FRACTURES OF THE HEAD AND NECK OF THE RADIUS*

By Condict W. Cutler, Jr., M.D.
of New York, N. Y.

Among the bone injuries commonly met with, the fractures of the head and neck of the radius present several features of more than ordinary interest. While not so frequent in their occurrence as many of the other fractures, they are yet sufficiently numerous to warrant the study of the surgeon. The various opinions advanced with regard to the method of production of these injuries, the different types of treatment advocated by observers and the lack of uniformity in the results obtained give evidence of the possible value of further investigation. Over and above these considerations these fractures are of interest because of their importance to the patients, entailing, as they not infrequently do, permanently disabling injury to the elbow-joint.

Fig. 1.—Example of Class 1. Simple crack in the radial head.

The fifty cases which are the subject of this report have been gathered from the records of the Roosevelt Hospital and its Outpatient Department covering a period of ten years. They represent all of the instances of fractures of the head and neck of the radius which could be found during this period, with the exception of four, in which the records were not sufficiently complete to be of value.

Incidence.—The fractures in this group were nearly evenly divided between the sexes. Twenty-seven of the patients were males and twenty-three females. Study of the age incidence bore out the statements of Rabourdin[1] and other observers that these injuries are more common in adults and young adults than in children. The average age of the patients was 31. The oldest was 55, while the youngest was 6. The preponderance of adults may perhaps be better indicated by the statement that 28 of the patients were thirty years of

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age or older, while but 12 were under twenty. A further distinction, with respect to age, should be made in considering the fractures of the neck of the radius. Here, as emphasized by Speed,[2] the younger ages predominated, with an average of 18 years. Eliminating this group raises the average age for fractures of the head to 37 years, which places these injuries still more definitely in the adult category.

Etiology.—Considering this group of fractures of the upper radius with respect to the nature of the injury producing them, it was found that 20, or 40 per cent., had been caused by falls on the elbow. Four (8 per cent.) were

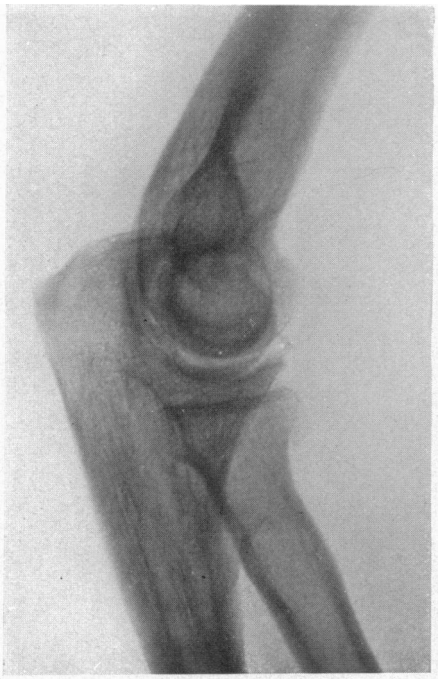

FIG. 2.—Example of Class 1. Simple crack in the radial head.

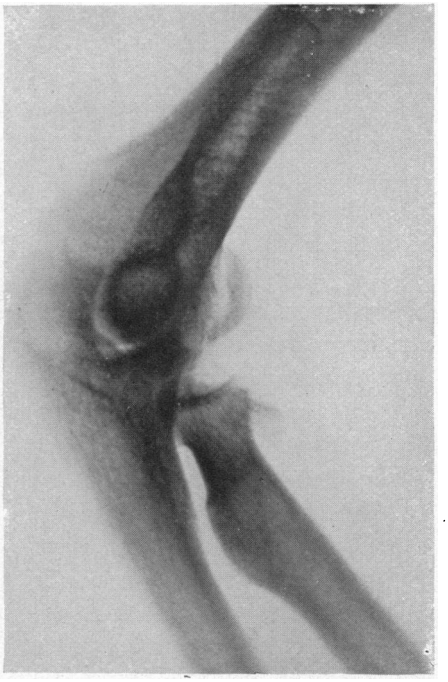

FIG. 3.—Example of Class 2. Fracture of the radius with separation of one fragment.

reported as following falls in which the forearm received the impact. Four were due to twisting injuries of the forearm, while falls upon the extended hand accounted for 10, or 20 per cent. In twelve the nature of the trauma was not reported. If the histories of these injuries are to be accepted as accurate, the findings in this group rather seem to support the views of Stimson [3] and of Rabourdin,[1] who mention direct trauma as the most frequent cause of this type of fracture, while Scudder [4] speaks of falls on the hand as being most commonly responsible.

