

precisely this position acted to effect the reduction I am not prepared to say; perhaps by drawing upon the coraco-brachialis and short head of the biceps—nor am I prepared to say that it would accomplish the same result in any other case, yet it may deserve a trial.

In the graver forms of the accident, where other bones about the shoulder are broken or dislocated, or the limb has suffered other severe injuries, which, as we have seen, constitute the larger proportion of the whole number, the treatment must generally have little or no regard to this particular injury.

## CHAPTER XXI.

### FRACTURES OF THE HUMERUS.

It is not sufficient to consider fractures of this bone as occurring through the shaft and its two extremities, as some systematic writers have done; since upon this simple arrangement it is impossible to base a natural division of their causes, symptoms, prognosis, and treatment.

We shall find it necessary to consider—

1. Fractures of the head and anatomical neck. (Intracapsular; non-impacted and impacted.)
2. Fractures through the tubercles. (Extracapsular; non-impacted and impacted.)
3. Longitudinal fractures of the head and neck, or splitting off of the greater tubercle.
4. Fractures of the surgical neck. (Including separations at the upper epiphysis.)
5. Fractures through the body of the shaft. (Shaft below the surgical neck and above the base of the condyles.)
6. Fractures at the base of the condyles. (Including separations at the lower epiphysis.)
7. Fractures at the base, complicated with fractures between the condyles, extending into the joint.
8. Fractures or separations of the internal epicondyle.
9. Fractures or separations of the external epicondyle.
10. Fractures of the internal condyle.
11. Fractures of the external condyle.

Of 203 fractures of the humerus examined and recorded by me, 51 occurred through the upper third, 43 through the middle third, and 103 through the lower third. An observation which is in contrast with the statement made by Amesbury, and which has been repeated by Lizars, B. Cooper, Fergusson, Gibson, and others, that this bone is most often broken in its middle third, unless they intended to speak of fractures of the shaft alone.

Of the fractures belonging to the upper third, 6 were supposed to be epiphyseal separations, one was probably a fracture at or near the ana-

tomical neck, with impaction and splitting of the tubercles, one was a fracture of the greater tubercle alone, and 44 were fractures at or near the surgical neck; some of them probably involving the shaft below the neck.

Of the fractures belonging to the lower third, 22 were through the internal condyle, 29 through the external condyle, 18 were at the base of the condyles, 6 through the condyles and across the base at the same time. One at the epiphysis, the remaining 27 being through the shaft, but above the base.

Unfortunately, surgical writers have not been agreed in the use and application of the terms "head," "neck," "anatomical neck," and "surgical neck" of the humerus; and, as a consequence, their meaning is often obscure, and their teachings are sometimes contradictory and absurd.<sup>1</sup> It is necessary, therefore, that we should define them more precisely.

The "head" of the humerus is that smooth, elliptical surface, covered by cartilage and synovial membrane, which articulates with, and is received into, the glenoid cavity of the scapula.

The "anatomical" neck is the narrow line immediately encircling the head, and which receives the insertion of the capsular ligament.

The "surgical" neck is that portion which commences at the lower margin of the tubercles, or at the point of junction between the epiphysis and the diaphysis, and which terminates at the insertion of the pectoralis major and latissimus dorsi.

The "neck" is all of that portion included between the head and the insertions of the pectoralis major and latissimus dorsi; comprising not only the anatomical and surgical necks, but also the tubercles; which latter occupy the triangular space between these two.

#### § 1. Fractures of the Head and Anatomical Neck. (Intracapsular; Non-impacted and Impacted.)

*Fractures of the Head.*—The causes which have been found competent to produce fractures of the head are, the penetration of balls or of other missiles directly into the joint, producing thus a compound, and generally comminuted, fracture of the head; and falls, or direct blows upon the shoulder, without penetration.

When the fracture results from the direct penetration of some foreign body into the joint, it is not only a compound fracture, but the head of the bone is almost necessarily broken into many fragments. If the patient recovers, sooner or later the fragments have generally to be removed, or resection has to be practised.

Examples of fractures of the head of the humerus, not caused by penetrating injuries, and not accompanied with fracture of the anatomical neck, or of the tubercles, are very rare. Nevertheless now and then a specimen has been found for which this distinction has been claimed. In most of which the fracture has been of the nature of a simple fissure.

Gosselin describes a case in which there were two fissures extending through the articular cartilage, and about one centimetre into the spongy structure. The joint contained half an ounce of blood; death having

<sup>1</sup> Boston Med. and Surg. Journ., June 24, 1868, p. 410.

occurred 14 hours after an accident, the exact character of which was not determined.<sup>1</sup>

Malgaigne has described a similar case, in which there were two fissures, one horizontal in its direction, and the other vertical.<sup>2</sup>

Gross refers to a case of single fissure of the head, which had become consolidated.<sup>3</sup>

Howe speaks of a specimen in the Dupuytren museum in which about one-third of the head has been broken off and united. He also refers to another specimen in the same collection which Lenoit regarded as a fracture of the anatomical neck and which was ununited.<sup>4</sup>

Examples in which the fracture of the head is accompanied with a fracture of the anatomical neck, or of the tubercles, are much more frequently observed.

*Fractures of the Anatomical Neck* sometimes follow, with a remarkable degree of accuracy, the line of the insertion of the capsular ligament, being always, according to Robert Smith, within the interior or outer margin of this insertion. He calls them, therefore, intracapsular. It is probable, however, since, as we shall presently see, bony union is not denied to certain supposed examples of this fracture—that the line of separation is not always, or generally, perhaps, completely within the insertion of the ligament, but that it is in some degree extracapsular, if not extracapsular.

Boyer says that he has seen several examples of this fracture, none of which, however, was accurately diagnosed until after death. He observes that the specimens which have been fully recognized as intracapsular, would seem to show that the superior fragment contributes almost nothing to the process of repair, but that, as in the case of intracapsular fractures of the neck of the femur, they are subjected to a process of partial absorption. He further illustrates the correctness of these conclusions, by reference to a case examined in the autopsy seven days after the accident, in which the head had already suffered a remarkable diminution by the process of absorption. He quotes, also, two cases described by Reichel, in which union had taken place, and the exact line of fracture could not, therefore, be so accurately determined.<sup>5</sup>

Mr. Spence exhibited a specimen to the Medico-Chirurgical Society of Edinburgh, May 2, 1860. A man advanced in life, in consequence of a fall, sustained a fracture. He died at the end of four weeks, from apoplexy. The fracture was found in the autopsy to have passed "through the anatomical neck ;"



Fracture of the anatomical neck.

<sup>1</sup> Gosselin, Gurlt.

<sup>2</sup> Malgaigne's Atlas, pl. 4, fig. 2. (In the text, vol. i. p. 526, only one fissure is described.)

<sup>3</sup> Gross, Treatise on Surg., 1st ed., vol. ii. p. 190.

<sup>4</sup> Howe, Gaz. des Hôp., 1858, p. 272.

<sup>5</sup> Boyer, Trait. des Mal. Chir., 4th ed., 1831, vol. iii. p. 199.

that is, between the head and tuberosities, and within the capsular ligament. No union had taken place.<sup>1</sup>

Gibson, also, thinks that the fragment occasionally remains without becoming necrosed, or causing suppurative action, being gradually absorbed and changed in figure. He says that his museum contains three or four well-marked cases of this kind, in all of which the head has lost its spherical form, and is very much diminished, and rough and flattened next to the scapula.<sup>2</sup> Other cabinets are said to contain similar specimens.

The displacements to which the upper fragment, or the head of the bone, is subject, are remarkable, and some of them do not seem to be satisfactorily explained. Frequently, indeed, its position is not sensibly disturbed, but at other times it is found impacted, or driven into the cancellous structure of the inferior fragment, in consequence of which one or both of the tubercles are frequently broken off.

Robert Smith relates the following case as having afforded him his first opportunity of ascertaining by post-mortem examination the exact nature of this form of displacement:

"A female, æt. 47, was admitted into the Richmond Hospital, under the care of the late Dr. McDowell, for an injury to the humerus, the result of a fall upon the shoulder. Five years afterwards, the woman was again admitted, under the care of Mr. Adams, with an extracapsular fracture of the neck of the femur, one month after the occurrence of which she died, in consequence of an attack of diarrhœa.

