infection is overwhelming in some cases, and amputation of the extremity is the only means that may possibly save the life. Large doses of antitoxin are indicated, intramuscularly, intravenously, and locally about the wound.

The treatment of the gas-infected wound revolves itself around an adequate extensive opening of the extremity where the infection is located. Muscle planes must be dissected out and dead sloughing tis-

sues removed. Dakin's solution carried throughout the entire wound in the usual manner in between the muscle planes is excellent treatment. It is customary to alternate the Dakin's solution with hydrogen peroxide. The bacillus is anaerobic, and oxygen supplied by the hydrogen peroxide is indicated. Early adequate opening, drainage, and antiseptic treatment often will save the extremity, particularly in the case where the progress of the infection is not extremely rapid. However, many lives have been lost by avoiding the radical treatment in the hope that more conservative treatment will save the infected extremity.

The secret of cure in gas bacillus infection lies in its early recognition. A thorough, early debridement is the best preventive. The infected case that must wait for a positive culture has often waited too long.

REDUCTION OF FRACTURE—GENERAL CONSIDERATIONS

The fundamental principles in the treatment of all fractures, the proper application of which constitutes good fracture therapy are:

1. Reduce by traction and countertraction.
2. Place the distal fragment in line with the proximal fragment.
3. Immobilize until firm union has taken place.
4. Immobilize the joints proximal and distal to the fracture site.

Muscle spasm is the invariable accompaniment of all fractures. It is involuntary. It is nature's protective mechanism. In the fracture which is overriding, muscle spasm must be overcome by traction and countertraction. In most cases this is best applied with the individual under complete anaesthesia. In some instances, as certain fractures of the femur or of the humerus, muscle spasm is overcome by gradual traction applied over a period of days or weeks.

It is self evident that the distal fragment must be placed in line with the proximal fragment. The proximal fragment always takes a position corresponding to the changed muscle pulls and leverage due to the fracture. Consequently the distal fragment is best replaced, approximated, and aligned by putting it in line with the proximal fragment.

The methods of fixation of the fragments are legion, each designed to meet certain specific problems in the type of fracture with which one is dealing. Immobilization should include the proximal and distal joints of the involved fractured bone. This rule is universally applicable in fractures of the shaft in one of the long bones. In certain specialized fractures, particularly about the joints, this rule can sometimes be disregarded. Colles' fracture and Pott's fracture are examples of this.

The four fundamental principles in the treatment of all fractures, if kept in mind, will often hold the initiate on the right road to the successful care of a fracture problem.

PLANNING THE TREATMENT IN A FRACTURE PROBLEM

The successful treatment of a fracture depends to no small extent on the plan of treatment laid down at the start. The social status of the patient, his home and surroundings, the type and kind of a fracture (simple, comminuted or compound), hospital, office, and home facilities, and many other factors enter into the planning for the care of the definite fracture problem at hand. A serious compound fracture requires immediate hospitalization and operating facilities, whereas a simple fracture may not necessarily. Fractures that require skeletal traction are usually hospital cases. Skin traction cases are best hospitalized, but can often be cared for in the home. Certain fractures can be made ambulatory by accepted methods of treatment, whereas other methods require recumbency. The use of plaster casts or mechanical stock splints may have to be considered. The character and mental reactions of the patient may need consideration. Some methods of treatment are more "fool proof" than others. The unruly patient may demand maximum protection from himself. The ability to weigh these many factors and to arrive at a plan most suitable and consistent with modern fracture surgery makes for success.

Once a plan of treatment has been outlined, it is well to follow it through until its inadequacy is definitely proved. Circumstance often may require a change of plan. If so, do not delay, but meet the new problem with new and appropriate program. Judgment and experience, of course, are largely responsible for the outline of the successful plan of treatment.

THE MAKING OF A PLASTER CAST

Plaster casts and plaster splints are made from plaster of Paris which is incorporated in crinoline, saturated in water, and applied during the hardening stage to the extremity to be immobilized. Plaster of Paris is calcium sulphate in more or less impure state. It is known in the trade as "Dental Plaster." In adding water to the calcium sulphate a molecule of water is taken up by the calcium sulphate. This molecule is known as the molecule of crystallization. A perceptible amount of heat is released, a point of value, since a cast warms up comfortably during application.