Pathology.—In reviewing these cases with regard to their pathology they were found to group themselves most readily into four main classes. The least severe injury was the simple crack in the head of the radius without displacement of the fragment. Of these there were seven. The second class

comprised those cases, fourteen in number, in which there was a fissuring of the radial head with separation of one fragment. In the third class were grouped eleven cases in which the head was fragmented or split into two or more separated pieces. Fractures of the neck of the radius, of which there were fourteen, made up the fourth class. In four cases the exact pathology could not be ascertained.

Although it is well recognized that the patient is not likely to remember or report accurately the manner of receiving his injury, an attempt was made to secure as exact a history as possible on this point. It was hoped that an

FIG. 4.—Example of Class 2. Fracture of the head of the radius with separation of one fragment.

FIG. 5.—Example of Class 3. Fragmentation of the head of the radius.

attempt to show the relation of the nature of the trauma to the pathology might throw some light upon the mechanism of production in these fractures. The results were as follows:

Type of Injury		*Nature of Trauma*				
		Striking elbow.	Fall on hand	Twist of forearm	Fall on forearm	Unknown
1. Crack in radial head	(7)	3	1		3	
2. Separation of one fragment	(14)	7	3	1	2	1
3. Fragmentation	(11)	2	2	2	1	4
4. Fracture of neck	(14)	6	5			3

From the above tabulation it would appear:

1. That direct trauma was more frequently the causative injury in simple crack of the radial head.

2. That separation of one fragment occurred relatively frequently from direct trauma. The single fragment was fractured from the anterior lip in eight of the fourteen cases.

It is suggested that this chipping of the anterior lip may be caused by falls in which the forearm lies beneath the body in mid-pronation. In this situation the force of the blow striking the lateral aspect of the radial head, may be transmitted across the head of the radius against its area of firm contact with the lesser sigmoid cavity of the ulna, resulting in cracking off the anterior part of the head.

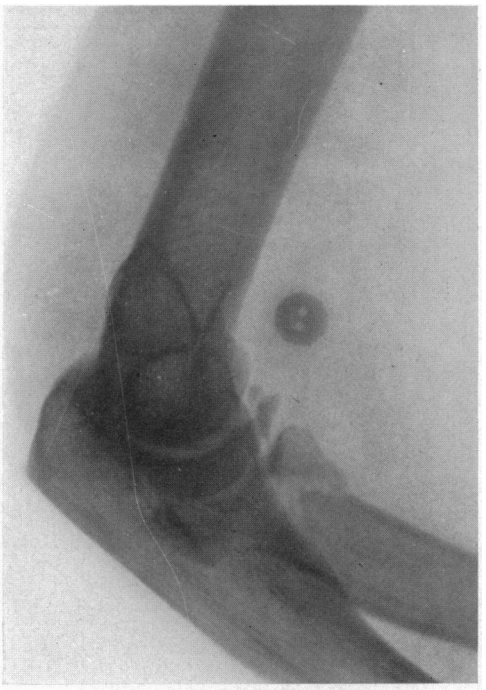

FIG. 6.—Example of Class 3. Fragmentation of the head of the radius.

3. That in fragmentation of the head, each of the usual accidents played about an equal part. Of four cases where wide separation occurred with apparent rupture of the orbicular ligament, two were caused by falls on the extended hand and two by twisting injuries of the forearm.

4. That direct and indirect violence were about equally responsible for fractures of the neck of the radius. Of the eight children under sixteen years of age who suffered this injury in the present series, four each were ascribed to direct and to indirect trauma.

A certain relation is suggested here between the fact that fractures of the neck of the radius are more common in children and the observation that direct trauma is so frequently the cause of this injury. It seems reasonable to suppose that in children a fall on the extended hand is more likely to cause injury at the line of least resistance above the humeral condyles than in the upper radius. In the adult the head of the radius, no longer partly cartilaginous but inelastic, cancellous and with a relatively thin shell of cortex, is more likely to be split or shattered by the upward thrust against the capitellum resulting from indirect trauma. Thus, while indirect violence seems more likely to cause radial head injuries in adults than in children, direct violence remains a competent cause of fractures of the upper radius in both.

