FUNDAMENTALS VERSUS GADGETS IN THE TREATMENT OF FRACTURES[1]

PAUL B. MAGNUSON, M.D., F.A.C.S., CHICAGO, ILLINOIS

THERE is a passage in the Bible which in part reads: "This is an evil generation. They seek a sign: and there shall no sign be given. . . ." In the fear that the statements made herein may lead some to think that I am of the opinion that this is an evil generation of surgeons, I hasten to state that this is quite contrary to the fact. Progress is achieved through the ideas and work of many men. It is necessary, however, to sift these ideas and take the good out of any or all and throw aside whatever is not adaptable to our purpose. A sign, a cure, a panacea, which will bring good results for our patients has not yet been given.

Each person is an individual and differs from all others, consequently each case must be considered a law unto itself. Fractures do not differ from other conditions in this. Although fractures are mechanical and tangible things, an apparatus will not do in one case what it has done in another. A new method of treatment is not necessarily good; it may have worked wonders in one case and in the hands of its originator, but may be a total loss in another similar case. In these days of mechanical advancement, we see many devices of strange and wonderful design advocated for the reduction and retention of fractures. Some are very ingenious applications of standard appliances to meet a condition which has arisen in a given case, some are strange and mechanical contrivances which it would take a Philadelphia lawyer and a mechanical engineer to apply. They might work if one could apply them, with nothing to bother about but mechanics, but many devices do not take into account the anatomy and physiology of the parts to be treated, and consequently cannot be used successfully in any but the unusual case. Such apparatus confuses and in the maze of mechanical gadgets the *principles* of treatment of the individual fracture in hand are overlooked and forgotten. There can be no objection to devising an apparatus which serves to answer a need in any case, but to the average surgeon it would be much more useful if it were presented as the application of a principle.

Fractures are not new in the field of surgery. Records of fracture treatment are in existence which were written 4500 years ago. The Edwin Smith surgical papyrus, of which the late Dr. James R. Breasted, professor of Egyptology at the University of Chicago, recently made an admirable translation, is apparently a collection of case histories extending over several centuries, and dating back to the 5th Dynasty. The distinguished gentlemen who delve into Egypt's past dispute among themselves the approximate date of the different dynasties, but are in apparent agreement that the 5th Dynasty reigned in Egypt at least 4500 years ago. Dr. Breasted and Dr. G. Elliot Smith, professor of anatomy in the Egyptian Government School of Medicine, have made some interesting observations on mummies exhumed in recent years. Breasted says that between 5000 and 6000 bodies were examined and that one in every 22 showed a fractured bone. Splints have been found still in place, but Breasted says that such cases must have succumbed soon after injury as no evidences of healing are seen. Fracture of both bones of the forearm was frequent, due to the custom in Egypt, then as today, of fencing with heavy sticks. These fractures were treated logically and the results, according to Smith, were excellent. The bark of a tree, supposedly the acacia, was molded carefully around the fractured arm from the base of the fingers to the elbow, and was well padded around bony points with folded linen. In 100 cases studied, many of which must have been compound, only one showed signs of suppuration.

Fractures of the femur did not fare so well. Splints were applied which immobilized the lower fragment including the knee and ankle, but extended only a few inches above the level

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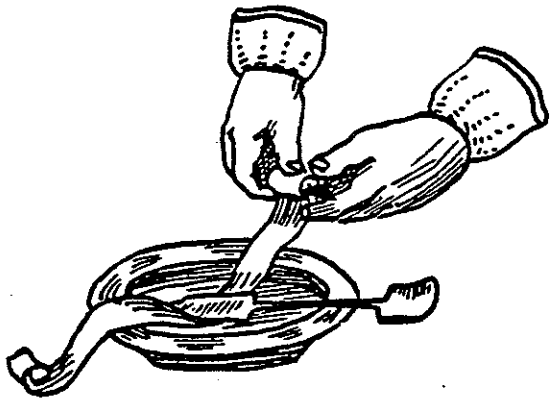

Fig. 1. Waxing a bandage. Double spatulas of the form shown are found among ancient Roman instruments from Pompeii. (After Scultetus.)

of the fracture. The results, as might be expected, were poor, and many show considerable shortening, displacement of bones, and exuberant callus. Not infrequently a case is brought into the accident ward today splinted with as little thought and understanding in exactly the same way, and we are inclined to wonder whether, after all, we have progressed far since the days of the Pharaohs.

