Treatment of fractures of the lower end of the humerus and of the base of the radius / by John B. Roberts.

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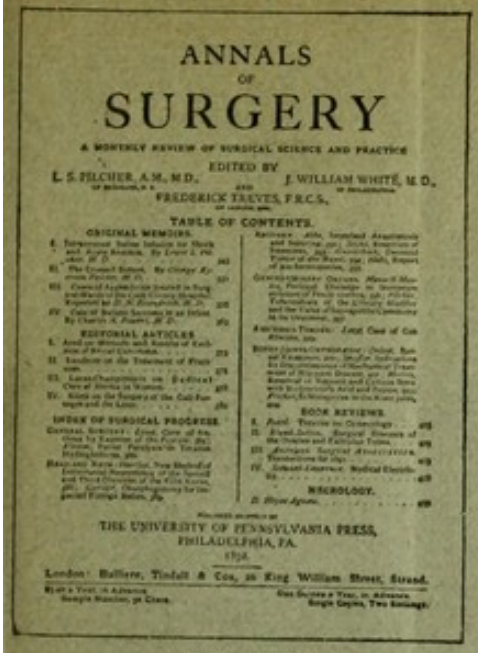

ANNALS
OF
SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

EDITED BY
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JULY, 1892.

Treatment of Fractures of the Lower End of the Humerus and of the Base of the Radius.

By JOHN B. ROBERTS, A. M., M. D.,
Philadelphia.

TREATMENT OF FRACTURES OF THE LOWER END OF THE HUMERUS AND OF THE BASE OF THE RADIUS.[1]

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AS a preliminary to the discussion of the topics which have been assigned me by the Committee on Business it is proper to state that there will be found in my paper no new ideas, no new anatomical or pathological facts. It simply gives my personal views on certain problems in clinical surgery.

The frequency of fractures at the lower end of the humerus and at the base of the radius, and the necessity of maintaining functional integrity of the joints of the upper extremity make the consideration of such injuries of primary importance. The desirability of an accepted and usually practiced method of treatment for these fractures will be unquestioned; while the value of establishing such rules of practice is fully recognized by all interested in surgical jurisprudence.

The great diversity of opinion exhibited by the members of this Association last year, when the subject of elbow injuries was introduced by Dr. L. A. Stimson, was a revelation to me. I had, up to that time, believed that my own views, derived from the study of surgical literature and clinical cases, were not very different from those of other surgeons. Hence, I was somewhat unprepared for the remarks of many of the speakers on that occasion.

A pretty thorough examination of the text-books in the hands of the practitioners and students of this country and an investigation of some of the writings of foreign surgeons have led me to believe that much bad surgery is taught and practiced. This state of affairs must be due to ignorance of recent advances

[1]Read before the American Surgical Association, at Boston, May 31, 1892.

in surgical pathology or to an indisposition to accept statements and methods of treatment which appear to me to appeal very strongly to surgical experience and intelligence. As an illustration, I quote from a recent work of M. Armand Després, published in 1890. The author, in speaking of fractures at the lower end of the radius, says:[1] "I am of Nelaton's opinion that the reduction is not necessary; the apparatus when well applied reduces the fracture by degrees and without pain." He, moreover, does not apply the splints until from twenty-four to thirty-six hours after the injury, but uses up to that time warm fomentations or cataplasms. Such a method of treatment seems to me so totally opposed to surgical principles and the advice of such a dangerous character to give students that any discussion which will neutralize the effect of this author's words cannot be without value.

Again, I find in Dr. Henry R. Wharton's valuable treatise on Minor Surgery and Bandaging, published in 1891,[2] the direction given that, before applying any splint in fractures of the lower end of the humerus, "it is well in many cases to apply over the region of the fracture several folds of lint saturated with lead water and laudanum, and to cover this dressing with wax-paper or rubber tissue, to diminish as far as possible the swelling which is very marked after these injuries." My own belief is very strong that such dressing is not only useless but harmful; because the application of these poultices over the injured limb often gives rise to the occurrence of cutaneous vesication in the inflamed region. Evaporation of the lotion is prevented by the rubber tissue or wax paper, and the encouragement of serous exudate beneath the cuticle is not infrequently followed by large blebs. Such applications are never required in fractures, since the swelling and œdema, due to the aseptic traumatic inflammation, rapidly subside if the fragments are properly adjusted and kept at rest. I have a continual struggle with young hospital residents to prevent their following this pernicious advice, which appears to be taught by more than one lecturer. In cases where the swelling and œdema will not subside by coaptation of the

[1] Treatise on Fractures, translated by Dr. E. P. Hurd, p. 4.

[2] P. 325.

fragments and rest, more active surgical interference than applications of lead water and laudanum is required.

The unfortunate tendency to use complicated facture dressings, which obtained in the early history of surgery, still remains to be overthrown by the continued advocacy of mechanical simplicity. Most of these appliances appear to have been invented by those more interested in the construction of ma-

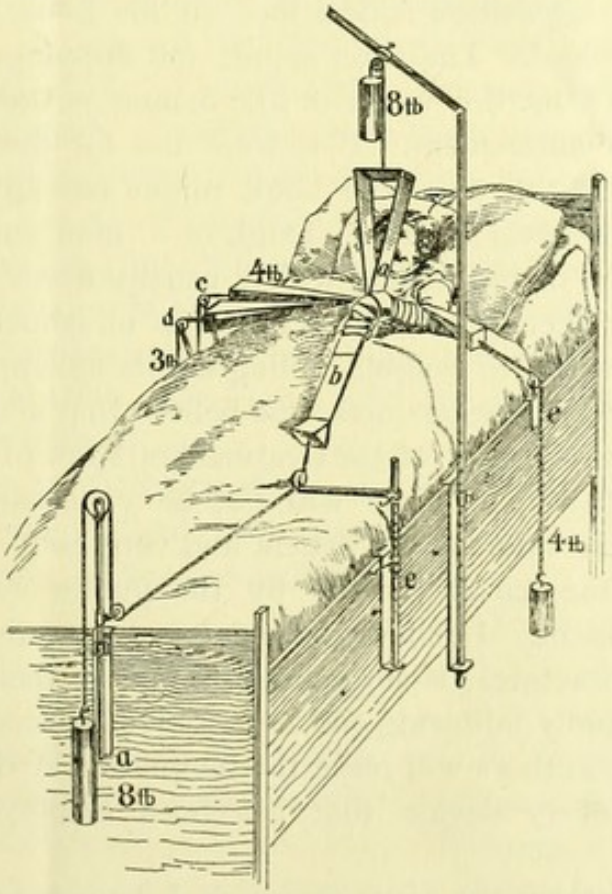

Fig. 1.
Fractura radii loco-classico.
Durch a wird das untere Ende des Vorderarmes dorsalwärts geleitet, durch c wird das obere Ende des Vorderarms fixirt, durch b wird die Hand und das untere Fragment volarwärts geleitet.

chinery than in a simple solution of the mechanical problems presented by osseous injuries. The application of these complicated dressings is nearly always expensive and uncomfortable to the patient, confusing to the average practitioner, and unintelligible to the student. Their use, moreover, tends to direct the attention of the surgeon to the kind of apparatus rather than to the conditions presented by the special injury under his care.

No better illustration of this tendency to devise unnecessary appliances for fractures is needed than this drawing of an apparatus of Prof. Bardenheuer for fractures of the lower end of the radius. You see the patient confined to bed, on the frame work of which are fastened six pulleys, through which five cords with weights make traction on as many different parts of the arm and hand. You will be surprised, perhaps, when I tell you that this device of the inquisition is described in his book published in Stuttgart in 1890[1]. The other splints and dressings represented and advocated by this writer in like manner strike the practical surgeon with amazement. If it were not for the indisputable evidence of the title page, the book might be regarded as the work of a mediæval author. Think of a man with fracture of the lower end of the radius, which usually needs no splint and often need not keep him from business for one hour, being confined to bed with five weights pulling on his unhappy arm.

These considerations make me believe that a discussion by this representative body of the treatment of some of the common fractures of the upper limb will not be valueless. Simplicity in dressings, comfort to the patient and very early restoration of function are the demands made by the public when fractures require treatment. I believe these demands can and will be met in nearly all fractures, if surgeons will but use their intelligence, instead of blindly following the advocates of special splints; and if systematic authors will resist the temptation of describing and cataloguing every device that has been employed for these lesions.

Believing that the methods which I have been led to adopt are founded upon good anatomical and pathological reasoning, I cannot but think that a trial of the simple dressings proposed in this paper will lead to a recognition of their value. I venture to hope that their adoption by surgeons generally will change the opinion, apparently existing in many minds, that good results after fractures at the elbow and wrist are rather the exception. I adhere strongly to the statement which I made at last year's meeting—that I approach ordinary fractures at the lower end of the humerus and of the base of the radius with a feeling that I

[1]Leitfaden der Behandlung von Fracturen und Luxationen, p. 96.

shall almost certainly obtain results satisfactory to myself as well as to the patient.