"The shoulder was of course carefully examined; the arm was slightly shortened, the contour of the shoulder was not as full or round as that of its fellow, and the acromion process was more prominent than natural. Upon opening the capsular ligament, the head of the humerus was found to have been driven into the cancellated tissue of the shaft, between the tuberosities, so deeply as to be below the level of the summit of the greater tubercle; this process had been split off, and displaced outward; it formed an obtuse angle with the outer surface of the shaft of the bone."<sup>3</sup>

The description is accompanied with two excellent drawings of the specimen, showing the distance to which the superior fragment had penetrated the inferior, and showing also complete union by bone.

I believe, also, that in the following example there was a fracture at or near the anatomical neck, with impaction, and splitting of the tubercles:

January 12, 1858, a young man, aged about sixteen years, fell from a height in a gymnasium, severely injuring his left shoulder. I saw him, with Dr. Boardman, soon after the accident, and found him complaining very much of the shoulder, which was somewhat swollen and tender. He could not tell us how he fell, nor could we discover any contusions by which to determine the point where the blow was received. All motions of the shoulder-joint were painful; and there was a remark-

<sup>1</sup> Spence, Ed. Med. Journ., vol. 5, p. 1140, 1860.

<sup>2</sup> Gibson, Elements of Surgery, vol. i. p. 279.

<sup>3</sup> R. Smith, Fractures in Vicinity of Joints, pp. 191-3.

able fulness in front of the joint, feeling like the head of the bone, yet not such as is usually present in a forward luxation. To determine this more positively, however, the limb was manipulated as for the reduction of a dislocation. Once during the manipulation a feeble but distinct crepitus was detected; yet the position of the bone remained unchanged. The head was found to be in the socket, but the precise nature of the injury was not made out.

Fifteen days later, when the swelling had completely subsided, a careful examination was again made by Dr. Boardman and myself, when we arrived at the conclusion that it was a fracture through the bicipital groove, and that the lesser tubercle was carried forwards half an inch or more from its fellow, while the head and the greater tubercle occupied their natural positions opposite the socket. The fragment projecting in front presented a sharp point, and could not be confounded with any swelling of the soft parts. There was a distinct space between the tubercles, into which the finger could be laid. No depression existed under the acromion process behind, but, on measurement, the head of this humerus was found to be half an inch wider in its antero-posterior diameter than the opposite.

That this fracture was accompanied with impaction was rendered certain by the repeated and careful measurements of the length of the humerus, which constantly showed a shortening of half an inch.

Under these circumstances union generally takes place; but it is usually accompanied with the formation of an irregular mass of osteophytes, which encircle the head like a coronet; presenting in this respect again a remarkable resemblance to extracapsular fractures of the neck of the femur. This ensheathing callus, as it may be called, is an outgrowth from the inferior fragment, and it sometimes incloses the upper fragment as the case of a watch incloses the crystal, only in a manner much more irregular, thus retaining it steadily in its place, although very little direct union has occurred. The cancellous tissue, nevertheless, is occasionally found united completely by a new and intermediate bony tissue, and at other times by a fibrous tissue, or by both fibrous and bony tissue.

In some cases a perfect false joint has been formed between the opposing surfaces; while in a few unfortunate examples the head not only refuses to unite, but by its presence, as we have already remarked, produces inflammation and suppuration, resulting in its final extrusion from the joint.

At other times the upper fragment turns upon its own axis, and is found more or less tilted or completely rotated in the socket; so that its cartilaginous or articulating surface rests upon the broken surface of the lower fragment, and its own broken surface presents toward the glenoid cavity.

Robert Smith has described a specimen of this kind which he removed from the body of a woman, aged forty, who many years previous to her death fell down a flight of stairs, and struck her shoulder with great violence against the edge of one of the steps. Whether she applied to a surgeon or not at the time of the accident, Mr. Smith was not able to

ascertain. After death the shoulder looked somewhat as if there was a dislocation of the humerus into the axilla, there being a marked depression under the acromion process, but the shaft of the humerus was drawn upwards and inwards toward the coracoid process.

When the capsular ligament was opened, the head of the bone was found to have been broken from the shaft through the line of the anatomical neck, and to have completely turned upon itself; and the cartilaginous surface was actually driven one inch into the cancellated structure of the shaft, so as to split off the lesser tubercle with a portion of the greater. Only one-half of the upper fragment was thus impacted, the other half projecting beyond the margin of the lower fragment. Between the cartilaginous surface and the shaft no union had occurred; but there was complete bony union between the upper and lower fragments, beyond the limits of the cartilage.

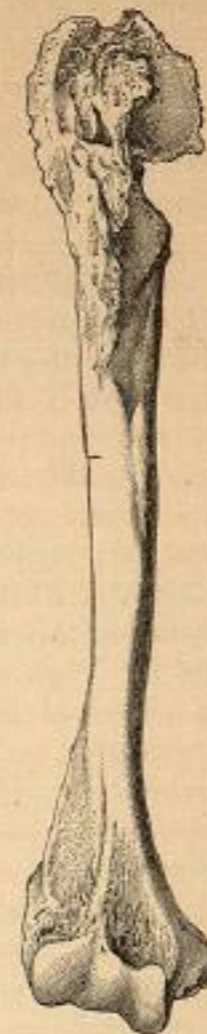
The upper surface of the superior fragment rested in part against the inner half of the glenoid cavity and upon its inner margin, and in part it rested against the neck of the scapula in the direction of the coracoid process.<sup>1</sup>

Nélaton saw a similar specimen in the possession of M. Dubled, the revolution of the upper fragment being complete; but there was no lateral displacement, and the union had been accomplished in a manner similar to that which is seen after intracapsular, impacted fractures, without reversion.<sup>2</sup>

I have also been permitted to examine a specimen belonging to the late Dr. Charles H. Pope, of St. Louis, Mo., which seems to have been broken not only through the line of the anatomical neck, but also through the surgical neck. Both fragments are united by bone, the lower fragment being carried in the direction of the coracoid process, while the upper fragment appears to be reversed, so that its articular surface is directed toward the shaft, and its broken surface articulates with the glenoid cavity. The history of this specimen is unknown.

Reverting to the histories of the several cases above referred to, in

FIG. 66.



Front view.

FIG. 67.



Side view.

Dr. Pope's Specimen.

<sup>1</sup> R. Smith, op. cit., pp. 193-6.

<sup>2</sup> Nélaton, *Eléments de Pathol. Chirur.*, tom. prem., p. 307.

which these extraordinary changes of position have taken place, it would seem to admit of a doubt whether they were the direct results of the accidents which broke the bones, or whether they ensued indirectly, in consequence of a chronic arthritis following the accident, and the constant but long-continued use of the arm, and muscular contraction.

There is another theory which, in my opinion, is capable of explaining most of the phenomena presented in some or all of those cases in which union of the fragments is claimed to have taken place, and which, if admitted, renders the supposition of a fracture unnecessary. It is, that in consequence of an injury, perhaps, but not of a fracture, chronic inflammation, softening and absorption have taken place, and that the changed position of the head is due to pressure alone, being acted upon by the muscles which surround the joint, and which act all the more vigorously because they partake also of the inflammation which has invaded the bone. This theory, which had already more than once suggested itself to me, was very strongly confirmed by its having occupied the mind also of Dr. Neill, of Philadelphia, and who at his own instance stated to me that he believed this was their true explanation. We were, at the time, examining Dr. Pope's specimen, already alluded to, and on comparing it with a specimen of dislocation and partial absorption of the head of the humerus contained in Dr. Neill's museum, the points of resemblance were so numerous and striking that we felt compelled to doubt whether Dr. Pope's specimen, together with those seen by Smith and Nélaton, did not belong to the same class with this of Neill's. Other writers have reported similar cases.