Our next historical evidence of the treatment of fractures dates to the time of Hippocrates, the Father of Surgery as well as of Medicine. In his three books wherein fractures and dislocations are considered, the fundamental principles in the treatment of fractures which he describes might find a place in the most modern textbook. These differ little from the generally accepted methods of today except from the standpoint of open reduction. The keynote of treatment 2500 years ago, as now, was traction and countertraction; so far as we know the Greeks did not apply suspension with continuous traction and countertraction, but they very apparently did take into consideration the constant displacing effect of muscles. The equivalent of our plaster cast was made by passing strips of thin cloth through melted wax, which hardened; the bandage was bound around the fractured limb while traction and countertraction was maintained (Figs. 1 and 2). These casts were reinforced with splints applied outside the cast and bound to it (Fig. 3). Traction and countertraction was

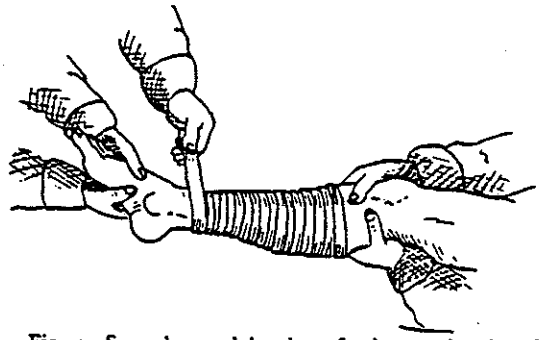

Fig. 2. Second waxed bandage fixed over the site of fracture and carried downward for several turns, preparing to return upward and end at the top of the first bandage. (After Scultetus.)

maintained by well padded wooden cuffs cut to fit at suitable points above and below the fracture; the cuffs were then held apart by rods of wood which acted as a straight spring. Hippocrates says that these bands must be well padded at bony points "as tissue dies beneath a constantly maintained pressure." He emphasizes this time after time (Figs. 4 and 5).

Apparently the reduction of fractures and dislocations was well understood, and many ingenious and powerful appliances are described for the use of the surgeon. The glossiconium for the reduction of fracture of the femur used pulleys and a windlass to exert the force necessary to overcome the powerful muscles of the thigh, this force being applied through strips of cloth put on the thigh in the form of a clove hitch (Fig. 6).

Incidentally, not so long ago this same hitch was described by Collins and since then it frequently has been referred to as the Collins hitch, but Hippocrates had described it as

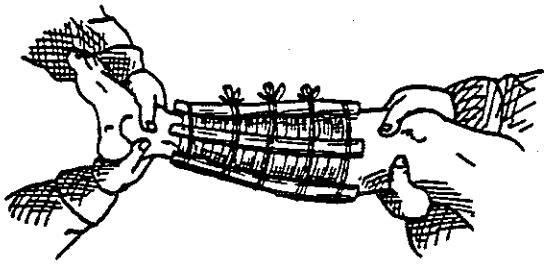

Fig. 3. Applying the splints on the seventh day. First the two bandages have been put on, then the waxed pads, the bandaging to fix which can be seen under the splints. (After Scultetus.)

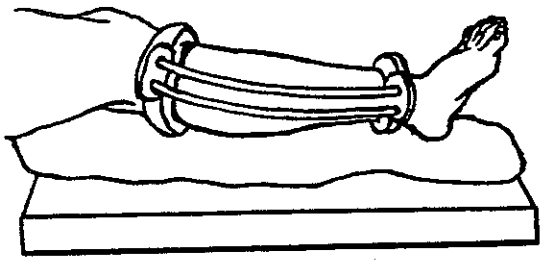

Fig. 4. Splint for leg fracture described by Hippocrates. Made of elastic rods fitting into loops on shackle-like pads above the ankle and below the knee. (After Littré.)

being an old form of knot which had been used by sailors for many years, and called attention to the fact that it would not slip.

There were fracture tables and portable fracture tables with perineal rests, ratchets, screws, levers and windlasses, and Vidius calls attention to the fact that the perineal rest must be well padded to avoid damage to the soft parts against which it presses (Fig. 7).

The scamnum described by Vidius for obtaining traction and countertraction embodies the same general principles. Hippocrates describes a fracture box (Fig. 9) although he does not advise its use.

Hippocrates says that the man who presumes to treat fractures must be equipped to do so under any conditions. The men in the larger cities should have the heavier equipment which has been described, but the men in the smaller communities and the traveling doctors must adapt whatever they have at hand to fit their needs. He describes a fracture table improvised from a ladder such as might be found in any household, by which

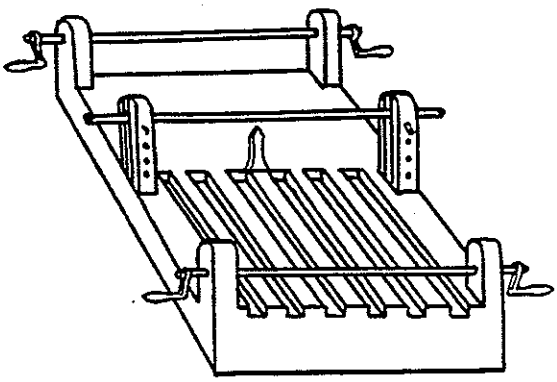

Fig. 7. The scamnum of Hippocrates. (After Littré.)