It is proper to explain what is meant here by the term "uncomplicated" fractures, since a proper understanding of the word as used in this communication is essential to the subsequent discussion. I mean fractures in which there is no dislocation of the joint, no rupture of large vessels, no laceration of the nerve trunks and no unusual contusion or laceration of surrounding tissues. In many of the cases which I am considering there is involvement of the adjacent joint by lines of fracture, splitting the lower fragment. I consider these cases uncomplicated, if the fractures are closed ones and if the comminution of the lower fragments is not extraordinarily great. I am aware that this involvement of the joint by fissures is technically a complication; but it is so common in the fractures which I desire to bring before you, and so unimportant so long as the injury is free from septic contamination, that I have used the word uncomplicated in connection with it.

In order to facilitate discussion I shall at once state my opinions and the methods of practice which I have come to adopt in these injuries. They are as follows:

Humerus.

1. In the treatment of fractures of the lower end of the humerus the divergent angle between the axes of the arm and forearm must be preserved; and hence dressings which interfere with the normal difference in level of the radius and ulna are not permissible.

2. Fractures of the lower end of the humerus of ordinary severity are, as a rule, more successfully treated in the extended than in the flexed position; because the carrying function is less liable to be impaired.

3. Passive motion at an early date is harmful, and should be deferred until union has occurred and the dressings have been finally removed.

4. Good results as to anatomical conformation and as to motion are generally to be expected and can usually be obtained.

5. Recent fractures in which satisfactory coaptation is not obtainable under anæsthesia may with propriety be subjected to exploratory aseptic incisions. Old fractures in which deformity and impairment of function are marked may, within certain limitations, be subjected to refracture or osteotomy for the relief of these conditions.

Radius.

1. Fractures of the lower end of the radius vary comparatively little in their general characteristics, because but one form is usual.

2. Muscular action has little or nothing to do with producing or maintaining the deformity.

3. Immediate reduction of the fragments is the essential of treatment.

4. Many of the splints devised for the treatment of this fracture have been constructed in ignorance of the pathology of the condition.

5. The ordinary fracture of the lower end of the radius usually requires no splint, and should be dressed with a wristlet of adhesive plaster or bandage.

6. When a splint is required a narrow short dorsal splint fixing the wrist is all that is necessary.

7. The method of dressing here advocated is the best, because it, by avoiding cumbersome appliances, annoys the patient as little as possible, and it permits free voluntary movements of all of the finger joints.

8. Passive motion is unnecessary until union has occurred and the dressings have been finally removed.

9. Good use of the wrist and fingers is early obtained and the anatomical conformation is restored as well as, and perhaps better than, by other more complicated dressings.

10. Fractures which have been improperly treated by omission of immediate reduction, may, with considerable success, be subjected to refracture even after the lapse of several months. At later periods readjustment may be possible only by osteotomy, which is a legitimate means of treatment.

Fractures of the Humerus.

Surgeons now generally recognize the necessity of maintaining the so-called carrying function of the upper extremity, and methods of treatment which tend to alter the relations of the

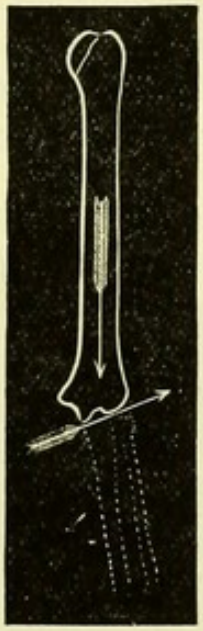

Fig. 2.
Normal angle of bones of forearm. (Allis).

axes of the arm and forearm should be discarded. The reasons assigned by Allis[1] for the frequent occurrence of "gun stock" deformity after fracture of the lower end of the humerus

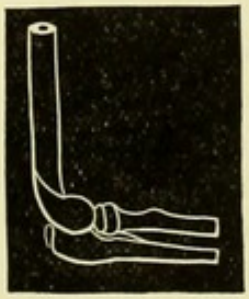

Fig. 3.
Differing planes of the radius and ulna. (Allis).

are, I think, correct. The commonly employed splints, and the displacing influence of the ordinary sling tend to bring the ulna and radius on the same level, and thereby destroy the divergent

[1]Annals of Anatomical and Surgical Society, Brooklyn, August, 1880.

angle of the bones at the elbow or create an angle in the opposite direction. It is asserted that the ascent of the internal condyle one-quarter of an inch will destroy the normal angular deflection at the elbow.[1] The direction of line of fracture and the point at which it enters the joint have, it must be remembered, a great influence on the possible occurrence of change in the axes of the arm and forearm. The principle is the same as that utilized in condyloid and supracondyloid osteotomy in knock-knee.

Packard makes the important assertion[2] that the plane of the articular surface of the humerus corresponds with the oblique

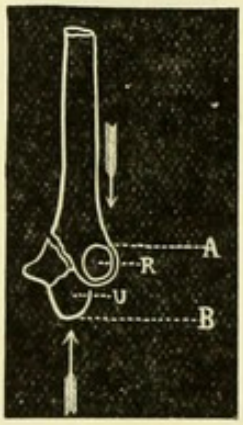

Fig. 4.

Relations of articulating portions of radius and ulna to humerus, in fracture of internal condyle; showing ease with which ulna and broken condyle can be forced up by splints and bandage, or sling, thus destroying carrying function of the arm.

furrow of the skin on the anterior part of the joint. We know, moreover, that when the elbow is flexed at a right angle the axes of the arm and forearm coincide. For this reason, it is much more difficult to be sure that the fragments are in the proper position, to insure integrity of the angular deflection, when the arm is about to be dressed in the flexed position, than when the surgeon compares the two arms and replaces the fragments while the injured limb is extended.

In my experience the angle of deviation is greater in muscular persons than in those of opposite development. In women and children it sometimes scarcely exists. It is well to remem-

[1]Stimson, Fractures and Dislocations, p. 403.

[2]Internat. Ency. Surg. Vol. iv. p. 144.

ber that Pilcher says[1] that there is a variation in the degree of this angular deviation in normal arms of the same individual. He found as much as five and one-half degrees difference in the two arms of one of the children whom he measured. In his opinion muscular action, particularly the action of the triceps, has much to do with the creation of the angular distortion which often occurs when elbow fractures are treated in the flexed position.

I see no objection to the surgeon cutting down upon the displaced fragments when it is impossible to properly coapt the irregular surfaces. An aseptic exploration of a closed fracture is better surgery than the conservatism which gives a rigid and distorted elbow.

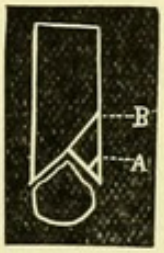

Fig. 5.

Diagram showing relation of ulna to lower end of humerus with the line of fracture entering the joint at different points. Some lines of fracture permit slipping up of the internal condyle under injudicious use of splints; other lines of fracture do not. (Allis.)

A surgeon who fully realizes the probability of impairment of the carrying function in these fractures can without doubt treat them equally well in either the flexed or the extended position. Accurate readjustment of the fragments and provision for careful maintenance of the coaptation will usually produce good results. In the flexed position plastic dressings, made with gypsum and similar agents, are far preferable to angular splints of wood, metal or other rigid material. The former are made to accurately conform to the limb immediately after the surgeon has reduced the fracture; hence there is not much opportunity for subsequent displacement to produce a change in the normal outline. If rigid splints are applied, however, the movable fragments are liable to be forced into undesirable relations by the bandage and

[1]Annals of Anatomical and Surgical Society, Brooklyn, Sept., 1880, p. 367.

sling. This occurrence is possible for many days after the fractured portions of the humerus have been skillfully adjusted by the surgeon.

Practitioners who see comparatively few cases are, however, less liable than surgeons to appreciate the probability of a "gun-stock" deformity. In the flexed position of the elbow, moreover, the deviation of the axes of the arm and forearm does not exist; hence in this position a slight displacement of the plane of the articular surface of the humerus is easily overlooked. For these reasons the extended position is the better for general adoption, since the angularity of the unbroken arm is then noticeable, and any interference with the normal deviation is very apparent.

If the sentiment of the profession was in favor of usually treating these fractures in the extended position there would be

Fig. 6.
Deviating angular splints for fractures at the lower end of the humerus.

very many less deformed arms. A specialist will vary his methods to suit each case; but for general use is needed a rule that will lead the practitioner of average experience and intelligence to get good results in the greatest possible number of cases. The extended position will, I believe, secure this result. By "extended position" I mean that position in which the elbow is extended almost, but not quite, fully. The forearm and hand are to be supine. Complete extension would be exceedingly uncomfortable to the patient, and is not what is meant.