I do not mean to deny the possibility of bony union under these circumstances, but only to suggest that such an occurrence would seem to be very improbable, and that its actual occurrence does not seem at present to be absolutely proved. If union by bone is improbable when the head of the femur is broken within the capsule, how much more improbable must it be when the head of the humerus is thus broken; in which latter case there is not even the poor supply of nutrition furnished to the head of the femur by the round ligament.

In a case of fracture of the "cervix humeri within the capsular ligament," examined by Sir Astley Cooper, there was also a complete forward luxation of the head; but ligamentous union had occurred between the fragments.<sup>1</sup>

### § 2. Fractures through the Tubercles. (Extracapsular; Non-impacted and Impacted.)

Under this division we intend to speak of all fractures traversing the upper end of the humerus, and involving the tubercles; or of all those which occur between the anatomical neck on the one hand, and the epiphyseal junction, or surgical neck, on the other hand, and which may be more or less oblique as well as transverse. Fractures of the greater or lesser tubercles are of course excepted, since they are more properly longitudinal fractures, and do not completely traverse the diameter of the bone. Nor do we intend to include those fractures which occur at the

<sup>1</sup> Sir A. Cooper on Dislocations, etc., p. 372.

epiphyseal junction; since, being below the principal insertion of those muscles which are attached to the tubercles, they present very peculiar and distinctive features, which will demand for them a separate classification and consideration.

*Causes, Pathology, and Results.*—Fractures through the tubercles, like fractures through the anatomical neck, are the results generally of direct blows received upon the shoulder. They are not usually accompanied with much lateral displacement at the point of fracture; a circumstance which finds a partial explanation in the fact that the line of fracture is through the insertions of the muscles converging upon the tubercles, and not entirely above or below them, so that they continue to act nearly equally upon both fragments; but it is also sometimes due in a measure to impaction; the head being forced downwards toward the axilla, and upon the shaft, until it is made to ride upon its inner or axillary wall like a cap; the compact bony tissue of the shaft penetrating the reticular structure of the head. These fractures generally unite by bone; yet more or less impairment of the motions of the limb results from the inflammation which occurs in and about the joint, or from the irregular deposits of callus in the vicinity of the fracture.

### § 3. Longitudinal Fractures of the Head and Neck; or Splitting off of the Greater Tubercle.

*Causes, Pathology, Symptoms, and Results.*—Mr. Guthrie seems to have been the first to call attention to this peculiar injury of the shoulder. In a lecture delivered in November, 1833, he described four cases which had come under his observation, and which he regarded as examples of separation of the small tuberosity, accompanied with more or less of the head, the fracture extending along a portion of the bicipital groove.<sup>1</sup>

Robert Smith, however, believes that it was the greater and not the lesser tuberosity which was thus detached in the cases mentioned by Mr. Guthrie, since the external signs were so nearly like those which were present in a woman seen by himself, and in whom an autopsy enabled him to verify his diagnosis. The following is the case as related by Mr. Smith:

"In July, 1844, I was requested to examine the body of Julia Darby, æt. 80, who had died of chronic pulmonary disease. Upon entering the room, the appearances of the left shoulder-joint at once attracted my attention, and struck me as being different from those which attend the more common injuries of this articulation.

"The shoulder had lost, to a certain extent, its natural rounded form; the acromion process, although unusually prominent, did not project as much as in cases of dislocation of the head of the humerus. The breadth of the articulation was greatly increased, and, upon pressing beneath the acromion, an osseous tumor could be distinctly felt, occupying the greater part of the glenoid cavity; it formed a prominence which was perceptible through the soft parts; it moved along with the shaft of the humerus, but was manifestly not the head of the bone.

<sup>1</sup> Robert Smith, p. 181, from Lond. Med. and Phys. Journal.

"A second and larger tumor, presenting the rounded form of the head of the humerus, lay beneath the base of, and internal to, the coracoid process, and between the two the finger could be sunk into a deep sulcus, placed immediately below the coracoid process. The elbow could be brought into contact with the side, and there was no appreciable alteration in the length of the arm.

"Upon removing the soft parts, the head of the bone presented itself, lying partly beneath and partly internal to the coracoid process. The greater tuberosity, together with a very small portion of the outer part of the head of the bone, had been completely separated from the shaft of the humerus. This portion of the bone occupied the glenoid cavity, the head of the humerus having been drawn inwards so as to project upon the inner side of the coracoid process; it was still, however, contained within the capsular ligament.

"The fracture traversed the upper part of the bicipital groove, which, in consequence of the displacement which the head of the bone had suffered, was situated exactly below the summit of the coracoid process. A new and shallow socket had been formed upon the costal surface of the neck of the scapula, below the root of the coracoid process, and the inner edge of the glenoid cavity corresponded to the posterior part of the sulcus, which separated the head of the bone from the detached tuberosity. The latter was united to the shaft only by ligament.

"The capsule had not been injured, but was thickened and enlarged, and the bone had been deposited in its tissue. The injury had evidently occurred many years before the death of the patient, but the history connected with it could not be precisely ascertained."

Mr. Smith relates one other case, in the living subject, which he saw in connection with Mr. Adams, at the Richmond Hospital, and he adds that "numerous" other living examples have fallen under his observation.

Sir Astley Cooper has also published the particulars of a case of fracture of the greater tubercle, which was communicated to him by Mr. Herbert Mayo.<sup>2</sup>

The following I believe also to have been an example of this rare accident:

John Hill, æt. 78, fell upon the sidewalk, striking upon his right shoulder. The physician to whom he was sent thought the humerus was dislocated, and directed him to the Buffalo Hospital of the Sisters of Charity, but he did not apply for admission until eight days after, Oct. 14, 1857, when Dr. Boardman and myself examined the limb carefully.

Although we placed him under the influence of chloroform, the diagnosis was not satisfactorily made out. We inclined, however, to the opinion that it was a fracture of the greater tubercle. The antero-posterior diameter of the upper end of the bone was greatly increased; there was occasional distinct crepitus, but the limb was not shortened.

<sup>1</sup> Robert Smith, *op. cit.*, p. 178.

<sup>2</sup> Sir A. Cooper, on Dislocations and Fractures of the Joints. Edited by B. Cooper. American edition, p. 384.

Subsequently, the examinations were repeated many times, and the depression between the fragments becoming more palpable, the diagnosis was at length confirmed.

No treatment was adopted, except confinement in bed, and stimulating embrocations. Two months after the accident he still remained an inmate of the hospital, his shoulder being quite stiff, and the projection continuing in front.

Dr. J. J. Charles, demonstrator of anatomy, Queen's College, Belfast, has reported a case with great care, which he believes to have been an example of this rare accident, and in which opinion I am disposed to concur. The man was 30 years old, and it is supposed that the middle of the head of the humerus was struck by the pole of a tram-car. Dr. Charles examined the patient fourteen months after the receipt of the injury; the breadth of the head of the humerus was greatly increased, there was a broad sulcus in the situation of the bicipital groove, and the humerus was shortened half an inch. The motions of his arm were very much limited, especially in abduction.<sup>1</sup>

Mr. Robert Smith thinks that when the displacement is considerable, the fragments generally unite by ligament, rather than by bone.

#### § 4. Fractures through the Surgical Neck. (Including Separations at the Upper Epiphysis.)

I have already defined the "surgical neck" as all of that narrow portion commencing at the upper epiphysis and terminating at the insertion of the pectoralis major and latissimus dorsi. It seems proper, therefore, that we should include under this division both fractures and separations occurring at the epiphysis, especially since, owing to their anatomical relations, they are subject to the same displacements as fractures occurring half an inch or one inch lower down; the capsular muscles, with the exception of the teres minor, having no more influence over the lower fragment when a separation occurs at the epiphysis, than when a separation occurs at any other point of the surgical neck.

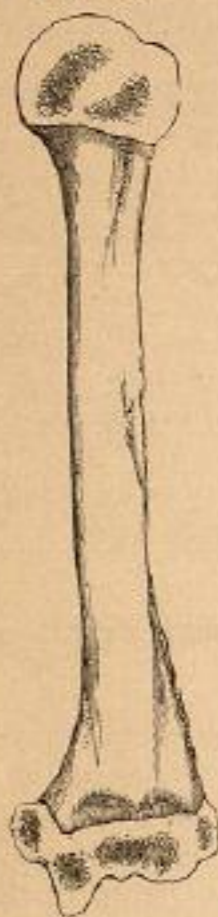
*Separation at the Upper Epiphysis.*—A brief description of the plan of development of the humerus will enable the reader better to understand the occasional separation of the epiphysis, both at the upper and lower ends of the bone.