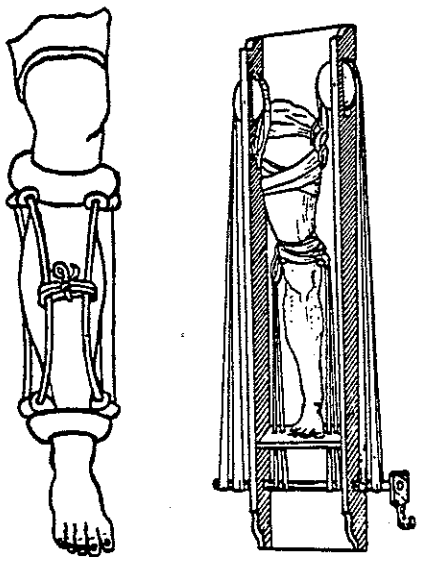

Fig. 5, left. Top view of same to show the tying together of the two top rods.
Fig. 6. The glossocomium of Galen, applied for fracture of the thigh. (After Vidius.)

the same traction and countertraction may be exerted (Fig. 10). For instance, in fractures near the elbow traction is applied by means of a clove hitch attached to the wrist. This in turn is acted upon by the system of pulleys seen in the illustration. Countertraction is

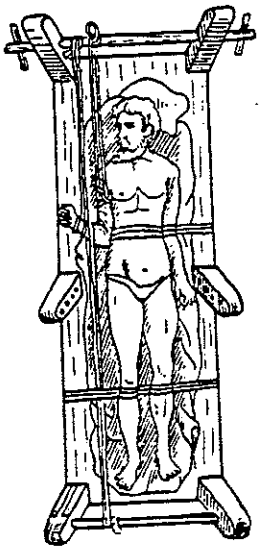

Fig. 8. The scamnum in dislocation of the elbow. (After Vidius.)

Fig. 9. Box splint or "canal." (After Scultetus.)

maintained by a rung of the ladder pressing firmly in the axilla on the injured side. Similarly, in reducing a fracture of the lower limb, the extension is applied by a clove hitch and counterextension by bands passed between the thighs and attached to the upper end of the table so the patient may not be displaced by the powerful pull necessary.

It is quite evident, therefore, that even in those days there were many methods. Hippocrates urges the practitioner to use the method which is best fitted to reduce the type of fracture with which he is dealing, and if one method does not work to try another. In his third book he cautions that "*extension of fractured or dislocated bones is not to be delayed to the third day but is to be carried out on the first day;* that slings may be used for some fractures in the upper extremities, but in the lower extremities fractures must be maintained by splints; that there must necessarily be great distinction drawn in the prognosis between simple fractures and compound fractures; that the alinement of bones must be regulated according to nature; that the line of the hand and arm in fracture of both bones of the forearm should be carefully studied; the forearm should be at right angles to the upper arm, but in fracture of the leg the straight position is preferable; that movement must not be allowed until the fracture is solid; and that extension must be made and maintained in a straight line"—that is, in the long axis of the bone. He says that the extension should be most powerful in the thickest bones with the greatest flesh, or in the forearm, having recognized that the muscles of the forearm are more irritable and active than many others of like size and bulk. He also calls attention to the fact that elevation reduced swelling; that in compound fractures it is impossible to tell

Fig. 10. Reduction of both bones of the forearm at elbow.

whether the bones will heal or whether the fragments of flesh and bone will be detached. He cautions that the fragment of bone which protrudes and is loose should be sawed off because it will die, will be extruded, and will prolong the convalescence; that if the flesh is completely torn from the bone it will die and become dried and exfoliate. Also we see that five centuries B.C. the statement is made: "When a bone is broken fairly across it is more easily treated, but when broken obliquely it is more difficult to manage." For the most part, Hippocrates says, in the case of the clavicle there is little disability resulting, but there is practically always a lump at the point of fracture. The differential diagnosis between a dislocation of the acromioclavicular joint and a fracture of the clavicle is also clearly made.

Prognosis as to time of healing is much shorter than would be given today. Hippocrates says that 40 days for fracture of the humerus can be expected, but if the fracture is not healed in that time the patient should be kept on a stricter diet for a longer space of time; he does not describe the diet, however. He cautions about frequent examinations, especially of the bones of the forearm, and says that when they are once put in place they

should be left there and not disturbed. He puts the period of convalescence at 30 days, but adds that there is nothing precise about this matter, "*for one constitution differs from another and one period of life from another.*" With regard to the femur, he says nothing should be omitted in order that the parts may be properly extended and put in a straight line, for, says he, it is a matter of great disgrace in an injury to exhibit a short thigh. In the arm where shortening might be concealed the mistake might not be noticed, but a shortened thigh bone would exhibit the man maimed. All these principles were laid down more than two thousand years ago, before anatomy and physiology were known. What keen observations and clear recording for colleagues and for posterity!