Dr. Lane gave in his paper in the Transactions of last year a very interesting account of the views of various surgical authorities on this question.

I have for a number of years used a narrow, light, wooden splint, long enough to extend from the upper part of the arm to the wrist, having a divergent angle at the elbow. I usually make this splint out of a thin board at the time of dressing the fracture, using the sound arm as a guide. A little padding of

cotton or oakum is laid in the bend of the elbow, to fill the hollow present there, because the joint is not fully extended. This padding is not intended to make pressure on the fragments. In cases where there is too much swelling to permit extension of the arm I apply an anterior obtuse angle splint or a posterior obtuse angle trough for a few days; but I soon change it for the anterior deviating splint above described. This method of treating fractures above the elbow has been fully discussed by me elsewhere.[1]

In supracondyle fractures, however, I have usually employed the flexed position, maintained by an anterior right angle splint or a posterior right angle trough. The reading and investigation necessitated by the preparation of this paper have, however, caused me to incline towards the adoption of the extended position for supracondyloid as well as condyloid fractures. The relaxation of the triceps so induced seems to me to be desirable especially as the supination of the forearm and hand relaxes the biceps, one of the main opponents of the triceps. This position, therefore, relaxes two of the strong factors tending to produce the backward displacement, which is so much feared by many in supracondyloid fractures or epiphyseal descriptions.

Allis[2] Pilcher[3] Verneuil[4] Gibney, Powers[5] and others are correct when they deprecate the early employment of passive motion in fractures about the elbow and other joints. Stimson put it very ably when he says,[6] "that the ankylophobia of the surgeon is more dangerous to the patient than the traumatism." Orthopædic surgeons give the same evidence in the study of the collateral topic of rest in joint diseases. Phelps[7] has seen normal joints immobilized for ten, twelve and eighteen months without ankylosis occurring in either the normal or the inflamed articulations. Experimental study on dogs has shown the same fact.

[1] Modern Surgery, Lea Bros. & Co., Phila., 1890. Pp. 399.

[2] Annals of Anatomical and Surgical Society, Brooklyn, Aug., 1880, p. 306.

[3] Idem, Sept., 1880, p. 369.

[4] Quoted by Pilcher.

[5] Medical Record, New York, Dec. 22, 1888.

[6] Trans. Amer. Surg. Assoc., 1891, p. 269.

[7] Proceedings Phila. County Med. Soc'y, 1891, p. 439.

In 1885 I stated in an article on "False Doctrine in the Treatment of Fractures"[1] that passive motion should not be commenced until union of a fracture is pretty well accomplished. My present belief is that it is best to delay it until union has occurred and the retaining dressings have been finally removed. If begun earlier it is very likely to be harmful by giving pain, causing arthritis, or displacing the fragments.

The advice of Hamilton urging early passive motion in elbow fractures is probably responsible for many stiff elbows. He says[2] concerning fractures of the base of the condyles, "At a very early date, so early, indeed, as the seventh or eighth day, the splint should be removed, and while the fragments are steadied, the joint should be subjected to gentle passive motion. This practice should be repeated as often as every second or third day, in order to prevent, as far as possible, ankylosis." Could any advice be more erroneous or dangerous than this; and yet it has appeared in successive editions, and is repeated as authoritative in many quarters? Dr. Stephen Smith fortunately adds an editorial note in the edition of Hamilton just quoted, saying that many surgeons believe early passive motion in this fracture to be detrimental and never to be practiced. It is to be hoped that the wisdom of this note will correct the monumental error of the original text.

It is interesting to note that Dr. L. C. Lane[3] believes that the flexed position of the elbow during treatment of fractures of the region under consideration is more favorable to ankylosis than the extended; because there is more room for neoplastic deposits in the anterior muscular and fibrous structures, which are plicated during flexion.

Deformity and impaired mobility may at times be improved by refracture or osteotomy done with careful asepsis. Cases for such radical measures must, however, be judiciously chosen.

Correspondence with the Fellows of this Association, the Members of the New York Surgical Society and the Fellows of the Philadelphia Academy of Surgery, shows me that I am cor-

[1]Journal American Medical Association, May 30, 1885, p. 589.

[2]Treatise on Fractures and Dislocations, Eighth Edition, edited by Stephen Smith, 1891, p. 244.

[3]Trans. Amer. Surg. Association, 1891, p. 413.

rect in the opinion that such uncomplicated fractures of the lower end of the humerus as I am discussing, usually recover, if judiciously treated, with little or no deformity and with good motion. My experience then is simply corroborative of that of other surgeons.

Letters sent to these surgeons elicited eighty-eight replies:

I.

a. The number who preferred the flexed position in treatment were 65
b. The number who preferred the extended position in treatment were 15
c. The number who employed both positions in treatment were . 7
d. The number who gave no definite answer to the query was . . 1

Total 88

II.

a. The number who preferred the flexed position because it was thought to insure better coaptation were 37
b. The number who preferred the flexed position because there was a fear of anchylosis were 18
c. The number who preferred the flexed position because it was more convenient and comfortable for the patient were . . 6
d. The number who gave no definite reason or answer 4

Total 65

III.

a. The number who began passive motion within four weeks were 64
b. The number who began passive motion after four weeks were . 7
c. The number who did not use passive motion at all were . . . 15
d. The number who gave no definite answer to the query were . 2

Total 88

IV.

a. The number who usually expect to obtain good use of the joint were 80
b. The number who are doubtful about obtaining use of the joint were 8

Total 88

In studying these tables it must be remembered that the manner in which some of the correspondents replied made it a little difficult for me to determine under which heading they

should be classed. I have endeavored to classify the replies correctly by studying the apparent feeling of the writer as well as his phraseology. In some cases several reasons were given for the choice of the flexed position; in these I tabulated the one to which most importance seemed to be attached. The views of each surgeon will be found in the detailed tables at the end of this paper. The small letters affixed to the replies indicate under what heading they have been put in this abstract. I am rather astonished at the number who fear ankylosis; and am interested in the admission of some that routine is the only reason they have for adopting certain lines of treatment. The number who cling to passive motion in the early weeks is larger than I anticipated. Those who begin passive motion after four weeks might with propriety be classified with those who attach no importance to it, since union of the fracture has become quite firm in four weeks.

Fractures of the Radius.

It is unfortunate that the name of Colles is still associated with fractures of the base of the radius. Such personal nomenclature is always objectionable; and is especially so here, since Colles placed the seat of lesion at a higher point than that at which fractures of the base of the radius usually occur.

Fractures of the lower end of the radius vary very little in their essential clinical details. The degree of displacement, comminution, or impaction is not always the same; but through all the variations, due to the character and continuance of the vulnerating force, the surgeon sees the same essential lesion, situated at nearly the same point of the bone. The treatment, too, needs little variation, and consists in immediate forcible reduction.

The usual line of fracture is situated at from one-third to three-quarters of an inch above the articular surface of the bone, and is generally more or less transverse in direction, though some tendency to lateral or antero-posterior obliquity is not infrequent. Displacement of the lower fragment backward upon the lower end of the upper fragment is the ordinary deformity, and is due to the fracturing force, not to muscular contraction. Some impaction is not unusual from driving of the dorsal wall

of the upper into the cancellated structure of the lower fragment, and actual loss of substance from crushing of the bony tissue is not infrequent. When impaction does not exist, entanglement of the fragments by interlocking of the irregular surfaces is very common. At times there is no displacement; at others it occurs only at the radial, and not at the ulnar side of the lower fragment, which then is tilted obliquely backwards. The styloid process of the radius is carried upward and backward by this displacement, and therefore the radial styloid process is often as high as, or even higher (that is, further from the hand) than the ulnar styloid process. This angular displacement tends to throw the articular surface with the attached carpus upward, backward and to the radial side, and produces the peculiar deformity so recognizable. Sometimes the integument over

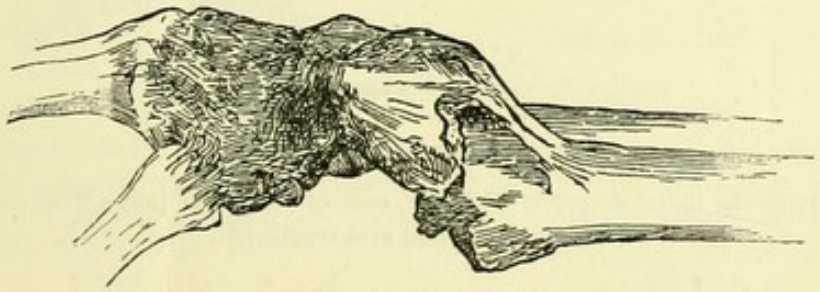

FIG. 7.