The humerus is originally formed from seven cartilaginous centres, namely, one for the shaft, one for the head, one for the greater tuberosity, one for each epicondyle, and two for the lower, articulating end of the bone. At birth the shaft is ossified in nearly its whole length. Between the first and fourth years ossification commences in the several centres composing the upper end of the bone, and they coalesce by the end of the fifth year, so as to form a single epiphysis, which finally unites with the shaft at about the twentieth year. At the lower end of the bone, ossification commences in the radial portion of the articular surface at the end of two years, in the trochlear portion at twelve years, in the internal epicondyle at the fifth year, and in the external epicondyle at

<sup>1</sup> J. J. Charles, *British Med. Journ.*, Sept. 26, 1874.

the thirteenth or fourteenth. At the sixteenth or seventeenth year all the centres are joined to each other, and to the shaft, except the inner epicondyle, which does not unite by bone until about the eighteenth year. It will be observed, therefore, that although ossification commences in the upper epiphysis first, it is the last to form bony union with the shaft.

FIG. 68.



Humerus, with epiphyses.  
(From Gray.)

The following is a brief account of all the cases of separation at the upper epiphysis which have come under my notice:

**CASE 1.**—In 1855, Mike Bovin, *æt.* 13 months, fell sideways from his cradle, causing some injury to his arm near the shoulder. He was taken to an empiric, who called it a sprain, and applied liniments. Three weeks after the accident he was brought to me, and I found the arm hanging beside the body, with little or no power on the part of the child to move it. There was a slight depression below the acromion process, and considerable tenderness about the joint; but the shoulder was not swollen, nor had it been at any time. The line of the axis of the bone, as it hung by the side, was directed a little in front of the socket.

On moving the elbow backwards and forwards, the upper end of the shaft moved in the opposite directions with great freedom, and could be distinctly felt under the skin and muscles. This motion was accompanied with a slight sound, or sensation, a sensation not unlike the grating of broken bone, but much less rough. There was no shortening of the limb. When the elbow was carried a

little forwards upon the chest, the fragments seemed to be restored to complete coaptation; and of this I judged by the restoration of the line of the axis of the shaft to the centre of the socket, and by the complete disappearance of the depression under the point of the acromion process.

I applied suitable dressings to retain the arm in this position; but five months after the injury was received the fragments had not united, and the child was still unable to lift the arm, although the forearm and hand retained their usual strength and freedom of motion. The same crepitus could occasionally be felt in the shoulder, and the same preternatural mobility. The shoulder was at this time neither swollen nor tender.

**CASE 2.**—Samuel Robuck, *æt.* 13, fell through a hatchway, July 9, 1868, striking on his shoulder. He saw a regular physician within five hours after the injury was received, who said that the arm was dislocated; and on the following day, under the influence of chloroform, he tried to reduce it. The doctor thought he had succeeded, and he then applied bandages to keep it in place. At the end of two weeks the doctor declined, for reasons which are not known, to have any further care of the case, and the patient consulted Dr. Voss, at the Dispensary. Dr. Voss detected the nature of the case, and sent him to me to confirm his

diagnosis. I found the upper end of the lower fragment projecting in front, and not united. The arm was shortened half an inch. I have not seen the patient since, and do not know the result.

**CASE 3.**—Joseph Snellback, *æt.* 16, fell backwards down a flight of steps, striking upon his back and arm near the shoulder, May 10, 1868, causing a separation of the upper epiphysis of the left humerus. Dr. —, of this city, now deceased, saw the patient within half an hour, and supposing that he had suffered a dislocation of the head of the humerus, he attempted to effect reduction with his heel in the axilla, and without anaesthetics. On the following day I found him in Ward 16 at Bellevue. The house-surgeons were divided in opinion as to its character, some at first believing it to be a dislocation; others, with myself, recognized it to be an epiphyseal separation.

All efforts at replacement proving ineffectual, splints were applied by my direction, and on the 15th of July the patient left the hospital with the fragments united, but overlapped at the point of fracture, the upper end of the lower fragment being in front of the upper fragment. The limb was shortened one inch, but its motions were free, and there was no reason to suppose that its utility was in any degree impaired.

**CASE 4.**—C. H., *æt.* 19, living in a neighboring town, in the delirium caused by fever, fell from a third-story window, May 12, 1868. Two very intelligent and experienced physicians, who were called, thought the boy had received a fracture of the acromion process, accompanied with a dislocation of the head of the humerus, and they attempted to reduce it, but without success.

On the 2d of June following, three weeks after the receipt of the injury, I saw the patient in consultation with his physicians, and found a separation of the upper epiphysis of the humerus. The upper end of the lower fragment projected in front of the acromion process, appearing a little above the level of the process, and covered only by the skin. No union had occurred between the two fragments.

**CASE 5.**—John Davis, *æt.* 18, fell about eight feet, September 2, 1873. Of the three surgeons first called, Drs. H. and S. thought the boy had received a fracture; the third believed it to be a dislocation, and having placed the patient under the influence of ether, attempts were made to reduce it. The deformity not being relieved, I was added to the consultation. I found the shoulder a good deal swollen. The upper end of the lower fragment could be felt distinctly in front of the acromion process. At first, the surgeons informed me, the broken end seemed just under the skin and almost ready to be thrust through, but the extension had made it retire somewhat. The end felt rough and serrated. While making extension I was able to detect a slight crepitus or click. Employing Dugas's test, I found the elbow would rest upon the front of the chest. In short, the diagnosis was complete, and Dr. S., having taken charge of the case, applied one long splint, and a sling under the wrist, but not under the elbow. The fragments have united with very little deformity.<sup>1</sup>

This case was subsequently seen by Dr. Moore at one of my Bellevue clinics, by whom my diagnosis was fully confirmed.

<sup>1</sup> The Medical Record, May 1, 1874.

CASE 6.—In Nov. 1876, I found in my service, at Bellevue, Wm. Hague, æt. 19, who, from a fall on the sidewalk, had broken the humerus at its upper epiphysis. He says, Dr. Erskine Mason reduced the fracture on the third day, and secured the limb with splints. He subsequently tried to reduce it by Moore's method under ether, but was unsuccessful. The displacement was complete, and the entire upper end of the lower fragment could be distinctly felt.

Robert Smith and Sir Astley Cooper both speak of it as a frequent accident in early life, but the recorded cases are very few. The case mentioned by Mr. Smith has been given very much at length, and, as a characteristic example, deserves to be repeated:

"During the early part of last year, a boy, eight years of age, was admitted to the Richmond Hospital, under the care of Dr. McDowell. About a week previous to his admission he had fallen upon the shoulder, and at once lost the power of using his arm.

"It was at first sight evident that there did not exist any luxation of the head of the humerus, and it was equally obvious that the case was not an example of any of the ordinary fractures to which the neck of the bone is liable. There was no diminution of the natural rotundity of the shoulder, nor any unusual prominence of the acromion process; the head of the bone could be distinctly felt in the glenoid cavity, and it remained motionless when the arm was rotated; there was very little separation of the elbow from the side, but it was directed slightly backwards.

"About three-quarters of an inch below the coracoid process there existed a remarkable and abrupt projection, manifestly formed by the upper extremity of the shaft of the humerus, every motion imparted to which it followed. Its superior surface, which could be distinctly felt, was slightly convex, and its margin had nothing of the sharpness which the edge of a recently broken bone presents in ordinary fractures.

"When this projecting portion of the bone was pushed outwards, so as to bring it in contact with the under surface of the head of the humerus (previously fixed as far as it was possible to do so), a crepitus was reduced by rotating the shaft of the bone. It did not, however, resemble the ordinary crepitus of fracture, but it would be extremely difficult, by any description, to convey a clear idea of what the difference consisted in.