Review of the above analysis of pathology with reference to character of injury would seem to indicate that it is impossible to predicate the type of lesion definitely from the history of the trauma. Direct and indirect trauma

were apparently capable of producing any of the four classes of fracture. Twisting injuries of the forearm, or falls with the forearm twisted, probably involving the element of forced abduction, appeared as causative factors in two of the classes in this group, namely those in which there was separation of one or more fragments of the head. It was of interest to note also, that in the more severe injuries (fragmentation of the head and fracture of the neck

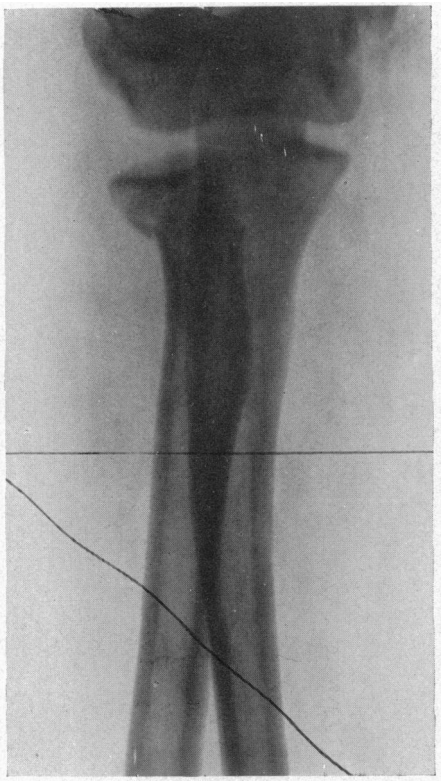

FIG. 7.—Example of Class 4. Transverse fracture of the neck of the radius.

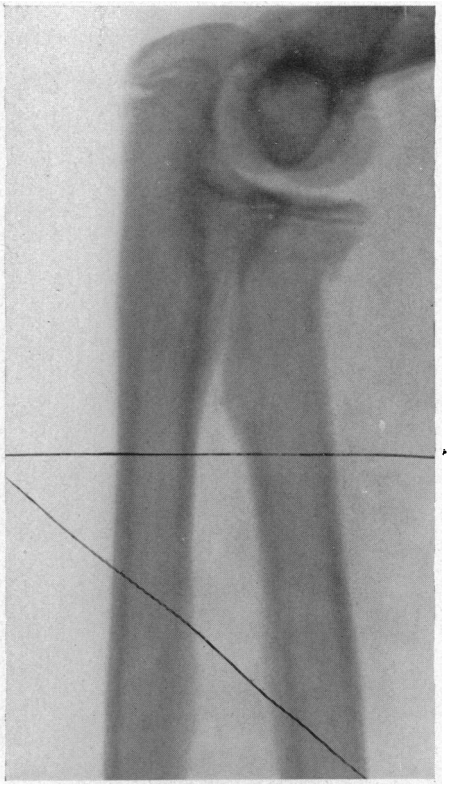

FIG. 8.—Example of Class 4. Transverse fracture of the neck of the radius.

with marked displacement) the ratio of indirect to direct trauma was greater than in the less severe cases.

Complications.—The fact that falls on the extended hand and twists of the forearm are likely to be productive of the more serious damage is further indicated by the complications which occurred in this group. Of these there were six. Two were posterior dislocations of the ulna with fracture of the neck of the radius, due to falls on the hand. One was a compound dislocation of the ulna with fragmentation of the radial head from a twist of the arm. One was a posterior dislocation with fracture of the olecranon and transverse separation of the head from a fall on the elbow. One was a fracture of the coronoid with an anterior chip broken from the head of the radius, due to a fall from a height. In this case a fracture of the skull further complicated the picture,

and a definite history of the mechanism was not obtainable. The remaining case, a fracture of the neck of the radius, was complicated by a fracture of the upper third of the ulna in a young child. Here also the history of the injury was not satisfactorily elicited.

Symptoms and Signs.—The symptoms and signs presented by these injuries of the upper radius showed a considerable degree of uniformity. Pain, referred to the elbow region, particularly at the outer side, was complained of in all cases except four. These four came for the relief of a disability result-

FIG. 9.—Transverse fracture of neck of radius in child of eight. Picture taken three years after complete removal of radial head. Complete restoration of function, shows enlargement of lesser sigmoid to form new radio-ulnar articulation. This case was complicated by fracture of upper third of ulna. (Case R. L., No. 1441.)