Profile view of Dr. Westbrook's specimen of fracture of lower end of radius. Annals of Anatomy and Surgery. Vol. III. (1881), p. 114.

the ulnar head is torn asunder by this radial displacement of the hand, and the ulna may even protrude through the laceration. Such a wound by no means implies an open or compound fracture of the radius, for frequently the wound has no communication with the fractured surfaces.

The fracture just described, with or without comminution of the inferior fragment, is the one usually seen. Associated fracture of the lower end of the ulna, of the ulnar styloid process, or synchronous rupture of the radio-ulnar ligaments; and epiphyseal fracture may, however, occur. Fracture of the lower end of the radius with forward displacement is very rare.

Fractures identical in pathology and deformity with those found clinically can readily be produced in the surgical labora-

tory by sudden hyperextension of the hand caused by heavy blows.

As there is no opportunity for living muscles to assist in the production or maintenance of deformity here it is reasonable to suppose that muscular action has little influence upon the fracture in patients. The tonic contraction of the muscles of the forearm may be an agent in holding the fragments in their abnormal position, when there is simple entanglement of the rough surfaces without true impaction, and the tendons may similarly cause the normal relations to be maintained after reduction by the surgeon. Further than this, muscular influences are unimportant, if my experience has taught me correctly. The conditions in a transverse fracture of the broad base of the

Fig. 8.

Deformity in the usual fracture of lower end of radius. Taken from cast made before reduction and treatment.

radius are very different from those in an oblique fracture of the shaft of this or other long bone surrounded by muscular bellies. The statement[1] that there is a great tendency to displacement by muscular action after reduction has been accomplished is unconfirmed by clinical observation, unless there be unusual comminution of the lower fragment. When the radius is broken two to two and a half inches above the joint, or in the middle third of the shaft, the conditions are probably different; but I am not considering such fractures at this time.

It seems impossible that any surgeon would think of advocating the omission of immediate or complete reduction of the lower fragment in this fracture, in which non-union is practically unknown. Yet, as I have stated in the earlier paragraphs

[1]Holmes' System of Surgery, Am. Ed. by Packard, 1881, vol. i, p. 864.

of this communication, M. Després does so. Equally astonishing to me is the advice of Dr. Wyeth[1] that "in aged patients, who have considerable impaction, it is not advisable to break up the impaction." Mr. Southam[2] speaks of cases in which the deformity cannot be made to disappear, and another writer[3] says that the impaction should be undone if possible implying that impossibility of reduction is not very unusual. About ten years ago I treated a woman of perhaps seventy years of age who had fallen from a roof to the ground, breaking both radii with great displacement. My duty would not have been done, in my opinion, if I had not used the same force in overcoming the interlocking of the fragments in this old woman as I would have employed in a young person. She rapidly recovered with

Fig 9.

Deformity produced by an experimental fracture of the lower end of the radius in a cadaver preserved by zinc chloride. A heavy blow was struck on palm, while hand was fully extended and forearm vertically placed with elbow on table.

perfect use of wrists and fingers, though distortion at the wrist was marked, because of the probable comminution of the lower fragment and the fact that the woman was imbecile and constantly pulled off the splints and dressings.

That reduction is at times impossible may perhaps be true, but I have never seen an instance which the power of my two hands, aided by leverage across my knee, could not reduce under anæsthesia. Reduction is to be accomplished by force, not by *gentle* pressure and manipulation, as some would have us believe. I usually accomplish it by extension and counter extension applied to hand and forearm, aided by sudden flexion of the wrist with simultaneous pressure on the dorsum of the lower fragment. This manœuvre is repeated, if necessary, until I feel

[1]Text Book on Surgery, 1888, p. 296.

[2]Treves' Manual of Surgery, Vol. II., p. 54.

[3]Druitt's Modern Surgery, edited by Stanley Boyd. Twelfth Am. Ed. p. 256.

no ledge of bone at the seat of fracture when I carry my fore finger or thumb along the dorsal surface of the lower third of the radius. The reduction is so quickly done that anæsthesia is generally omitted. In recent cases this manipulation is generally sufficient, but in unreduced cases of several weeks' duration, and sometimes in recent cases, I have been obliged to bend the limb over my knee so as to break up the connection between the misplaced fragments. Very firm impaction, entanglement of the fragments in the tendons, or dorsal periosteal bands may require the surgeon to bend the hand and attached lower fragments strongly backward, in order to release the interlocking, before making traction, flexion and pressure. This manipulation is, however, seldom necessary.

It has been asserted that the long supinator or square pronator opposes reduction of the deformity; this is undoubtedly a fallacy in so far as real obstacle is offered by these muscles. Mr. Howard Marsh[1] makes the extraordinary statement "Should reduction not be accomplished on the first trial, the attempt should be repeated a week later when the fragments may have become somewhat loosened on each other, and when, swelling having subsided, manipulation can be more accurately directed."

Dr. John Ashhurst in a publication issued several weeks ago[2] makes statements equally misleading and, in my opinion, exceedingly dangerous. The deservedly high reputation of Professor Ashhurst will cause many practitioners to follow his words implicitly. The result will, I fear, be the production of many unnecessarily stiff wrists and fingers after fracture of the base of the radius. He says, "The important part of the treatment is, of course, to keep the fragments in their proper position. If you bear in mind the mode in which the fracture occurs, you can at once see how the compresses which we use should be applied to counteract the deformity." Two compresses, a dorsal and a palmar, and a Bond's splint, are used by Dr. Ashhurst, who continues, "When the compresses are brought together, the bones are necessarily pushed into position. Even if you cannot

[1]Heath's Dictionary of Pratical Surgery, Vol. II., p. 293.

[2]International Clinics, Vol. I., p. 201, Philadelphia, 1892.

accomplish this at once, you will find that, by careful dressing, in a few days the deformity will disappear."

It is possible that this method of dealing with a fracture of the lower end of the radius might be admissible and do well at the hands of this eminent surgeon in the case he was discussing, in which the lower fragment may have been greatly comminuted. I feel very sure, however, that the omission to call attention to the necessity of immediate and complete reduction, as a first step in all these fractures is a grave error, and that the apparent or intentional direction to rely upon the compresses to overcome the deformity is most unwise.

Further on in his clinical lecture, which was delivered at the University Hospital, Dr. Ashhurst states, " I have seen sloughing occur from the pressure of the compresses when this precaution has not been adopted." The precaution to which he has reference is the use of " lead-water and laudanum or some other soothing fomentation " in the early stages of the treatment, or when there has been much bruising. Is it not possible that the sloughing was the result of injurious pressure by the compresses rather than the omission of local fomentation? The use of the latter, as I have previously said, in speaking of fractures of the elbow, is always undesirable and useless.

In a paper[1] read before the Philadelphia Academy of Surgery about eighteen months ago I mentioned that I had repeatedly been obliged to refracture and reduce fractures of the lower end of the radius after treatment in splints by other physicians. In a series of forty-eight cases reported at that time six cases came to me with the lower fragment still unreduced, though a splint had been applied in each instance. This personal experience can be duplicated, doubtless, by nearly every surgeon who sees many fractures in hospital or consultation practice; and is due to the fact that teachers and text-books do not sufficiently emphasize the necessity for reduction. The profession should be shown that the treatment of fractures of the lower end of the radius is reduction, and *not* a splint, either with or without compresses.

The ignorance of the true pathology of this fracture was formerly so great that many ridiculous splints have been devised

[1]Medical News, Dec. 13, 1890, p. 615.

for its treatment. Many were constructed on the theory that the extensor muscles of the thumb were a cause of the deformity; and not a few were employed that failed to recognize the curvature of the palmar surface of the lower portion of the radius. These errors are intelligible and were excusable; but I fail to appreciate the acumen of the authors who still figure these useless antiquities in their text books or of the surgeons who advocate and use them.

After reduction the ordinary fracture of the inferior extremity of the radius rarely requires such rigid support as a splint, because the transverse character of the fracture gives a broad rough surface of contact, and the extensor tendons running over the dorsal surface of the bone act as tense straps to hold down the lower fragment.

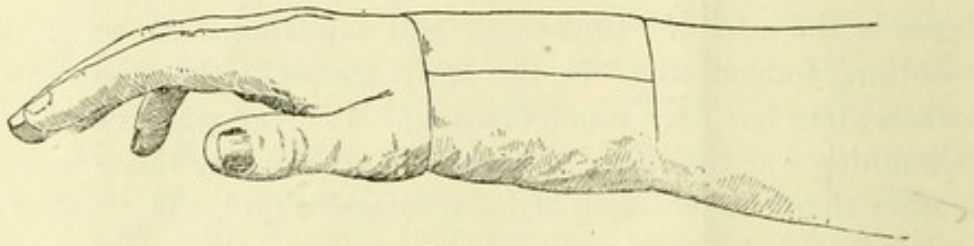

Fig. 10.