"From a careful consideration of the symptoms and appearances above mentioned (taking into account also the age of the patient), the diagnosis was formed, that the injury consisted in a separation of the superior epiphysis of the humerus from the shaft of the bone. Various mechanical contrivances were employed in this case, but all proved ineffectual in maintaining the fragments in their proper relative position."<sup>1</sup>

Sir Astley Cooper has also briefly described one example, which occurred in a child ten years of age.<sup>2</sup>

According to Malgaigne,<sup>3</sup> Bertrandi found this condition in a child born dead, and Durocher reported a case, in which it was produced at birth by a midwife, who had hooked her finger into the armpit to expedite the delivery.

<sup>1</sup> Robert Smith, *op. cit.*, p. 201.

<sup>2</sup> Sir A. Cooper, *op. cit.*, p. 382.

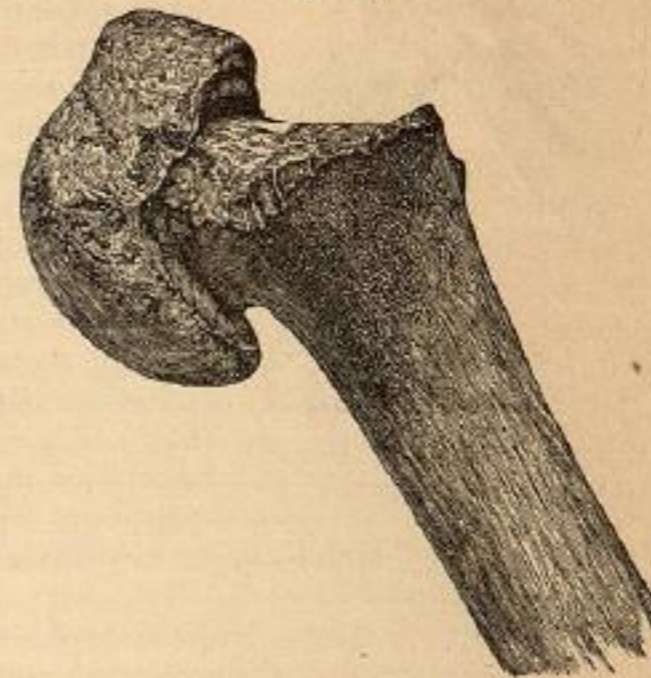
<sup>3</sup> Bertrandi, Durocher, Malgaigne, *op. cit.*, t. i. p. 69.

Prof. E. M. Moore, of Rochester, in a paper read before the American Medical Association, in 1874, and published in the Transactions for that year, has called attention to what he considers the true condition of the separated fragments in most of these cases, and to the proper remedy. He observes that the displacement is not usually complete; but that the upper end of the lower fragment is carried inwards to the distance of about one-fourth of its diameter, when it is arrested, by a convexity of the lower fragment becoming lodged in a natural concavity in the upper fragment. The upper fragment now becomes tilted by the action of the muscles, its internal margin ascending in the glenoid cavity, and its outer margin descending until it is arrested by the capsule.

FIG. 69.



FIG. 70.



Upper epiphysis of humerus. (From Moore.) Epiphyseal separation. (From Moore.)

If, under these circumstances, the arm is carried forwards and upwards to the perpendicular line, the upper fragment or epiphysis will remain fixed, being held fast by the capsule inserted into the outer and posterior margin of the head, while the lower fragment or diaphysis, aided by the natural action of the muscles, will move outwards and resume its original position.

The correctness of this opinion he has verified by having in this manner effected the reduction with great ease, in three cases which have come under his observation. The patients were respectively six, fourteen, and sixteen years of age.

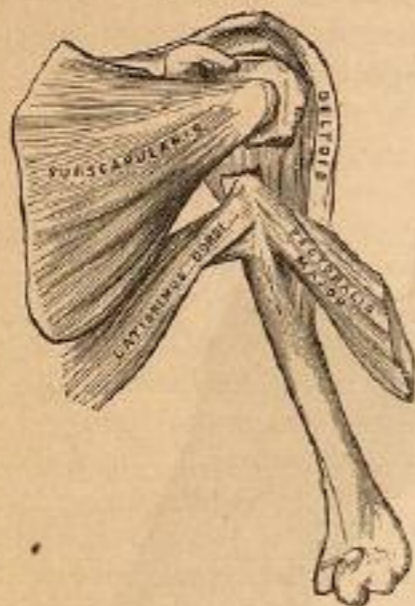
In the first case the reduction was effected on the fourteenth day; in the second case, on the second day; and in the third, on the seventeenth day. In both of the latter, ineffectual attempts had been already made to reduce what was supposed to be a dislocation.

In order to maintain the reduction, it was only found necessary to bring the arm down while in a state of moderate extension, and to secure it beside the body with a Swinburne extension splint. Any of the forms

of dressing applicable to a fracture of the surgical neck would probably prove equally efficient.

The observations made by Professor Moore seem to me exceedingly valuable; yet I do not think it always happens that the separation is incomplete, nor does Professor Moore say that it is, but that was the condition in all the cases seen by him. Prof. Pooley, of Columbus, Ohio, reports a case occurring in a boy twelve years old, which he was

FIG. 71.



Fracture of the surgical neck of the humerus. (From Gray.)

unable to reduce by Moore's method.<sup>1</sup> Dr. Richmond reports another example in a young man nineteen years old successfully reduced by this method.<sup>2</sup>

In Cases 4, 5, and 6, reported by myself, the upper end of the lower fragment was above the level of the coracoid process, and seemed to be directly beneath the skin. These were probably examples of complete separation; but the remaining three presented the symptoms described as characteristic of the partial separation in Professor Moore's paper; the projection was less marked, and on a level with the coracoid process, or a little below it.

In all my cases, except the first, the upper end of the lower fragment could be felt, not sharp or pointed, as in most examples of fracture of the surgical neck, but somewhat irregularly transverse, and when covered with the skin and muscle, might be easily mistaken, by the inexperienced, for the head of the bone.

*True Fracture at the Surgical Neck.*—It seems necessary, in order to a full understanding of the varying aspects under which this accident occurs, and in order to the establishment of the diagnosis, prognosis, and treatment, to relate a few illustrative examples.

*CASE 1. Simple fracture, never displaced; union without deformity.*—Alex. Balentine, *æt.* 62; admitted to the Buffalo Hospital of the Sisters of Charity, Dec. 19, 1851. He had fallen upon the sidewalk, striking upon his right arm. Dr. Johnson, of Buffalo, had reduced the fracture, and applied appropriate dressings. No union of the fragments had yet occurred; but as the surfaces were in apposition, it was only after considerable manipulation, and not until we bent the forearm upon the arm, and rotated the humerus by means of the forearm, that the crepitus became distinct, and gave unequivocal evidence of the existence of a fracture, and of its situation.

The treatment, after admission, consisted in the application of one gutta-percha splint, accurately moulded, and extending from above the shoulder to below the elbow, and encircling one-half the circumference of the arm; the splint being secured with the usual bandages, etc.

The result is a perfect limb.

<sup>1</sup> Pooley, *New York Journ. Med.*, February, 1875, p. 139.

<sup>2</sup> Richmond, *New York Med. Journ.*, Nov. 1877.

*CASE 2. Simple fracture; union, with displacement and deformity.*—White, of Buffalo, *æt.* 12, fell fourteen feet, striking on the front and outside of the left shoulder. Dr. P., of Erie County, saw the lad within three hours (July 19, 1853). He was brought to me on the fourth day after the accident. The upper part of the arm was then very much swollen. I found the arm dressed as for a fracture of the middle or lower third of the humerus. It was shortened one inch. The elbow was inclined backwards, and there was a remarkable projection in front of the joint, feeling like the head of the bone. The hand and arm were powerless. I suspected a dislocation of the head of the humerus forwards; and, having administered chloroform, I attempted its reduction with my heel in the axilla. Whilst making extension, I felt a sudden sensation like the slipping of the bone into the socket, but on examination I found the projection continued as before. I then repeated the effort, with precisely the same result.

I now applied an arm-sling, and directed leeches and cold evaporating lotions.