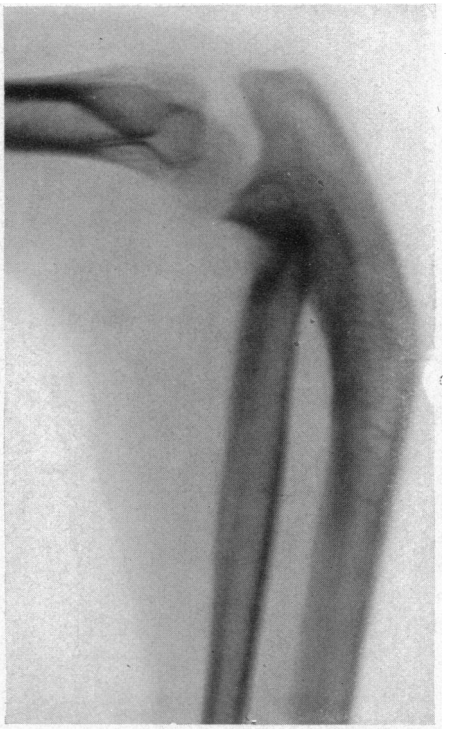

FIG. 10.—Transverse fracture of neck of radius in child of eight. Picture taken three years after complete removal of radial head. Complete restoration of function, shows enlargement of lesser sigmoid to form new radio-ulnar articulation. This case was complicated by fracture of upper third of ulna. (Case R. L., No. 1441.)

ing from injury some time previously. Disability was a uniform complaint, having been noted in all the cases of the group, both recent and old. This disability involved characteristically all motions at the elbow, flexion and extension as well as pronation and supination, varying somewhat in degree according to the severity of the injury. In the few cases in which it was noted, the attitude assumed by the patient was that of mid-flexion of the elbow, with the arm supported. Swelling, in the cases seen within twenty-four hours after injury, occurred in about two-thirds of the patients and was noted as being usually diffuse about the elbow.

Ecchymosis was less common, being observed in but nine of twenty-two recent cases. Bony irregularity was noted in but four of the cases seen soon after injury. Each of the four had suffered transverse separation of the head from the shaft with rather marked displacement. With the exception of the four old cases mentioned as applying for relief of disability, and the one of compound fracture-dislocation, all of the cases of the group showed tenderness. Direct and indirect tenderness were present together in forty-three instances. Direct tenderness, over the head of the radius proved to be the most reliable of all the signs, appearing as the only localizing evidence in three of the cases observed. Failure of the head to rotate with the shaft was noted in two cases of fractures of the neck. No observation was made, or at least none was recorded, of the presence of abnormal lateral mobility, one of the physical signs mentioned by Stimson.[3]

FIG. 11.—Fragmentation of the head of the radius in boy of twelve. Treated by removal of fragments. Picture shows condition three years after operation. Exostoses and bony proliferation marked. Slight limitation of flexion and pronation. (Case H., No. 1442.)

Diagnosis.—In view of these findings the diagnosis of a typical case of fracture of the head of the radius rests upon a history of a fall on the hand or the elbow, or a twisting injury of the forearm, followed by pain about the elbow, limitation of supination and pronation as well as flexion and extension; showing some swelling about the elbow, referring indirect tenderness to the region of the radial head and with direct tenderness elicited in the same region. If, in addition, failure of the head to rotate with the shaft can be demonstrated, or if bony irregularity of the head varying from its normal relations can be felt, separation of the head may be diagnosed. The X-ray picture is confirmatory. Emphasis should be laid upon the necessity of making the exposures in two directions. If this is not done a number of cases in which the head is merely cracked will fail of proper diagnosis.

The X-ray findings in the cases of this group have been indicated in the discussion of the pathology. In general they showed a considerable variety in the injuries sustained, even in each of the four main classes into which the group has been divided. For example, in the class of crack in the radial head with displacement of the fragment, several of the cases showed but slight

displacement of the separated piece, while in one instance (as proved at operation) the fragment lay in the flexor muscles completely outside the joint. Similar variations in degree of fragmentation and amount of displacement of the radial head occurred in classes three and four, respectively, But one case of impacted fracture of the neck was observed, although Thomas [5] mentions this injury as being frequent. Another point of interest was noted, in that, although there were eight cases of separation of the radial head in children, only two were epiphyseal separations, the others being frank fractures of the neck, distal to the epiphyseal line.