Fracture of the lower end of the radius dressed with a wrislet of adhesive plaster.

If there is much comminution or if the patient is a careless man or a romping boy, it may be wise to use a short and narrow dorsal splint upon the back of the wrist. It may be made of a piece of cigar box, a strip of metal, or consist of two or three whalebones, such as are used in ladies' dress waists. It should only extend from the middle of the metacarpal bones to the junction of the middle and lower thirds of the forearm, being, therefore, about six inches long. Its width need not be over one inch. It can be held in place by adhesive plaster or a bandage encircling the limb. This dressing should not be employed longer than ten days or two weeks at the most during all of which time the patient should use his fingers as freely as pain and swelling will permit.

In the great majority of cases this dressing is unnecessary, and a simple roller bandage, or a wristlet made of two or three

superimposed strips of rubber adhesive plaster, is all that is required. It makes no difference whether the hand is maintained in the prone or supine position during treatment. The patient holds it first in one and then in the other, varying the position at pleasure. This simple method of treating the fracture gives the patient the necessary freedom in moving his fingers, from the instant the fracture is set, does not prevent his wearing a sleeve, allows inspection of the parts, and is inconspicuous, light, clean and efficient. If the surgeon is unwilling to use either of these forms of dressing the moulded metal splint devised by Levis for application to the palmar aspect of the forearm and hand is the best of the special splints. The arched or curved nature of the palmar surface of the lower third of the radius prohibits a straight splint being applied there; but on the dorsal surface a straight splint may be used.

Passive motion should not be employed in fractures of the lower end of the radius, for the reasons that I have given in speaking of humeral fractures. It is not needed for the wrist joint; and the finger joints are being moved constantly by the patient during the entire treatment, except when pain or swelling makes this impracticable. Under such circumstances passive motion would not be desirable, if practicable

When, in ten days or two weeks, sufficient union has occurred, for the dressings to be removed, soaking in warm water, friction with liniments and passive motion are useful to hasten the restoration of function. This is usually very little impaired except in rheumatic subjects, and in cases where great associated injury to the soft parts has occurred.

The dressings employed may usually be discarded in ten days or two weeks in ordinary cases, and in three or four weeks in comminuted fractures. Long retention of the appliances is unnecessary, and even deleterious when splints are employed, because of the greater tendency to stiffness induced.

In properly treated cases of ordinary severity, perfect use of wrist and fingers is obtained within a few weeks after injury. Patients can often write a little and use the hand for dressing themselves within ten days or two weeks. This facility varies with the amount of comminution and inflammation. Persons of rheumatic or gouty tendencies are probably more liable to stiff-

ness of the fingers and wrist than others. Fractures in other regions present the same complication in such individuals. Much of the rigidity of wrist and fingers attributed to rheumatic and gouty causes, or to the senility of the patient, I believe to be due to imperfect reduction of the fragments and to unscientific and unwise treatment. I have not recognized the stiffness and rigidity after this fracture in the aged, which some authors mention with emphasis. I expect the same early and perfect freedom of motion in them as in the young, except in so far as the aged are more liable to rheumatism and gout.

It is the opinion of Bryant[1] that "after this form of fracture the wrist-joint rarely recovers its normal movement." My belief is that after this fracture the wrist-joint usually, but not always, perfectly recovers its normal movement, provided that reduction has been complete at the outset of the treatment and the case well managed. Moderate deformity, due to shortening of the radius, alteration in the plane of its articular surface and abnormal prominence of the head of the ulna, is not unusual, but is unimportant if motion is perfect, as it generally is.

Mears[2] advocates early passive motion, and recommends that after the removal of the splints, at the end of five or six weeks, the manipulations should be continued to restore function and "remove the rigidity of the articulation which inevitably follows fracture at this point, and enable the patent to regain, to a great degree, if not completely the function of flexion, extension, supination and pronation." This seems to indicate his belief that final restoration of motion is possible after a long interval. My experience teaches me that it is usual almost as early as the date at which Dr. Mears discards the splints.

The statement of Stimson[3] in discussing this topic is, "This rigidity of the fingers is due in part to their prolonged immobilization and in part to inflammation within the sheaths of their tendons in the forearm." This is probably correct and indicates the harmfulness of many methods of treatment in which the fingers

[1]Practice of Surgery, 4th American Edition, 1885, p. 880.

[2]Practical Surgery, 1885, p. 206.

[3]Fractures and Dislocations, p. 460.

are confined for from four to six weeks. Under prognosis, Hamilton[1] gives the essence of the matter in these words, "In cases treated by myself, where I have exercised great care in reducing the fragments thoroughly, and where the bandages and splints have not been applied too tightly, nor kept on too long, deformity to any considerable extent is the exception, and the stiffness is soon dissipated."

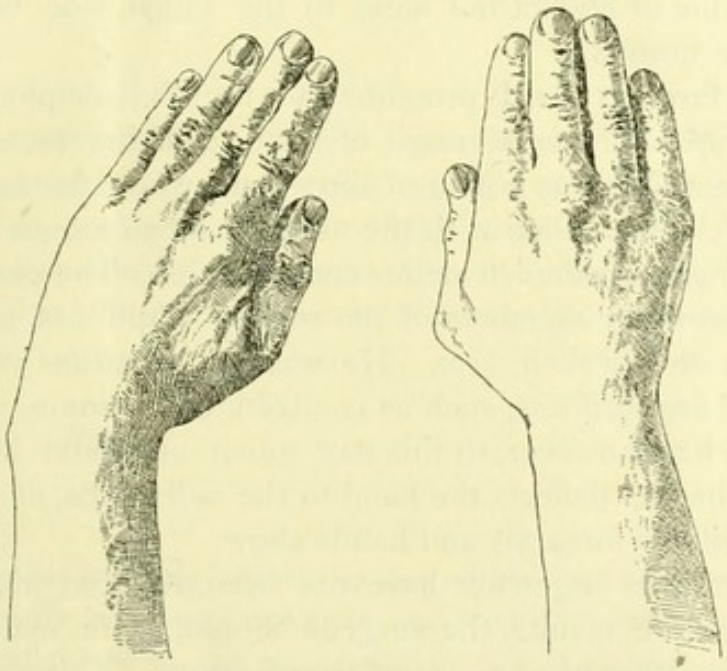

FIG. 11.

Plaster casts showing abnormal voluntary abduction of hand after fracture of the lower end of the left radius No deformity and no loss of mobility of wrist or fingers exists. The figure of the right or uninjured forearm shows fullest abduction which is possible in the normal wrist.

If great comminution or crushing has been incidental to the fracture, perfect restoration of the anatomical contour of the wrist may be impossible. Recurrence of deformity may take place after reduction has been well accomplished, if there be unusual comminution of bone and laceration of ligaments. Such cases show preternatural mobility and marked crepitus as symptoms. These cases, and even those of less severity, quite often present, after union and recovery of normal motion, an undue prominence of the ulnar head and a deflection of the hand to the

[1]Fractures and Dislocations, Edition of 1891, edited by Dr. Stephen Smith, p. 284.

radial side. This deformity is due to shortening of the radius, the result of imperfect coaptation of fragments, absorption of small particles of the bone separated by crushing, change in the plane of the articular surface of the radius, or interference in young patients with the normal growth at the epiphyseal cartilage. This alteration in the anatomical conditions of the lower end of the radius may make it possible for the patient to voluntarily incline or abduct the hand to the radial side very much more than normal.

In March, 1882, I presented to the Philadelphia County Medical Society[1] several cases of fracture of the lower end of the radius. One was a man of sixty years who, after mounting a high bicycle, had fallen with the machine down a high bank.

He fractured the left radius and two ribs. The cure was so perfect that many members of the society could not tell which had been the broken arm. He was by no means young, but never had any stiffness, such as is attributed by some writers to age. He has, however, to this day much unnatural latitude of motion when he deflects the hand to the radial side, as the plaster casts of his forearms and hands show.

When the fragments have not been reduced and vicious union therefore results, the surgeon should, as in mal-union of fractures in other regions, resort to re-fracture. This can be done by bending the limb across the operator's knee, while the patient is under anæsthesia; aided, perhaps, by hyper-extension of the hand and wrist. I have successfully done this as late as eight weeks after injury and have seen it done five and a half months subsequent to the original traumatism. The correction of deformity will not be as perfect as in cases treated properly from the beginning; nor should such good results, as to complete and early mobility of fingers and wrist, be expected. Dr. Richard H. Harte[2] has reported cases in which he did osteotomy to overcome the viscous union. I am inclined to believe that refracture would have been possible in his cases, as they were seen early. Osteotomy is undoubtedly, however, the proper treatment when refracture requires force liable to do serious damage to the soft parts.