This knowledge recorded by Hippocrates was carried to Rome along with other Greek culture. Medicine and surgery was not a popular vocation among the ancient Romans. Theirs was a mercenary semi-civilization, and medicine did not offer in those days, any more than now, too much compensation for the time, skill, and labor involved in its study. The majority of the noted surgeons of the day were Greeks, either slaves or freemen. Celsus, though not a medical man, compiled a huge encyclopedia of the then current knowledge, most of which had come from Greece. In the first century A.D., Martial referred to the fact that Hermes was recognized as the best surgeon for fractures, and remarked that there were many specialists, some for enlarged tonsils, some for the removal of brands from slaves, etc.

Galen, 130 to 200 A.D., makes three commentaries on Hippocrates' account of fractures and offers some suggestions from his own experience, which doubtless was extensive, inasmuch as he was surgeon to the gladiators. A recently discovered statue, presumably dating from the time of Galen, represents the partially dissected body of a Gibraltar ape, the anatomy of which, as we know, differs little from that of the human body. It may be assumed that not only Galen but his predecessors as far back as Hippocrates and even farther, studied anatomy in this manner, although in ancient Egypt the destruction of the body meant the destruction of the soul also. It does not seem possible that Hippocrates could have gained his knowledge of the anatomy of the body without the aid of dissection, and after all, there were plenty of slaves and criminals in those days, in whose bodies no one had any particular interest, and in their souls, less.

From the fall of the Roman Empire in the 3rd and 4th centuries A.D., the long period of the Dark Ages of Europe intervened until the dawn of the Renaissance, and during this period nothing of note pertaining to fractures was written or described. The Church, always jealous of its perquisites, was responsible for the practice of medicine as a whole and guarded its secrets, and while there must have been many fractures in those centuries of almost incessant warfare, nothing of importance appears to have been recorded. An Arabian authority in the 10th century emphasized the importance of crepitus in the diagnosis of fractures, and at about the same period another authority advised sawing off the ends of fragments in non-union and described fractures of the spine resulting in paralysis. The science of medicine in the East far outstripped that of the West. Europe was peopled with barbarians during that period and the culture and enlightened ideas that brought her out of the Dark Ages were an importation from the East by the Crusaders. Previously the Moors, who conquered Spain, had brought much of the ancient knowledge of the East with them. The great Alexandrian Library probably provided the basis for their medical culture.

In the 15th century, the barber surgeons of France were given an examination on the care of fractures and dislocations, which incidentally was conducted in public before the mayor and other dignitaries. What the mayor knew about fractures no one has disclosed. Paré's work in the following century is well known, but it was Vesalius, whose work was published in 1543 when he was only 29 years of age, who laid the basis for our present understanding of anatomy. However, for many years fractures and dislocations were cared for mostly by bone-setters, although the army surgeons had considerable experience. I am

unable to find any understandable description of the methods of the bone-setters, or any reasons for their doing what they did. In England and Wales the profession apparently was hereditary in comparatively modern times. Watson has recorded eight consecutive generations of bone-setters in Wales. The paternal great-grandfather of Hugh Owen Thomas (1735–1814) was apparently the most celebrated and skilful. A generation later there were 21 practitioners in the Thomas family, representing both sexes. Evan Thomas, the father of Hugh, set up as a bone-setter and practiced among the neighboring farmers. In this country the Sweet family of Rhode Island was famed for their skill as bone-setters, and Comstock recorded that one of them successfully treated DeWitt Clinton of Erie Canal fame, after 52 physicians and surgeons had failed. That fracture must have been treated by all the doctors in Rhode Island and some from neighboring states, and the bone-setter probably had as good a press agent as a certain foot-twister of today.

The first modern book on the treatment of fractures and dislocations was written by Sir Astley Cooper in 1822, and by 1839 this publication had had 10 editions. This work undoubtedly was responsible for the revival of interest in the treatment of fractures, at least in this country. In 1827, Nathan R. Smith devised suspension in fractures by the long anterior splint and in the same year J. Kearney Rodgers was the first to wire ununited fractures successfully, although it had been attempted in 1805 by Moreau in France. Two years later Daniels, of Georgia, published his work on weight and pulley traction for fractures of the femur, which he had been using since 1819. This is the first record of suspension. Barton wired fractures of the patella in 1834: Detmold began drilling ununited fractures in 1850, and Brainard of my own city followed him 4 years later. In 1857 Van Ingen advised elevating the foot of the bed to make the body act as countertraction in fractures of the femur, in addition to Daniels' weight and pulley. Buck's well known extension appeared in 1851, and Hodgen's equally well known splint appeared in 1863. In the previous year, Hunt, of Philadelphia, introduced sandbags. The starch bandage was invented in 1840, and the plaster-of-Paris cast by Mathieson, an army surgeon of Holland, about the same time. How many sleepless nights were spent, and how many needless gadgets were invented *before* these steps is not recorded, but worthwhile ideas do not usually spring full blown from the brow of the gods.