The crinoline which is used is ordinary cotton gauze with a wide mesh. It should be noted that crinoline may be sized or stiffened by two different methods. Starch-sized crinoline should be used. Certain crinolines are glucose-sized. Glucose (sugar) prevents, to an extent, the water and plaster of Paris from uniting in a normal way. Many of the disastrous plaster of Paris casts which crumble and fail to harden are due to this error in the technique of making plaster of Paris bandages.

The manufactured, ready-to-use plaster of Paris bandage in cans is used, but is not too satisfactory. They are machine made, often wound too tightly; often the crinoline has been in the plaster medium for many months and has lost its tensile strength. Recent developments in the manufacture of the plaster bandage has considerably improved them. For one using plaster only occasionally, they are adequate. The best bandages are those freshly made and hand rolled. A good way to prevent the plaster from being shaken out of the rolls is to cover them with paper or cellophane.

Plaster of Paris bandage when put in the water should not be handled. Handling the bandage during the time of its saturation often leaves areas which are not saturated. Plaster must be rubbed well into the meshes of the crinoline during its application. A thin, well-applied plaster cast frequently has far more strength than a heavy cumbersome one which has been unskillfully made.

Reinforcements of metal, or webbing covered metal, are popular in some places. They, however, leave a plane of cleavage in the plaster cast. They render the removal of the cast often extremely difficult, and can in most cases be discarded. In areas where unusual stress takes place, freshly prepared plaster reinforcements are quite satisfactory in reinforcing the cast.

Materials required for making plaster casts.

1. Dental plaster incorporated in crinoline rolls.
2. Stockinette—appropriate width.
3. Sadler's felt.
4. Sheet wadding.
5. Warm water.
6. Reinforcements—plaster or metal.

PLASTER CASTS

Plaster casts are used for immobilization in a multitude of ways.

1. The aeroplane plaster cast for fractures of the upper arm and shoulder.

2. The single spica cast for fractures in the region of the neck of the femur, and femur.
3. The double spica cast for fractures in the region of the hip and pelvis, also the femur.
4. The cylinder cast for fractures of the lower leg.
5. The body cast for fractures of the spine.
6. The body, neck and head cast for fractures of the cervical spine.

To apply such casts, one must know how to handle plaster of Paris. One must have at hand fracture tables, or apparatus substituting for such tables. One must know the difficulties such as pressure points, the weaknesses, where to reinforce a cast, the nursing problems, where to carry your weight and where to release it in order to prevent the difficulties which pressure at any bony point is liable to produce. Experience only will give this knowledge. Properly made plaster casts are superior to any type of immobilization by braces or frames or previously designed apparatus. They are superior, if properly applied, because they fit the individual much in the same way that a tailored suit is superior to a ready-made one.

THE MOLDED PLASTER SPLINT

If one learns to use plaster as a splint, no mechanically previously prepared splint can possibly take its place. Such a splint fits exactly and holds the part in the exact position in which the operator has placed it. It is the surgeon's product for the specific performance of a certain job. He is wholly responsible for it. He cannot shift the burden of errors to anyone but himself.

The plaster splint has many difficulties and dangers. One must know how to handle plaster, its rate of hardening, its strength and its dangers. No circular plaster splint should ever be applied to an upper extremity which is not so designed as to be quickly and simply released. If the padded splint is used, the prominences of bone at the joints must be protected. The nerve trunks which are superficial and which are influenced by pressure must be cared for. If one uses the unpadded splint as advocated by some, he must know his plaster and his danger even better than in the padded type of splint. No unpadded plaster cast to either an upper or lower extremity should be applied that is not at once cut so that the constricting pressure is released.

Molded plaster splints are particularly useful in fractures of the forearm and wrist. Measure the length of the anterior and posterior splint needed. Make the plaster splint by laying the bandage back and