[1] Proceedings 1881–82, p. 159.

[2] University Medical Magazine, 1887.

An aseptic or antiseptic osteotomy gives no real risks and allows the surgeon to see the bone and choose the exact line of his osseous incision.

Questions similar to those mentioned in the discussion of fractures of the humerus were sent to the Fellows of the American Surgical Association, the Members of the New York Surgical Society and the Fellows of the Philadelphia Academy of Surgery.

I.

This correspondence elicited replies from 88.

a. The number who frequently treat fractures of the lower end of the radius without any form of splint were 9
b. The number who always use some form of splint were 78
c. The number who made no definite answer to this particular query was 1

Total 88

II.

a. The number who use passive motion within four weeks were . 68
b. The number who use passive motion after four weeks were . . 3
c. The number who do not use passive motion at all were 15
d. The number who made no answer to this query were 2

Total 88

III.

a. The number who usually expect to obtain good use of the wrist and fingers were 69
b. The number who usually expect to obtain good use of the wrist and fingers except in aged, rheumatic or gouty patients were . 13
c. The number doubtful about obtaining good results were 4
d. The number who made no definite answer to this query were . 2

Total 88

The same conditions attach to the compilation of this table as are mentioned after the similar table relative to fracture of the humerus on page 13.

HUMERUS.

Surgeon.	Do you treat fractures of lower end of humerus of ordinary severity in flexed or extended position?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of joint?
1. B. A. Watson.	Extended.	More easily retained in proper position.	Fifth week in children, seventh in adults *b*	Yes.
2. T. R. Neilson.	Flexed.	Seems more favorable for coaptation and is more comfortable than extended position. *a*	Generally at end of first week. *a*	Yes.
3. F. Lange.	Flexed.	For securing better apposition and useful position in case of stiffness. *b*	Differs. Mostly after 3 weeks. *a*	Gradually.
4. C. H. Mastin.	Extended, I think Allis' method by all odds the proper one.	Because the bones are kept in exact position.	After consolidation is perfect. *c*	Always.
5. R. B. Bontecou.	Flexed.	The fragments are easily kept in position and it is more comfortable. *a*	Third week. *a*	Yes.
6. W. W. Van Arsdale.	Flexed at 80°.	Because, in case of callus formation in fossa, it is more important to be able to flex the arm than extend it. *b*	At end of fourth week on removal of splints. *b*	Limited.
7. J. E. Michael.	Flexed position.	Comfort and convenience of patient. *c*	Second week, generally. *a*	Usually good, sometimes perfect.
8. B. F. Curtis.	Usually flexed—extended (for 10 days) in fractures which threaten loss of 'carrying point.'	No answer given. *d*	None. Active motion in 4 to 6 weeks. *c*	Yes.
9. J. McCann.	Flexed.	More complete relaxation of muscles of arm and forearm; natural position of limb at rest; better coaptation of fragments. *a*	Not until all tenderness has disappeared from joint. *a*	Good.

* Indicates that the replies are not given in full.

RADIUS.

What splint do you use for the ordinary fracture of the lower end of the radius?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of wrist and fingers?
olles' fracture, E. M. Moore's system.	Gives better results.	Don't usually employ it. *c*	Yes. *a*
Bonds'.	Carefully padded and with compresses it maintains good adjustment in majority of cases.	Generally at third dressing. *a*	Yes, except those past middle life. *c*
Two (volar and dorsal).		Depends upon the features of case. *a*	Yes; sometimes after prolonged treatment. *a*
The so-called Nelaton or pistol splint.	It preserves interosseous space and, by overcoming the action of quadratus muscle, keeps the fragments in apposition.	After bone is united. *c*	My results have been uniformly successful. I have never had a deformity in any case after having used this method. *a*
Any straight board for the palmar aspect, only extending to second phalangeal articulation, with a roll in the palm and compresses under distal end of radius.	It is efficient and comfortable.	Third week. *a*	Yes. *a*
One single straight board 10 in. long, $\frac{3}{16}$ in. thick, wide as sound wrist; dorsally applied.	Because there is less interference with circulation than with any other method, less deformity and better results.	End of third week on removal of splint. *a*	Yes. *a*
Flat splints, dorsal and palmar, after careful reduction; sometimes Porter's wire splint.	Best by my experience and observation, as well as theoretically correct.	Third week. *a*	Yes, and am very rarely disappointed. *a*
Anterior splint, elbow to wrist; posterior splint, elbow to knuckles; both flat and stiff.		Active motion in fingers from first, and of wrist in 7 to 10 days. *a*	Yes. *a*
A splint slightly curved to fit contour of wrist and hand and of forearm.	It affords good support to fragments, fixes wrist, and allows motion in fingers.	Not until late, after union of fragments and disappearance of pain. *c*	Good in almost every case unless bones are much comminuted. *a*

HUMERUS.

Surgeon.	Do you treat fractures of lower end of humerus of ordinary severity in flexed or extended position?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of joint.
10 R. H. M. Dawbarn.	Flexed.	In case of bad results (ankylosis) it is a better position. *b*	Not until I think bony union is complete, say, 4 to 7 weeks. *c*	Yes.
11. A. G. Gerster.	Extended.	Because reduction of fragments is secured easier in this than in flexed position.	Ten days to 3 weeks.* *a*	Mostly, though not always.
12. H. A. Wilson.	Extended.	To prevent angular deformity.	Beginning of fourth week. *a*	Yes, generally.
13. T. J. Dunott.	Usually prefer extended *	The complications are often different.	No regular time. *d*	Partial.
14. J. S. Wight.	Position of right angled flexion.	It gives the best possible reduction of the fragments if ankylosis occurs; it gives a useful limb. I have operated upon a large number of cases which have been treated in the extended position: By forcible flexion or by exsection. *b*	In 2 or 3 days. *a*	As a rule, I obtain good use of the joint.
15. Geo. R. Fowler.	Extended for the first 10 or 15 days.*	No answer given.	From 10 to 15 days.* *a*	Yes.*
16. V. P. Gibney.	No answer given.	No answer given.	I would never begin passive motion. *c*	By rejecting absolutely passive motion I would expect to obtain a good use of the joint.
17. F. S. Dennis.	Depends upon line of fracture—if extended, weight and pulley, like Buck's extension to knee.	No answer given.	Two weeks. *a*	Not always; depends on circumstances.

RADIUS.

What splint do you use for the ordinary fracture of the lower end of the radius?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of wrist and fingers?
I think the kind of splint very unimportant; the proper reduction, usually under ether, is the thing; after that is done my preference is for plaster of Paris both here and always for splinting.		After bony union is complete, say 4 to 6 weeks. *c*	Yes. *a*
Pilcher's wristlet, if there is no tendency to displacement; otherwise, a dorsal plaster of Paris splint.	The latter is moulded to extremity and is easily removed for examination.*	Insist on active movements of fingers from beginning; commence passive motion after consolidation. *c*	I do. *a*
Plaster of Paris in form of Levis splint.	Accurately adapted, and because Levis proved that position necessary.	In third week. *a*	Expect good use of wrist and delayed good use of fingers. *a*
Straight splint.	After coaptation, under ether, has given me better results.	No stated time. *a*	Yes. *a*
A trough splint made of wire cloth.	This splint supports the ulna and comes up in front and on the back of the forearm and the hand.*	In 2 or 3 days. *a*	Yes.* *a*
No splint whatever. A simple bracelet of broad, adhesive plaster, with or without the use of a pad to support the ulna, according as the latter is displaced or not.	No other apparatus is needed; motion is not restricted.*	Usually not necessary. In 2 or 3 weeks the dressings are abandoned and active movements encouraged. *c*	Invariably. *a*
No answer given.	No answer given.	I would never begin passive motion. *c*	No answer given. *d*
Two lateral splints reaching to lower end of lower fragment.	No answer given.	Two weeks. *a*	Yes. *a*

HUMERUS.