John T. Hodgen, who was a graduate of the University of Missouri, a general practitioner and afterward surgeon general of Missouri, had a decidedly mechanical turn of mind, and undoubtedly was far in advance of the current practice of his day. He emphasized the extreme folly of urging any specific apparatus in the treatment of fractures of any particular bone, and said it was too apparent "to require a remark in refutation." With reference to his famous splint, he said it was a modification of the wire splint of Smith and Swinburne's extension, with his own strip bandage supports used in the cradle splint.

In the 1860's Hugh Owen Thomas described the splint with which we are all so familiar. He had established himself in the great port of Liverpool, where he came to be surgeon for 28 labor unions. It was in this practice that he gained his vast experience in the treatment of injuries, especially fractures. My former teacher, Professor John Ridlon, one day counted 160 cases coming to Thomas' clinic. Sunday was set aside for his charity clinic. He had no hospital appointments and his splints and many other forms of apparatus were made and fitted on his premises. Probably he did more work in this line than anyone of his generation, and his pupil, Sir Robert Jones, until his death carried on the work and ideals of his teacher. In the treatment Thomas stressed the importance of enforced, uninterrupted and prolonged rest. He pointed out that the circular compression induced by plaster interfered with the true conception of rest: hence, in 1867 he devised his famous splint, which today I believe is adaptable in original or modified form to the proper treatment of more fractures of the long bones than any other splint ever invented. I say this without fear of contradiction. It can be used in the reduction of fragments and also for

their maintenance in reduction. It can be adapted for suspension or ambulatory treatment, and when properly used is of the greatest service.

In 1895, the discovery by Wilhelm Konrad von Roentgen of the ray which bears his name marked the next great step forward in the diagnosis and treatment of fractures. Robert T. Morris, of New York, said "When the X-ray came into use as a diagnostic resource, it was for surgeons what a stereoscopic view of the soul would have been for the theologians. It was the X-ray that taught us the difference between anatomical position and a functional result. We worried overmuch when the picture showed the ends of the bone out of complete contact, and forgot that these ends had wonderful ways of uniting in those days prior to the time the X-ray permitted us to see them." I want to add, however, that this does not preclude the desirability of an ideal anatomical result, because undoubtedly there is a larger percentage of good functional results when the fragments are brought into anatomical re-position than when there is some degree of overlapping or misalinement.

The section on surgery of the British Medical Association in 1910 recommended a report on the ultimate results obtained in the treatment of simple fractures with or without operation, and this review embraced a period from January, 1906, to December, 1910. There were gathered from 20 hospitals throughout the United Kingdom, 1016 records of patients under 15 years of age, and 1580 records of patients over 15 years of age. Good results were obtained in 45.4 per cent of the cases without anatomical re-position, but in 66.3 per cent of cases, good functional results were obtained by anatomical re-position. The conclusions were that no method, either non-operative or operative, which does not definitely promise a good anatomical result, should be accepted as the choice.

The report says that mobilization and massage by themselves have not been found to secure a high percentage of good results; they are, however, valuable supplementary methods. Methods which secure re-position and absolute fixation of the fragments yield better results than those which fall short of this. Imperfect fixation by wire or other suture has been found unsatisfactory for long bones, except in cases in which the olecranon process is involved. The conclusion is followed by the statement that *operative treatment should not be regarded as a method to be resorted to after failure of non-operative measures, and that to secure the most satisfactory results from operation, it should be employed as soon as possible;* but it must be appreciated that operative treatment requires special skill and experience, and in addition, such facilities as will assure asepsis. A considerable portion of the failures recorded were due to infection.

Great stimulus was given in this country to the operative treatment of fractures by the visit, in 1910, of Sir Arbuthnot Lane, and for a number of years following there was promiscuous fixation of fractures with Lane plates by persons who had had no training in the treatment of fractures or in surgical technique. The result was the frequent occurrence of osteomyelitis due to infection following operative treatment of fractures employing fixation by steel plates. This is still one of the favorite forms of fixation. Unquestionably, it is applicable to certain cases. Probably the reason for its popularity is not that it is the method of choice in most instances, but because the application of the plate is easy and requires small outlay for equipment, and little skill. One needs nothing but a plate, some screws and a screwdriver, a will to operate, and sometimes, it is to be feared, a lack of conscience and an absence of a feeling of responsibility for the end-result. I once asked Dr. John B. Murphy how many Lane plates he removed, and his answer was: "Eight out of every ten I put in, and I don't know who takes out the other two." It would seem that a method which necessitates two operations and the insertion of an irritating material could in many cases be avoided; and certainly to make an incision over a bone which lies close under the skin, and place a foreign body immediately under the incision—and this is not infrequently done—does not display good surgical judgment. So here again we have a question of experience and judgment in the use of a valuable method, but a method which is to be selected for the individual fracture.