FIG. 12.—Fragmentation of the head of the radius in boy twelve. Treated by removal of fragments. Picture shows condition three years after operation. Exostoses and bony proliferation marked. Slight limitation of flexion and pronation. (Case H., No. 1442.)

Prognosis.—Considering the variations in pathology observed it is obviously difficult to lay down a general rule of prognosis for the composite group of fractures of this type. The prognosis in each case must take into account such factors as the type and extent of the fracture, the presence or absence of complications, the age of the patient and the method of treatment employed. Study of this particular group of cases indicates that the best results may be expected in the less severe injuries where the head is merely cracked or where one fragment is displaced, while in fragmentation and fracture of the neck, particularly where there is much displacement, the prognosis is less favorable. Where the picture is further complicated by the presence of other fractures in the region or by dislocation, the prognosis is least favorable. Here, as in other types of fracture, the younger ages offer the better prospect of satisfactory recovery. As important as any of these factors in determining prognosis is the question of treatment. Scudder [4] emphasizes this in saying that with proper treatment uncomplicated fractures of the head or neck of the radius should result in union and normal function.

Treatment.—Yet as to what constitutes proper treatment in these cases the opinions of the various writers differ. Scudder [4] takes the somewhat conservative view that fractures without much displacement are amenable to treatment by immobilization in right angle position until union occurs, followed by mobilization. Where the fragments are widely separated, or where non-

union, adhesions, callus, or displaced fragments impair the usefulness of the arm he advocates operation. Mouchet,[6] referring particularly to fractures of the neck, feels that immediate movement and massage is indicated without attempt at reduction. Rabourdin,[1] on the other hand, feels that non-operative treatment is only applicable in cases where there is a fissure of the radial head, and advocates the removal of fragments and an early cleaning of the joint in all others. Jones[11] recommends excision when the head is displaced with fracture, and when supination cannot be obtained. Hitzrot[7] cites 13 of 15 cases which, without operation, showed loss of one-half the normal rotation, while Thomas[8] mentions 12 of 18 unoperated cases which showed ankylosis, non-union, or impaired function. Estes[9] states it as his opinion that resection is too seldom practiced, while Wilson and Cochrane[10] believe that the end results are often surprisingly good without operation, and recommend the closed method of treatment as best in dealing with cases which show either only slight displacement, or extensive comminution.

FIG. 13.—Case Lu., No. 8468. Fragmentation of the head of the radius in a boy of nine. Immobilization in flexion for ten days, followed by sling and baking and massage.

In the group of cases under consideration the treatments used in the various classes were as follows: All of the seven cases of simple crack in the radial head were treated by the closed method. Of those showing displacement of one fragment of the head six had operative treatment and eight did not. In eight of those with fragmentation the fragments were removed, while three were not operated upon. The radial head was removed in eight of the cases with separation of the head, while no operation was performed in six. Four of the cases in which operation was done were old cases in which much limitation of motion was present. One of these showed much callus and practically ankylosis following marked fragmentation of the head, while the other three were complicated by dislocation of the ulna. Eighteen of the unoperated cases were treated by placing the arm in supination and acute flexion for from five to twelve days, followed by the use of sling and baking and massage, active and passive motion. The remainder were treated

with rest in a sling from the start. Reduction of a displaced fragment (separated head with forward displacement) was attempted twice, once with success.

It is felt that the treatment of these conditions in the flexion position with supination (where the closed method is used) has certain advantages. In general, the ability to secure flexion and supination indicates that the fragments are in such position as to permit of this range of motion, and that they may be retained there, with at least the possibility of union. Also, as in other fractures of the elbow, this position obtains the early restoration of these important motions, which otherwise are often difficult to regain. In the class of radial head fractures with a simple crack, this advantage is sufficient to warrant the use of the method. In fragmentation or separation of the head the failure of an attempt to secure this position by reason of bony interference may well be the indication for excision of the fragments, as full and useful function of the arm is not then otherwise obtainable. If flexion and supination can be secured, union and restoration of function are possible.