Surgeon.	Do you treat fractures of the lower end of the humerus of ordinary severity in flexed or extended position?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of joint?
18. DeF. Willard.	Extended, as a rule; not invariably.	Less deformity.	Third week. *a*	Yes.
19. L. C. Lane.	Extended.	Thus displacement of condyloid fragment is prevented.	Never later than 48 hours. *a*	Yes.
20 Basil Norris.	Flexed.	From fear of anchylosis. *b*	Following day. *a*	Eventually.
21. Jos. Ransohoff.	Flexed.	If ankylosis results most favorable position. *b*	2 weeks or 10 days. *a*	Yes.
22. Chas. A. Powers.	Flexed at an angle of 110° to 120° retaining normal angle between axes of arm and forearm.*	Results seem to justify such course. *d*	Practically never. *c*	Yes.*
23. J. D. Bryant.	Thus far always in the flexed position.	Comfortable and convenient for the patient. Best posture if anchylosis occur.* *b*	Do not consider passive motion essential to the prevention of anchylosis. Employ it occasionally.* *c*	Yes.*
24. T. A. McGraw.	Flexed at acute angle with lateral angular splints.*	Fear of anchylosis.* *b*	End of week or 10 days.* *a*	Yes, usually.*
25. C. W. Dulles.	Flexed invariably. Metal trough preserving obliquity of axes of arm and forearm.*	Because I can secure thus the conditions requisite for good union with normal anatomical position and direction of *whole* arm. *a*	Move elbow joint from beginning of treatment when changing splints.* *a*	Yes.*
26. Parker Syms.	Flexed. Sometimes have to vary this to replace fragments.	For better position of fragments, and comfort and rest. *a*	Fourth week. *a*	Yes.
27. A. Vander Veer.	Flexed.	More comfortable for patient, and long time treatment among surgeons here. *c*	End of third or fourth week. *a*	Yes, in children. Not always in adults.

RADIUS.

What splint do you use for the ordinary fracture of the lower end of the radius?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of wrist and fingers?
Levis' or two straight.	No answer given.	Third week. *a*	Yes. *a*
Hollow, straight splints ending at the wrist.	For such dressing permits movement of wrist and hand.	At once. *a*	After 45 years of age function of these parts will remain impaired.* *c*
Silver fork.	Admits of free use of fingers.	Following day. *a*	Yes. *a*
Levis' palmar splint.	After reduction by hyperextending as good as any other.	Ten days to two weeks. *a*	Yes. *a*
Two flat, heavy pasteboard splints.*	Results seem to justify this procedure.*	Never.* *c*	Yes. *a*
Palmar and dorsal splints, padded to correct deformity.*	It is simple, comfortable and effective.	Little attention is paid to passive motion. It is not attempted until splints have been removed.*	Yes.* *a*
Two straight, wide splints *	I have always obtained good results if I have been able first to reduce the deformity.	End of week.* *a*	Yes; except in old people, those disposed to articular rheumatism and where there is great injury of joint and tendons.* *c.*
Always a straight posterior splint from elbow to *first* interphalangeal joint.	An accurate, cool and clean dressing.*	No occasion for passive motion, for have motion during all the time of treatment.* *c*	Yes.* *a*
Long palmer and dorsal, fixing hand.	To secure complete fixation.	Fourth week. *a*	Yes. *a*
Lateral straight splints. Treat many cases without any splints.	Secure best results and greatest comfort.	End of third week. *a*	Yes. Not always, however. *a.*

HUMERUS.

Surgeon.	Do you treat fractures of lower end of humerus of ordinary severity in flexed or extended position?	Why.	When do you begin passive motion?	Do you usually expect to obtain good use of joint?
28. John B. Roberts.	Extended.	Carrying function is less liable to be impaired. *c*	Not until union has occurred and dressings finally removed. *c*	Yes.
29. Thomas Bryant. (London).	Flexed.	To relax muscles which move bone. *a*	At end of second or third week. *a*	Yes.
30. F. W. Murray.	Flexed.	Position more comfortable to patient, and functional results good. *c*.	Third to fourth week. *a*	As a rule yes; but it depends on nature of fracture.
31. John E. Owens.	Flexed.	Fear of anchylosis.* *b*	Four or five weeks in supracondyloid fracture and 2 weeks in fracture of a condyle. *a*	Yes.
32. N. Senn.	Extended.	In order to prevent rotation of forearm and preserve normal angularity between forearm and arm.	After bony union has taken place. *c*	Yes.
33. Reginald Harrison. (London.)	Flexed generally.	For accurate apposition and future usefulness. *a*	Two weeks. *a*	Yes.
34. Victor Horsley, (London.)	Flexed elbow 90°.	Comfortable, convenient, and affords the best means for relaxing the muscles.* *a*	One month gently. *b*	Yes.
35. J. Ewing Mears.	In flexed position.*	Better apposition of the fragments is secured by this method. *a*	At the end of 12 to 14 days. *a*	Yes.*
36. W. T. Briggs.	Extended.*	Muscles have least tendency to displace fragments.*	Not until bones are firmly united. *c*	Yes.*
37. E. M. Moore.	Flexed for a week, then angle changed every other day by a new splint.*	Find it successful.* *a*	Changing splint gives passive motion enough.* *a*	Yes.*
38. L. A. Stimson.	Flexed.	For reasons given in paper last year. *a*	If at all, fifth week. *c*	Yes.

RADIUS.

What splint do you use for the ordinary fracture of the lower end of the radius?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of wrist and fingers?
No splint or straight dorsal.	Simplest and best.	Not until union has occurred and dressings finally removed. *c*	Yes. *a*
Carr's is the best.	It supplies wants of case, and is comfortable.	At end of 10 days. *a*	Yes. *a*
Straight, wooden splints, anterior and posterior.	Simplest and best, and easiest of application.	In fingers 10 days In wrist third or fourth week. *a*	As a rule, yes. In old people there is stiffness at times. *c*
Pistol shaped; compress over back of wrist and an anterior board splint or Levis' splint.	Use first when the deformity indicates, the second for the same reason, the last when there is no deformity.	In about 2 weeks. *a*	The greater the original deformity the greater is likely to be the impairment of function. *b*
Have no faith in splints.	Because perfect reposition brings fragments accurately in apposition. They remain so without mechanical support.	After bony union has taken place. *c*	Fair use of hand and fingers after several months. *b*
Straight splint down to middle of hand.	Best apparatus.	Ten days. *a*	Yes; if fingers are not cramped by the splint. *a*
Carr's.	Most even support. Most opposition to re-establishment of deformity. Least confinement of fingers.	Fingers 10 days. Wrist 1 month. *a*	Yes.* *a*
Bond's or Coover's.	Apposition more easily maintained and comfort given to the patient.*	Eight to ten days. *a*	Yes. *a*
Levis' splint or one that acts on the same principle.	Maintaining position as well as or better than any other apparatus.*	After bone is pretty firmly united. In old subjects sometimes very early.* *a*	In the young, yes. In the old considerable stiffness at times.* *c.*
None. Cylindrical compress to hold up ulna while sling allows hand to hang down.*	Replaces ulna and draws extensor tendons over fragments.*	Not answered. *d*	Not answered. *d*
Moulded plaster of Paris.	Fits and stays best.	I have the fingers moved from the first. *a*	Yes. *a*

HUMERUS.

Surgeon.	Do you treat fractures of lower end of humerus of ordinary severity in flexed or extended position?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of joint?
39. S. H. Weeks.	Flexed.	Maintains the fragments in best position. *a*	Second week. *a*	Yes.
40. Wm. J. Taylor.	Flexed.	Comfort to patient. *c*	End of third week. *a*	Yes.
41. W. H. Carmalt.	Flexed with extension (traction J. B. R.)	Most comfortable. *c*	Two weeks. *a*	Yes, depending upon age.
42. John B. Deaver.	Flexed.	Believe the results better. *a*	Two weeks. *a*	Yes.
43. J. R. Weist.	Flexed.	Best position of arm if loss of motion occurs. *b*	Ten days. *a*	Yes, often loss of perfect extension.
44. M. H. Richardson.	Flexed.	Better position of reduced fragments. *a*	Three to four weeks. *a*	Yes.
45. A. J. McCosh.	Flexed.	In case of anchylosis and no disadvantage. *b*	Fourteenth to twenty-first day. *a*	Yes.
46. Oscar H. Allis.	Extended.	Published reasons in ANNALS OF SURGERY.	After union say 4 weeks. *b*	Yes.
47. T. G. Morton.	Flexed.	Less danger of displacement of fragments. *a*	According to age, 4 weeks. *a*	Yes, if accurate reduction is secured.
48. T. S. K. Morton.	Flexed.	For fear anchylosis in extended position and because cases do well thus. *b*	Almost immediately. *a*	As a rule.
49. J. W. White.	Flexed.	More important muscles relaxed, better position of fragments, more comfort during treatment. *a*	If joint is not involved in 3 weeks. *a*	Yes.
50. C. B. Porter.	Flexed.	No answer given. *d*	From third to fourth week *a*	Yes.
51. H. H. Mudd.	Flexed.	More comfortable for patient going about and better if anchylosis occurs.* *b*	After bone is firm at end of 4 weeks. *b*	Yes.

RADIUS.