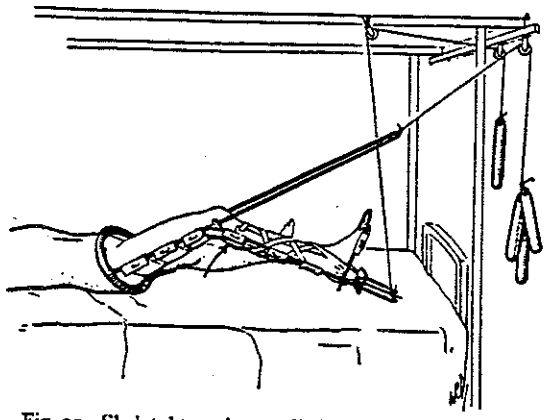

Fig. 11. Skeletal traction applied through the lateral and crucial ligaments. Traction on the end of the Thomas splint and points of pressure on the calf near the upper end of the tibia.

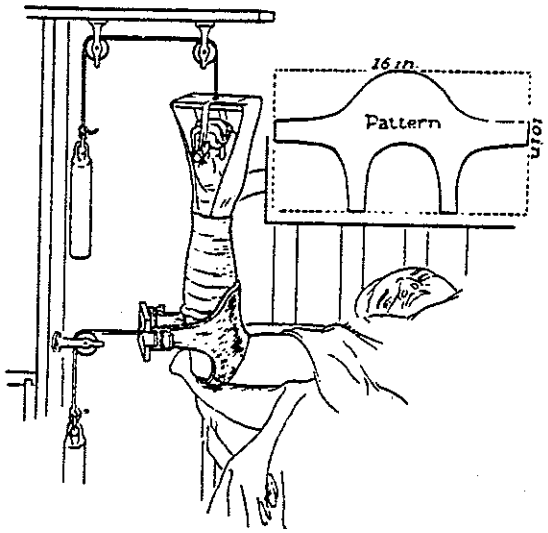

Fig. 12. Skeletal traction through the lateral ligaments of the elbow applied through the upper forearm to the lower end of the humerus.

In 1909, Steinmann demonstrated his famous nail, by means of which traction could be applied directly to the bone. During the great war, however, calipers were devised to take the place of the Steinmann nail, which has this handicap: should infection occur in the presence of the nail it may extend into the tunnel through which the nail is driven, a tunnel of infection through the middle of a bone is not easily handled and may result in permanent damage. By means of calipers the same skeletal traction can be secured and in some cases with some advantage over the nail, and should infection occur it is usually localized to the surface points of contact instead of going through and through. This does not mean, however, that the Steinmann nail is not the method of choice in some cases.

Kirschner's wire was introduced in 1909; a method of skeletal traction exerted by piano wire stretched tight and held in a U, through which traction could be maintained. This many times has proved to be a great advantage over both calipers and Steinmann nail. No preliminary drilling need be done because the wire acts as a drill, and there is less likelihood of infection because the foreign body introduced into the bone is small. Kirschner wire, in my opinion, has been one of the greatest contributions to the treatment of certain fractures that has appeared in the last generation. Skeletal traction may also be maintained on the femur by traction through the lateral ligaments of the knee (Fig. 11, femur) and on the humerus through the ligaments supporting the elbow, if these joints are flexed and pressure is applied close to the flexion angle (Fig. 12, elbow).

The vast development of industry and high speed transportation has brought about a tremendous increase in the number of fractures in the last 25 years. Since the advent of the automobile, even during the early days of 15 and 20 miles an hour speed limits, we have encountered many unusual types of fracture unknown to our predecessors. In 1917, Dr. Scudder established a fracture service at Massachusetts General Hospital. Five years later, realizing the tremendous disability caused by improper treatment of fractures, and the lack of understanding of fractures which were occurring with greater frequency, he called a conference in Boston, attended by 25 surgeons, and out of this conference grew the Fracture Committee of the American College of Surgeons, which was established in 1927 with Dr. Scudder as chairman. This committee has worked for the enlightenment of the profession to the end that fractures would be treated more intelligently and that there would be improvement in results. The committee has established standards for

equipment in hospitals, and, wherever possible, has persuaded the hospital staff to install a special fracture service to be headed by men especially interested in, and equipped to treat, fractures from their inception. Fractures, however, do not always occur under conditions to bring them within the intent of the Committee; they have a tendency to occur at inopportune localities. A large percentage fall into the hands of doctors who have not mastered the fundamental principles underlying treatment. The terrific violence which causes many of these injuries has produced many new and hitherto unheard of fractures—fractures which the textbooks cannot describe, because each one is a law unto itself and must be treated as such.