On the 25th, five days after the accident, it was examined by Drs. Mixer, McGregor, Joseph Smith, with myself. We still believed it was a dislocation, and, having administered chloroform, we again attempted its reduction. The same slipping sensation was produced as before, and the deformity was repeatedly made to disappear; but, on suspending the extension, it as often reappeared.

The character of the accident was now made apparent, and we proceeded at once to apply the splint and bandages suitable for a fracture of the surgical neck of the humerus, namely, a gutta-percha splint, extending, on the outside, from the top of the shoulder to below the elbow, with an arm and body roller secured with flower paste.

On the 31st, twelve days after the accident, Dr. Wilcox, Marine Surgeon at Buffalo, saw the arm with me. The fragments were displaced the same as when I first saw it, and the same as when no apparatus was applied. We examined it again carefully, and attempted to make the fragments remain in place, but we were unable to do so, except while holding them and making extension.

August 9 (twenty-first day). I removed all the dressings. Motion between the fragments had ceased, but the projection and shortening remained as before; now, also, the irregular projections of the fractured bones were more distinctly felt. The dressings were never reapplied. Three months later no change had occurred. He could carry the elbow forwards freely, as well as backwards, the motions of the shoulder-joint being unimpaired.

*CASE 3. Simple fracture, with displacement; resulting in deformity and non-union.*—L. B., of Lockport, *æt.* 43, was thrown from his horse in February, 1854, striking upon his right elbow.

Dr. Maxwell, an experienced surgeon of Lockport, examined and dressed the fracture. Dr. Fassett was present and assisted at a subsequent dressing. Three surgeons, who examined the arm before Dr. M., called it a dislocation.

Twelve weeks after the accident, Mr. B. called upon me. The right arm was shortened one inch; the elbow hung off slightly from the body;



the upper end of the lower fragment was distinctly felt in front of the shoulder-joint, under the clavicle, feeling very much like the head of the bone. The fragments were not united, but they could be seized easily, and made to move separately and freely. He stated to me that he was subject to rheumatism, and especially in the shoulder and arm of the side injured. He wished to know whether it could not be "reset."

Two years after, I found the bone still ununited. He was, however, able to write with that hand, having first lifted his arm with the other hand and laid it upon the table.

*CASE 4. Simple fracture, probably impacted; resulting in deformity.*—Wm. A., of Buffalo, æt. 15, fell backwards, June 4, 1855, striking on his back and left shoulder. Dr. L. saw the case immediately, and, regarding it as a dislocation, attempted its reduction. He subsequently repeated the attempt. I saw the patient with Dr. L. on the tenth day. The arm was shortened one inch and a half. The fragments were displaced forwards, projecting in front of and a little below the joint. As in Case 3, it might easily be mistaken for the head of the bone; but the difficulty of diagnosis had been very much lessened by the subsidence of the swelling. There was no motion between the fragments; nor could the deformity, by any manipulation or extension, be made to disappear. It was probably impacted.

March 23, 1856, nearly ten months after the accident, I found the fragments remaining as when I first examined the limb, and the arm shortened one inch and a half. The elbow hung a very little back from the line of the body. The upper end of the lower fragment was lifted to within one inch of the head of the humerus; the upper fragment having its head in the socket, with its lower end downwards and forwards. The arm was, however, in every respect as useful as before it was broken. It was equally strong, and he could raise his arm as high and move it in every direction as freely as he could the other.

*Causes.*—Epiphyseal separations belong almost exclusively to the periods of youth and childhood, but true fractures at the surgical neck occur most often in adult life; with the exception of one girl and two lads, aged, respectively, eleven, twelve, and fifteen years, all of the examples of this latter accident recorded by me (44) occurred in adults; yet Sir A. Cooper declares these fractures to be most common in infancy, while Malgaigne has never seen a case in a person under fifty-three years.

Both epiphyseal separations and fractures at this point are occasioned, in most cases, by direct blows or falls upon the shoulder. Of thirty-one examples in which I find the cause recorded, twenty-two were from direct blows, eight from indirect blows, and one from muscular action, as in throwing a ball. Of the eight resulting from indirect blows, one was from a fall upon the hand, seen by Desault, and seven were from falls upon the elbow, of which two were seen by Desault, and five by myself.

*Pathology.*—I have found the fragments sensibly displaced in twelve cases out of seventeen; a proportion much greater than has been observed by Malgaigne, who has only seen a displacement twice in more than twenty cases. It is certain, however, that complete or sensible

displacement is less common in this fracture than in most other fractures, the broken ends being retained in place, probably, by the long tendon of the biceps, and the long head of the triceps.

As to the direction of the displacement, I have generally found the upper end of the lower fragment drawn forwards and upwards toward the coracoid process; in one of which examples the upper fragment plainly followed in the same direction. Sir Astley Cooper declares that with infants this direction is constant, and in museum specimens I have seen but one exception. In the specimens of fracture of the surgical neck, with also displacement of the head, belonging to Dr. Pope, this direction of the fragments is plainly seen, as also in one of the specimens belonging to Dr. Neill, of the Pennsylvania Medical College, where the lower fragment almost reaches the coracoid process, and in a specimen contained in one of the cabinets of the University of Pennsylvania, where the upper end of the lower fragment has become united by bone to the coracoid process.

The only exception which I have met with is in the possession of Dr. Neill. In this example the two ends are tilted toward the axilla. I am compelled, therefore, to doubt the accuracy of Malgaigne's observations, who thinks he has seen the lower fragment most often drawn toward the axilla, as well as the observations of those who think that the upper fragment is generally displaced outwards; yet, no doubt, they do sometimes assume this position. Desault has seen them both thrown backwards; while Dupuytren, Paletta, and others have seen them pushed outwards; and I have in my collection the copy of a specimen in which both fragments are drawn outwards, but the lower fragment is to the inner side of the upper.

When the fracture occurs at or near the epiphysis, it is sometimes accompanied with impaction, of the same character as we have already described when speaking of fractures through the tubercles. Robert Smith has given, in his treatise, an engraving intended to illustrate the relative position of the fragments in extracapsular impacted fractures, and the line of separation very nearly corresponds to the line of junction of the epiphysis with the shaft.

But in a majority of cases no impaction occurs. Dr. Charles A. Pope, of St. Louis, Mo., has two specimens of this kind, in which no union has taken place, nor is there any evidence that impaction had ever occurred. In one case the line of fracture commences at the junction of the head with the shaft, and extends thence irregularly across to a point half an inch below the greater tuberosity. In the second specimen the fracture commences at the same point, and terminates three-quarters of an inch below the greater tuberosity. In relation to these bones, Dr. Pope remarks: "These are not cases of detachment of the epiphyses, as the bones are evidently those of adults, and there is, at their lower extremities above the condyles, no trace of an epiphyseal line."

*Results.*—Sixteen of the examples of fracture of the surgical neck recorded by me are known to have resulted in perfect limbs; that is to say, there is no displacement, overlapping, or shortening, and the patients have recovered the free use of the limbs. These were all, probably, examples in which no displacement ever occurred. Of the remainder,

all, so far as I have been able to determine, have united with some displacement; but in nearly all the functions of the limb have been fully or almost fully restored. The only exception I can recall is the single one in which no bony union ever took place (Case 3, Report on Def. after Frac.).

*Symptoms, or Differential Diagnosis of Accidents about the Shoulder-joint.*—No place could be more appropriate than this to call attention to the difficulty of diagnosis in the case of accidents about the shoulder-joint, a difficulty which surgeons have constantly recognized, and which has sometimes rendered diagnosis impossible.

Let us first study the ordinary signs of a dislocation at the shoulder-joint, regarding this as the type with which the other accidents are to be compared.

a. *Signs of a Dislocation.* (Cause, generally a fall upon the elbow or hand, yet not very unfrequently a direct blow.)

1. Preternatural immobility.
2. Absence of crepitus.
3. When the bone is brought to its place, it will usually remain without the employment of force.

These three are common signs, which apply to any other joint as well as to the shoulder.

4. Inability to place the hand upon the opposite shoulder, or to have it placed there by an assistant, while at the same time the elbow touches the breast. This is a sign common to all of the dislocations of the shoulder.<sup>1</sup>

The following are special signs, or such as belong only to particular dislocations of the shoulder.