What splint do you use for the ordinary fracture of the lower end of the radius?	Why?	When do you begin passive motion.	Do you usually expect to obtain good use of wrist and fingers?
Carr's.	Maintains the fragments in the best position.	Second week. *a*	Yes. *a*
Levis' tin splint always.	Retains fragments in position better than others; less deformity.	Beginning third week. *a*	Yes, almost always. *a*
Straight antero-posterior.	It usually meets indications; if it does not, I use another.	Two weeks or less. *a*	In children and youth, *yes*. After 50, *no*. *c*
Bond and compress.	Believe the results better than by any other means.	Two weeks *a*	Very good. *a*
Levis' metallic.	Seems to fill indications perfectly.	In one week. *a*	Yes, except in old persons. *c*
Posterior spoon and anterior flat.	Simple and effectual.	Three weeks. *a*	Yes. *a*
Short antero-posterior splints.	To prevent stiffness at wrist joint.	Twenty-eighth to thirty-fifth day, fingers moved from outset. *b*	Yes. *a*
Modified Bond.	After reduction of deformity it affords rest.	Early after first week. *a*	Yes, in cases of intense severity. *a*
Immaterial; padded light splints. Bond or modification makes little difference what splint, if reduction is attended to.	The essential treatment consists in absolute and early reduction under ether.	Fingers early, wrist 3 weeks. *a*	Yes, if reduction has been complete. *a*
Bond or improvised of same nature.	Most comfortable, parts can best be kept in position by pads, joint most relaxed, good results.	Dress every or every other day and commence motion at first dressing. *a*	Confidently in every case. *a*
Two straight splints or Bond's splints preferably the former.	They meet all the indications better than other dressings.	Fingers in a few days, wrist in 3 weeks very generally. *a*	Yes. *a*
Anterior and posterior.	No answer given.	Of fingers early and wrist a little in second week.* *a*	In young and middle aged, yes. Old, not so good. *c*
Simple straight board.	Efficient and comfortable.*	No answer given. *d*	Yes. *a*

HUMERUS.

Surgeon.	Do you treat fractures of lower end of humerus of ordinary severity in flexed or extended position?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of joint?
52. W. Meyer.	I treat fractures of lower end of humerus (condyles) of ordinary severity in semiflexed flexed and extended position Days Semiflexed, 10 Flexed, 10 Extended, 8 — 28	To avoid anchylosis. *b*	When changing splint and after 3 to 4 weeks. *a*	Yes.
53. J. H. Brinton.	Flexed by anterior angular splint.	Because with *strong* extension of forearm I can get good results. *b*	As soon as the swelling or inflammatory symptoms subside, 8 to 10 days. *a*	Yes.
54. Louis A. Sayre.	Flexed usually.	Adjustment of bones equally good and position more comfortable to patient. *a*	End of second week. *a*	Yes.
55. Wm. G. Porter.	Flexed.	Because I have always done so and am satisfied with the results obtained. *a*	About tenth day. *a*	Yes.
56. Chas. K. Briddon.	Flexed.	Can get better apposition with right angled anterior splint. *a*	When the fragments are united. *c*	Yes.
57. Geo. McClellan.	Extended.	Because of the adjustment.	As soon as the swelling, etc, have been reduced. *a*	Yes.
58. Wm. Barton Hopkins.	Flexed right angle.	For better adaptation splint; hand doesn't swell. *c*	Second dressing. *a*	Yes.
59. L. S. Pilcher.	Both.	Depends on comfort of the patient and tendencies to displacement.	Never. *c*	Yes.
60. John Homans.	Flexed.	Because this position relaxes the muscles and retains the fragments in position, and, if anchylosis occurs, makes a more useful limb. *a*	I use very little. *c*	Yes.

RADIUS.

What splint do you use for the ordinary fracture of the lower end of the radius?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of wrist and fingers?
Hospital practice pasteboard and hand straight, private practice. Poroplastic felt (hand flexed.)	Hospital practice, convenient and sure. Private practice, result more insured.	In reviewing splint and after 3 weeks. *a*	Yes. *a*
Bond's in some form.	Get better results and less stiffness.	As soon as swelling, etc., begin to subside, 7 to 10 days. *a*	Yes, unless the patient is very old or has rheumatic or gouty diathesis, etc. *c*
Pistol shape, or according to Moore of Rochester.	Because it is followed by less deformity.	Early. *a*	Yes. *a*
Bond's or a simple straight splint.	I think the splint of little importance if the fracture has been thoroughly set and the deformity removed.	About tenth day. *a*	Yes, in simple uncomplicated cases. *a*
After perfect reduction straight anterior splint, padded to fit curvature of radius.	Because back splints produce mischevious pressure.	As soon as painless. *a*	Yes, but only after persistent massage. *a*
Levis' or flat angular splint with compresses.	The former when there is little deformity; the latter to relax the biceps when there is.	In third week. *a*	Not always; depends upon amount of damage to surrounding parts. *b*
Bond's splint, fingers enclosed in bandage.	Keeps its place readily, padded to fit.	Second dressing. *a*	Yes, except in aged and rheumatic. *c*
None.	None required.	After first week. *a*	Yes. *a*
At first external and internal splints, broad board, the posterior extending to tips of fingers. Later a Bond's splint.	To support the hand and wrist and not to squeeze the radius and ulna together.	I use very little. *c*	Yes, but not without deformity. *a*

HUMERUS.

Surgeon.	Do you treat fractures of lower end of humerus of ordinary severity in flexed or extended position?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of joint?
61. Robert Abbe.	Flexed.	Because if the fracture is thoroughly reduced under ether, it can be best maintained thus. *a*	I use very little passive motion. The patient's voluntary use is superior. *c*	Yes.
62. W. T. Bull.	At right angle.	It permits easier apposition of fragments. *a*	Three or 4 weeks *a*	Yes.
63. R. N. Isham.	Flexed with inside splint.	To avoid inside deformity of elbow, with ease of position. *a*	As early as fifth day. *a*	Yes.
64. D. W. Cheever.	Flexed.	To relax muscles, etc. *a*	Two to 3 weeks. *a*	Sometimes.
65. J. A. Comingor.	Flexed.	In case of anchylosis, arm is more useful. *b*	In 10 days. *a*	Yes.
66. C. B. Nancrede.	Flexed.	At a right angle or less the (2) axes of arm and forearm coincide and thus save carrying angle. *a*	During third week, but don't believe in it. *a*	Yes.
67. L. W. Steinbach.	Extended.	Because it is the natural position.	Three or 4 weeks *a*	Yes.
68. H. R. Wharton.	Flexed.	Because it gives best result if joint function is impaired. *b*	In about 3 weeks *a*	Yes.
69. G. W. Gay.	Flexed.	Best way as far as I know. *a*	In about 10 days. *a*	Fair.
70. R. F. Weir.	Flexed.	Anatomically correct. *a*	Early. *a*	If not primarily involved.
71. A. T. Cabot.	Flexed.	To prevent posterior displacement. *a*	After 3 or 4 weeks. *a*	Yes.
72. F. Hartley.	Flexed.	Apposition better, dressing does not slip. *a*	Three or 4 weeks *a*	Depends on kind of fracture.
73. J. H. Packard.	Flexed.	Because it relaxes the muscles, and obviates deformity, etc. *a*	At once. *a*	That depends.

RADIUS.

What splint do you use for the ordinary fracture of the lower end of the radius?	Why?	When do you begin passive motion?	Do you usually expect to obtain good use of wrist and fingers?
Nelaton's. Two flat and padded splints.	Pressure can be graduated and parts watched.	Four weeks. *a*	Uniformly. *a*
Short palmar and dorsal splints.	Simplest form of retentive apparatus.	Three or 4 days. *a*	Yes, in majority of cases. *a*
Short palmar and dorsal.	To permit flexion and adduction of hand.	Two weeks, but of fingers at once. *a*	Yes. *a*
Carr's or Bolles's.		Three to 4 weeks. *a*	Doubtful. *b*
Plaster cast.	Avoid stiff wrist and finger joints.	One week wrist, fingers one day. *a*	Yes, have not failed for 15 years. *a*
No special one, but always pad, etc , so as to conform to the normal curvature of radius.		Third week, but don't believe in it. *a*	Yes. *a*
Levis.	It conforms to the part in state of rest.	Three or 4 weeks. *a*	Yes. *a*
Bond's splint with compresses.	Because I see the best results from this dressing.	Three weeks. *a*	Yes. *a*
Carr's or similar.	Light and convenient.	About 2 weeks. *a*	Fair, except in old rheumatics. *c*
Short plaster Paris after complete reduction under *ether*.		Early. *a*	Yes. *a*
Spoon and anterior.	I am accustomed to it.	Three or 4 weeks. *a*	Yes. *a*
Anterior and posterior long splints.	Absolute quiet better secured.	Three to 4 weeks. *a*	Yes. *a*
A small block of wood.	Because it prevents the flexion upward.	At once. *a*	As a general rule, yes. *a*