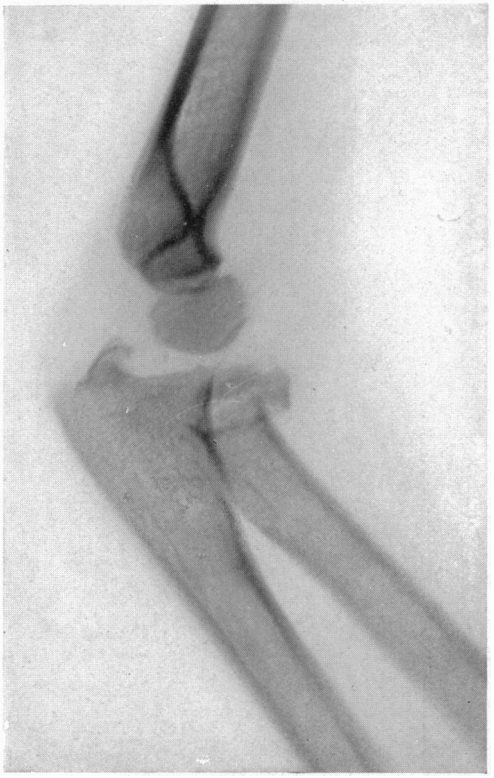

FIG. 14.—Case Lu., No. 8468. Fragmentation of the head of the radius of a boy of nine. Immobilization in flexion for ten days, followed by sling and baking and massage.

Results.—In tabulating the results of treatment in the cases of this series the following criteria are used: Good—complete restoration of function; Fair—slight limitation of one or more motion; Poor—marked limitation of one or more motion. The early results, noted at the time of discharge or of cessation of treatment, were as follows:

Class of Injury.	*Excision*			*Non-operative*		
	Good.	Fair.	Poor.	Good.	Fair.	Poor.
1. Crack in the radial head				5	2	
2. Separation of one fragment	2	3	1	4	3	
3. Fragmentation	2	6		1	2	
4. Fracture of the neck	1	5	2	3	2	1

The report of late results, secured by examining the patients a year or more after discharge, is less complete, but indicates in a general way what may be expected in the treatment of these injuries.

Class of Injury	*Excision*			*Non-operative*		
	Good.	Fair.	Poor.	Good.	Fair.	Poor.
1. Crack in the radial head				5	1	
2. Separation of one fragment	5	1		2		
3. Fragmentation	3			1		
4. Fracture of the neck	3	2		5	1	

Upon the basis of these results alone it would be manifestly impossible to make a satisfactory comparison between the operative and non-operative methods of treating fractures of the head and neck of the radius. The figures

FIG. 15.—Result in case shown in Figs. 13 and 14.

FIG. 16.—Result in case shown in Figs. 13 and 14.

do indicate, however, that the closed method of treating simple cracks of the radial head produces satisfactory results. As regards fractures of the other three classes it can only be said that each method has yielded some results that were good, as well as a few that were imperfect. It would seem, therefore, unwise to advocate excision in every case of fragmentation or fractured neck. This is especially true since the operative procedure itself is not free from danger. The technical difficulty of locating and removing a single displaced piece of the head, or of finding and extracting all pieces in a multiple fragmentation may be considerable. In one case of this group, at least, not all of the fragments could be extracted. In addition, three of the cases operated upon suffered infection of the wounds, resulting in delayed convalescence and in impaired results in two. Considering also the fact that should the closed method fail of good results in appropriate cases recourse may still be had to

surgical removal of the fragments, it would seem best to treat these injuries without operation except where definite indications for removal are present. Such indications would appear to be: 1. Such displacement of a fragment or of the whole head as would interfere with full joint motion. 2. Irreducible complicating dislocation of the radius or ulna or both. 3. Mal-union, ankylosis or impaired motion in old cases.

REFERENCES

[1] Rabourdin: Theses, Faculty of Medicine, Paris (Steinheil), 1910, p. 11.
[2] Speed: Surgical Clinics of No. America, 1924, vol. iv, p. 651.
[3] Stimson: Fractures and Dislocations, 7th Edition, p. 296, *et seq.*
[4] Scudder: Treatment of Fractures, 9th Edition, 1922, Chap. X, p. 291.
[5] Thomas, T.: ANNALS OF SURGERY, 1907, vol. xlvi, p. 280.
[6] Mouchet: Revue Chirurgical, vol. xxi, p. 596.
[7] Hitzrot: ANNALS OF SURGERY, 1912, vol. lv, p. 353.
[8] Thomas, T.: University of Penna. Medical Bulletin, 1915, vol. xviii, pp. 184, 221.
[9] Estes: In Oschner's Surgical Diagnosis and Treatment, Edition, 1920, vol. iv, p. 91.
[10] Wilson and Cochrane: Fractures and Dislocations, 1925, p. 203, *et seq.*
[11] Jones: Oxford War Primers, 1915.