5. Depression under the acromion process; always greatest underneath the outer extremity, but more or less in front or behind, according as the dislocation may be into the axilla, forwards or backwards.

6. Round, smooth head of the bone sometimes felt in its new situation, and very plainly removed from its socket; moving with the shaft. Absence of the head of the bone from the socket.

7. Elbow carried outwards, and in certain cases forwards or backwards, and not easily pressed to the side of the body.

8. Arm lengthened in the subcoracoid and subglenoid dislocations; and only shortened in the subclavicular and subspinous. Occasionally, in old cases, the head of the humerus, leaving the subglenoid position, becomes subscapular, being placed upon the centre of the scapula, and the arm is shortened.

b. *Signs of a Fracture of the Neck of the Scapula.* (Cause, generally a direct blow; exceedingly rare.)

1. Preternatural mobility.
2. Crepitus, generally detected by placing the finger on the coracoid process, and the opposite hand upon the back of the scapula, while the head of the humerus is pushed outwards and rotated.
3. When reduced, it will not remain in place.

<sup>1</sup> Report on a New Principle of Diagnosis in Dislocations of the Shoulder-joint, by L. A. Dugas, Prof. of Surgery in the Medical College of Georgia. Trans. Amer. Med. Assoc., vol. x. p. 175.

4. The hand may generally, but with difficulty, be placed upon the opposite shoulder, with the elbow resting upon the front of the chest.

5. Depression under the acromion process, but not so marked as in dislocation.

6. Head of the bone may be felt in the axilla, but less distinctly than in dislocation. Never much forwards or backwards. Head of the bone moves with the shaft. Head of the bone not to be felt under the acromion process, although it has not left its socket.

7. Elbow carried a little outwards, but not so much as in dislocation. Easily brought against the side of the body.

8. Arm lengthened.

9. The coracoid process carried a little toward the sternum, and downwards.

10. Pressing upon the coracoid process, it is found to be movable, and it is also observed that it obeys the motions of the arm.

c. *Signs of a Fracture of the Lower or Anterior Lip of the Glenoid Cavity.* Not yet fully determined.

d. *Signs of Fracture of the Anatomical Neck of the Humerus. Intracapsular.* (Cause, a direct blow; generally opening to the joint, but not always.)

1. Mobility not increased, nor diminished.
2. Crepitus, generally discovered by pressing up the head of the bone into its socket and rotating; or, when the tubercles are also broken, by grasping the tubercles and rotating the arm.
3. Fragments not generally displaced.
4. The hand can be placed easily upon the opposite shoulder, with the elbow against the front of the chest.
5. Very slight, if any, depression under the acromion process.
6. Head of the bone generally in its socket, but not felt so distinctly as before the fracture.
7. Elbow falls easily against the side of the body, or is easily placed there.
8. Arm not lengthened, nor appreciably shortened, unless the head be driven so much into the body as to separate the tubercles.
9. In this latter case there are present also the signs of fracture of the tubercles.

e. *Signs of Fracture of the Humerus through the Tubercles. Extracapsular.* (Cause, direct blows.)

The signs which characterize this accident are more obscure than in either of the other shoulder accidents. They are mostly negative, and will not generally be determined positively except in the autopsy.

1. Generally, there is neither marked mobility nor immobility, except what immobility may be due to a contraction of the muscles.
2. Crepitus, discovered, but not so easily as in intracapsular fractures, by rotating the arm while the tubercles are grasped firmly.
3. If displacement exists, the fragments are not always easily kept in place when once reduced.
4. The hand can be placed upon the opposite shoulder, with the elbow against the front of the chest.
5. No depression under the acromion process.

6. Head of the bone in its socket, and moving with the shaft, when, as is usually the case, it is impacted.

7. Elbow hangs against the side of the body.

8. Arm shortened when impacted, but not much.

f. *Signs of a Longitudinal Fracture of the Head and Neck, or splitting off of the Greater Tubercle.* (Cause, direct blow upon the front of the shoulder.)

1. Mobility of the limb natural.

2. Crepitus; elicited especially by grasping the tubercles and rotating the arm, or by carrying it up and back and then rotating.

3. When reduced, the fragments will not remain in place.

4. The hand can be placed upon the opposite shoulder, while the elbow rests against the front of the chest.

5. Some depression under the acromion process.

6. A smooth bony projection directly underneath the coracoid process, or close upon its inner or outer side, moving with the shaft. The head of the bone cannot be felt in the socket, yet the space under the acromion is not entirely unoccupied.

7. Generally, but not always, the elbow hangs against the side. Sometimes it inclines a little backwards. It can always be easily brought to the side.

8. Arm generally neither lengthened nor shortened.

9. A remarkable increase in the antero-posterior diameter of the upper end of the bone.

10. A deep vertical sulcus between the tubercles, corresponding with the upper part of the bicipital groove.

g. *Signs of a Fracture through the Surgical Neck.* (Cause, generally direct blows, but in old people frequently caused by a fall upon the elbow.)

1. Preternatural mobility often, but not constantly, present.

2. Crepitus, produced easily when there is no impaction, or when the displacement is not complete, but with difficulty when impaction exists or the displacement is complete.

3. When once the fragments have been displaced, it is exceedingly difficult ever afterward to maintain them in place.

4. The hand can be easily placed upon the opposite shoulder, while the elbow rests against the front of the chest.

5. A slight depression below the acromion, not immediately underneath its extremity, but an inch or more below.

6. Head of the bone in the socket, and moving with the shaft when impacted, but not moving with the shaft when not impacted. The upper end of the lower fragment being often felt distinctly pressing upwards toward the coracoid process; its broken extremity being easily distinguished by its irregularity from the head of the bone.

7. Elbow hanging against the side when the fragments are not displaced, but away from the side when displacement exists.

8. Length of arm unchanged unless the fragments are impacted or overlapped; or both fragments are much tilted inwards. If the fragments are completely displaced, the arm is shortened.

h. *Signs of a Separation of the Epiphysis.* (Cause, direct blows.)

1. Preternatural mobility.

2. Feeble crepitus; less rough than the crepitus produced when broken bones are rubbed against each other.

3. Fragments replaced are not easily maintained in place, unless the reduction has been effected by Moore's method.

4. Same as in preceding variety of fracture.

5. The depression is not immediately under the acromion, yet higher than in most fractures of the surgical neck, perhaps one inch below the acromion process.

6. Head of the bone in its socket, and not moving with the shaft. Upper end of lower fragment projecting in front, when displacement exists, and feeling less sharp and angular than in case of a broken bone; indeed, being slightly convex and rather smooth, it may easily be mistaken for the head of the bone.

7. Same as preceding variety.

8. Length of arm not changed unless the fragments are overlapped, or both fragments are tilted upon each other. When the fragments are overlapped, the arm is shortened.

9. This accident is peculiar to the young. It can seldom occur after the twentieth year.

There are other accidents about the shoulder-joint, such as a pathological partial luxation of the humerus, dislocation of the tendon of the biceps, etc., which might possibly be confounded with fractures, but the consideration of which I shall reserve for another time.

My readers will here permit me to quote at length a portion of a clinical lecture delivered by myself at Bellevue Hospital, in 1875, calling attention to two new differential signs:<sup>1</sup>

"Examples of errors of diagnosis in the case of injuries involving the shoulder-joint are very frequent. My personal experience furnishes me with probably forty or fifty cases in which the head of the humerus has been supposed to be dislocated when it was not; or in which it has been supposed to be broken when it was not. For this reason it is important that we be informed of every known means of diagnosis; and to those which are already known and published I will now add two more, of which we will be able pretty often to avail ourselves.

"When the head of the humerus is in its socket it projects outwards, beyond the extremity of the acromion process, from half an inch to an inch; varying more or less according to the age and size of the person. It projects also in front of the acromion process a little, but not at all behind.