Fractures are mechanical in origin, and are controlled by mechanical factors, and the man who undertakes the treatment of fractures should have a thorough knowledge of mechanics, the fundamentals which underlie the production, the reduction, and the retention of the fracture at hand, and the reason for applying the mechanical means of maintaining the fragments in position. Unless the surgeon has an understanding of the anatomy and the physiology of the parts, as well as the pathology, he will continue to treat fractures by somebody's method. Fractures never have been reduced by brawn without a liberal mixture of brains. We have had innumerable kinds of apparatus invented and described for the reduction of fractures, and if one were to have one-tenth of it in his equipment he would spend half his income and might be able to use only one piece a year to advantage. Splints have been devised that look beautiful in the picture—shiny and efficient, with many straps and buckles—but when applied, frequently it is found that the straps do not give support in the right place and the splint cannot be held at just the particular angle necessary to fix that particular fracture in the most favorable position. The soft parts cannot stand the pressure, the patient is too fat or too thin, or the splint will not stay in position for one reason or another. Traction and countertraction are difficult to maintain, and in ambulatory treatment practically impossible, and when it is necessary to maintain these the patient should be in bed. Because a patient *can* walk around with a fracture of the arm is no reason why he should be allowed to do so. Suspension with traction and countertraction is still the most valuable form of treatment, and when I say suspension I do not mean traction and countertraction alone. I mean suspension which allows freedom of motion of the body as a whole while still maintaining the line of traction on the fracture.

Boehler's work has given great impetus to the use of many forms of mechanical apparatus, particularly to the skin-tight cast. In the hands of Boehler they are undoubtedly excellent. Boehler knows how to choose the case to which his methods are applicable. But when one sees an attempt to maintain traction in a straight line on a fractured femur, by means of an apparatus which rests on the bed while the patient tries to change his position or allow usual nursing care, the lower fragment fixed to a support which rests on the bed and the upper fragment fastened to the body which is not fixed, one is inclined to wonder whether the surgeon understands what he is attempting to do. This is what happened in the ancient Egyptian cases previously mentioned; the lower fragment is well immobilized up to the point of fracture and the upper fragment is allowed to ride free and engage in all motions in which the body engages. When one sees five Kirschner wires driven through an extracapsular and intertrochanteric fracture of the femur, up into the hip, to maintain a fracture in position which could easily be maintained by traction and abduction, he wonders whether gadgets are not taking the place of good sense.

Ridlon observed that Thomas' success was due to the application of right principles rather than to the use of this or that apparatus; this corresponds to the opinion of Hodgen, and to the teaching of my old friend Dr. G. G. Davis, of Philadelphia. Dr. Davis was one of the greatest anatomists of his time, and from his teaching his pupils gained an insight of anatomy far beyond the abstract—they saw a living, pulling, bending, circulating, sensitive anatomy, where one looked at the skin and saw beneath it the fascia, the muscles, the ligaments, the bones, their interrelationship,

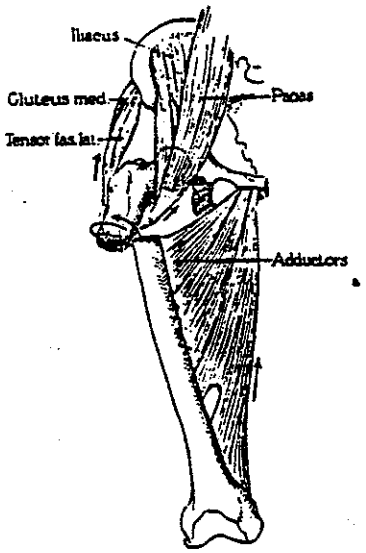

Fig. 13. Diagram of muscle pull controlling fracture of the femur at or near the junction of the upper and middle third, illustrating the principle "the fragment which can be controlled should be brought into alinement and rotation with the fragment which cannot be controlled."

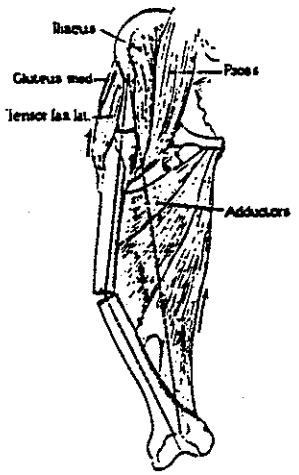

Fig. 14. Diagram of muscle pull applied to fracture about the middle of the femoral shaft, demonstrating the displacing effect of adductors on the lower fragment.

their activity, their nerve supply, their viability. It is only by this conception that one visualizes a fractured femur at the junction of the upper and middle third, with the upper fragment being externally rotated by the powerful external rotator muscles and flexed by the ileopsoas (Fig. 13, femur); a fragment too short to be controlled by any means other than operative fixation. Then one realizes there is a long lower fragment that can be controlled by traction, suspension, and rotation, and that the tension of the obliquely pulling adductors can be relieved of the spasm created by the irritation at the point of fracture if there is careful balancing of traction against their displacing effect (Fig. 14). This great adductor group can be prevented from producing an angulation at the point of fracture if the limb is properly suspended and weight applied sufficient to overcome its pull. One will also see immediately that it frequently is impossible to control a fracture of both bones of the forearm occurring between the supinators and pronators, because of the great angulating pull of these muscles, and will resort to open operation before there is fibrosis, tissue, or callus around the site of fracture and contracture in the muscles attached to the fractured bones, which almost precludes even the operative replacement and retention in anatomical alinement and rotation. He will know that a fracture of the surgical neck of the humerus, put up in full abduction, has such a tremendous pull placed on the upper end of the lower fragment by the pectoralis major, that it cannot be held by anything other than lateral traction, which it is impossible to apply because of the brachial nerves and arteries that lie immediately between the skin and the medial surface of the bone (Fig. 15, shoulder). If these and many other principles were understood and were borne in mind when any fracture is being treated, there would not be so many difficulties and so many bad results.

I quote from an article written by Dr. George Crile, which appeared in the *Annals of Surgery* in October, 1919, after his experience with many war injuries. He entitled it "The Good Surgeon."

The surgeon and the pathologists who for four years have intensively studied war wounds have formulated many theories of treatment—many apparently contradictory theories. Thus there have been presented the claims of the value of various chemical agents against those of no chemical agent; of moist dressings against dry; of heat against cold; of frequent dressings against infrequent dressings, and of no dressings against both; of sunlight and of

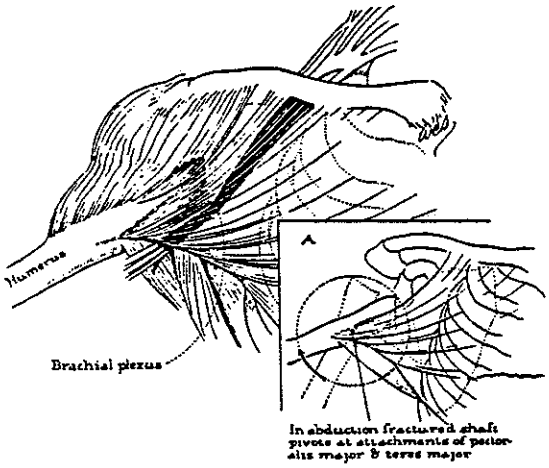

Fig. 15. Fracture at the surgical neck of the humerus, demonstrating the action of the adductor muscles of the humerus becoming a fulcrum which causes the upper end of the lower fragment to descend as the lower end of the same fragment is brought into abduction. This involves not only displacement of the upper end of the lower fragment but may injure the brachial plexus by angulating it over the sharp edge of this fragment.

electric light against occlusions; of immersion against hot air; of bacteriological control against clinical judgment; of vaccine toxin and foreign proteins against normal reaction; of wound inoculation with harmless organisms against wound sterilization; of isotonic against hypertonic solutions; paste has competed with paste; bipp with ip, sap with both, and chromic paste with all.

Does not this intensive study of infection in war wounds for this comparatively short period equal and recapitulate the more leisurely study of infection during the 30 years since Lister first proposed the carbolic spray? And is there not slowly emerging from the present conflict of opinions the same fact as that which emerged from the post-Listerian period—that the one agent of successful surgery, whether war surgery or civil surgery, *is the good surgeon?*

We cannot hope that all surgeons who treat fractures are good surgeons in every line, and the definition of a good surgeon is very broad. The surgeon, however, who attempts to treat fractures should consider first whether he is the type of surgeon to treat the fracture confronting him. Has he the fundamental knowledge and the mechanical skill to meet the exigencies of the case? His conscience must be his guide, and if his conscience misleads him to attempt something that results in a crippling deformity which could have been prevented, he will have erected a monument that probably some day he will wish to hide, and will have made somebody's life a burden that could have been a pleasure. There are no splints which reduce fractures automatically.

Looking back 25 centuries to Greece, we find the same principles described in the treatment of fractures that we use today, or should use. Civilization has progressed in some ways, but the anatomy and the temperaments of people have not changed. We have at our command X-ray equipment and mechanical appliances that the ancients did not have. We also have many types of fractures, due to the speed of the times both in industry and in transportation, which they seldom, if ever, met. But if we use our knowledge of anatomy and physiology and build up fracture treatment on the basis of this knowledge, using the X-ray, operative surgery and the approved mechanical devices, there is no reason why there should be as many poor results in the treatment of fractures as there are today.

Hippocrates' teaching is still the best teaching. A fracture should not be allowed to go to the second or third day but should be reduced, and properly reduced, as soon after it occurs as it is possible to apply the reduction apparatus, which is thought out to meet the needs of that particular case—whatever they may be. Let's forget any particular method, and when we see a fracture, look through the skin to the tissues that lie underneath; weigh the value of any method for that particular fracture, or invent a new one, and reduce it once and for all so that it will stay reduced. Principles stand from generation to generation; gadgets come and go. Let us go and sin no more!