"In case of a dislocation, in whatever direction the head of the humerus is displaced, there can be no bony projection outwards beyond the acromion process. This fact may be ascertained always, unless there is very great swelling of the soft parts over the point of the shoulder; but it will be necessary that we should be familiar with the natural outline of the acromion process, and this is a study which medical men too much neglect, namely, the study of the natural form of the surface of the body, or what I call 'Superficial Anatomy.' We must learn to

<sup>1</sup> Two New Differential Signs of Dislocation of the Shoulder. Clinical Lecture by the author at Bellevue Hospital. Med. Record, March 27, 1875, p. 220.

know where is the outer end of the clavicle, where is the outer end of the acromion process, and where is the coracoid process, if we expect to determine the existence or absence of a dislocation of the shoulder. This exercise you can pursue in your bedrooms, on your own persons or on the persons of others. With a camel's-hair pencil, moistened with the tincture of iodine, you can mark out upon the skin the line of the clavicle, acromion process, spine of the scapula, etc. In attempting this for the first time you will probably find that there is much to learn that you did not know before, however thoroughly you have studied the anatomy of the shoulder in the dissecting-room, when the skin is removed. The same applies to all the other joints of the body; and now you will understand why some men, perhaps wholly ignorant of anatomy as it is usually taught, but familiar by long practice with superficial anatomy, will recognize in a moment the nature of a joint injury, which you may fail after a very careful examination to detect.

"Let us return to the consideration of the two special signs of shoulder-joint dislocation (liable to only one exception, as I shall hereafter explain), which I wish to add to those already given by surgical writers.

"*First.* While the head of the humerus remains in its socket, if a rule be laid upon the outside of the arm from the shoulder to the elbow, it will not touch the acromion process, but will be distant from it at least half an inch, generally one inch or more. On the other hand, if the bone is removed from the socket, in whatever direction it may be displaced, whether forwards, downwards, or backwards, unless the shoulder is much swollen, the rule, placed in the manner above stated, will touch the acromion process.

"*Second.* If, standing behind the patient (in case of the right shoulder), the thumb and forefinger of the left hand are made to grasp the top of the shoulder in such a manner that the interdigital commissure shall rest upon the acromion process, just outside of the acromio-clavicular articulation; and if then the finger and thumb are dropped perpendicularly, the tip of the finger will (in case the head of the humerus is not dislocated) rest upon the centre of the round upper extremity of the humerus, as it projects in front of the acromion process, while the end of the thumb will rest upon the head of the humerus behind; but the head will be felt indistinctly by the thumb, for the reason that instead of projecting as it does in front, it actually recedes a little beneath the acromion process. Up to this moment the surgeon may entertain some doubt whether he is actually grasping with his thumb and finger the head of the bone; but if he now moves the elbow of the injured limb forwards, so as to carry the head of the humerus backwards in its socket, he will feel it press strongly upon the thumb, and this will be conclusive. If a dislocation exists, the head of the bone cannot be felt in this situation, and by the thumb thus placed.

"As we have said before, both of these differential signs, in their application to shoulder-joint injuries, are liable to one exception. The phenomena would be the same, so far as these two signs are concerned, whether there was a dislocation of the head of the humerus, or a fracture with displacement of the neck of the scapula. The latter accident must, therefore, be first excluded by a careful application of the rules of

diagnosis given in our treatises upon surgery; but that upon which you can most safely rely is the relative infrequency of the two accidents. It is doubtful whether a long and active surgical practice will ever furnish you with an example of fracture of the neck of the scapula, while you will meet with a great many cases of dislocation of the shoulder."

*Treatment.*—I have already spoken of the treatment of fractures of the neck of the scapula, and my remarks will now be confined to fractures of the upper end of the humerus.

*Fractures of the Anatomical Neck; Intracapsular.*—As has already been stated, these are generally compound fractures, and, from the extent of the injury, often demand resection, or amputation of the entire arm. If an effort is made to save the arm, splints will not be applied, and the treatment will have little or no reference to the existence of a fracture; it will be directed only to the reduction or prevention of the inflammation, etc.

Simple fracture of the anatomical neck, if not entirely within the capsule, without any external wound communicating with the joint, and accompanied, as it is sometimes, with impaction, may unite, or the upper fragment may become incased in the lower.

It is not proper in such cases to employ great violence for the purpose of detecting crepitus, lest the fragments should become displaced; and if the arm should be found to be a little shortened, it must not be extended, with a view to overcoming the shortening, since upon the impaction probably depend, in a great measure, the chances of union.

The elbow and forearm may be suspended in a sling, while the arm is gently supported against the side, merely to insure quietude. No splints are necessary or useful.

*Treatment of Fractures through the Tubercles (Extracapsular); Non-impacted and Impacted.*—In these cases, also, the fragments being seldom displaced, very little, if any, mechanical treatment is demanded. A sling is all that is usually required. If, however, on account of displacement of the fragment, a splint is thought necessary, it must be applied in the manner hereafter to be directed in cases of fractures of the surgical neck.

If impaction, with shortening, exists, the same remarks are applicable here as in intracapsular impacted fractures, namely, that we ought not to rotate the limb much, nor violently, in order to discover crepitus, nor make extension with the view of overcoming the shortening, since the fragments unite more promptly and certainly when the impaction remains, and its continuance in no way damages the usefulness of the limb.

*Treatment of Longitudinal Fracture of the Head and Neck, or of a Separation of the Greater Tubercle.*—In the only instance which I have recognized as a fracture of the greater tubercle, and already referred to, the displacement was moderate, and could not be overcome either by change of position or by pressure with extension. The patient was, therefore, merely laid upon his back in bed. No dressings of any kind were employed, and the fragments seemed to unite promptly, and with no increase in the displacement.

If the displacement is originally more considerable, attempts ought

to be made to reduce the fragments, by extension and abduction of the arm, with direct pressure; yet they will not generally prove completely successful, nor will it be found easy to retain them when reduced.

Mr. Mayo treated a fracture of this character, which occurred in a man of sixty years of age, with a figure-of-8 bandage, and a sling, with a lathe splint on the other side of the humerus, the upper part of which was made to bear on the fragments, by uniting the upper part of the circular arm roller to the figure-of-8 bandage. "The fracture united favorably," he says, but we presume that he does not mean to affirm that it united without any degree of displacement; a result which probably ought never to be expected. Mr. Mayo adds, however, that "for a long time the patient had some difficulty in carrying the arm backwards."<sup>1</sup>

*Treatment of Fractures of the Surgical Neck, including Separations at the Epiphysis.*—We have already considered the value of Moore's method of reduction in cases of incomplete epiphyseal separations of the upper end of the humerus; but the reduction having been accomplished, I see no reason to suppose that the indications of treatment can essentially vary in separations at the epiphysis from those in true fractures through any part of the surgical neck, since the relative action of the muscles remains the same, and the direction of the displacement is generally the same. My remarks, therefore, upon this point may be considered as equally applicable to fractures and epiphysary separations.

In a considerable proportion of these cases not much displacement of either fragment takes place, and consequently we have only to apply such moderate retentive means as will insure quiet. Indeed, under such circumstances we might not hesitate to adopt the posture treatment practised by Dupuytren in two cases, both of which terminated favorably. The treatment consisted in placing the arm, semi-flexed, on a pillow, the pillow being arranged so as to form a pyramid, the summit of which was lodged in the axilla, while the elbow was secured to the side of the body by a bandage.<sup>2</sup>

Unhappily, however, as we have seen, this condition is not always present; the most frequent form of displacement being that in which the lower fragment is drawn upwards and inwards, or toward the coracoid process.

In such cases it will require, often, no little perseverance and skill to effect reduction, if it is not found to be actually impossible, and still more to retain the bones in place when once reduced. Indeed, it is proper to say that a complete reduction is seldom accomplished and permanently maintained, owing, probably, to the advantageous action of the muscles which tend to produce the displacement, and in part also to the difficulty of applying any apparatus or dressing which shall act efficiently upon the fragments.

Sir Astley Cooper recommends for this accident a couple of splints, to be placed one in front of and one behind the shoulder, an axillary pad,

<sup>1</sup> B. Cooper's edition of Sir A. Cooper on Dislocations, etc., American edition, p. 835.

<sup>2</sup> Dupuytren on Bones, Sydenham edition, p. 99.

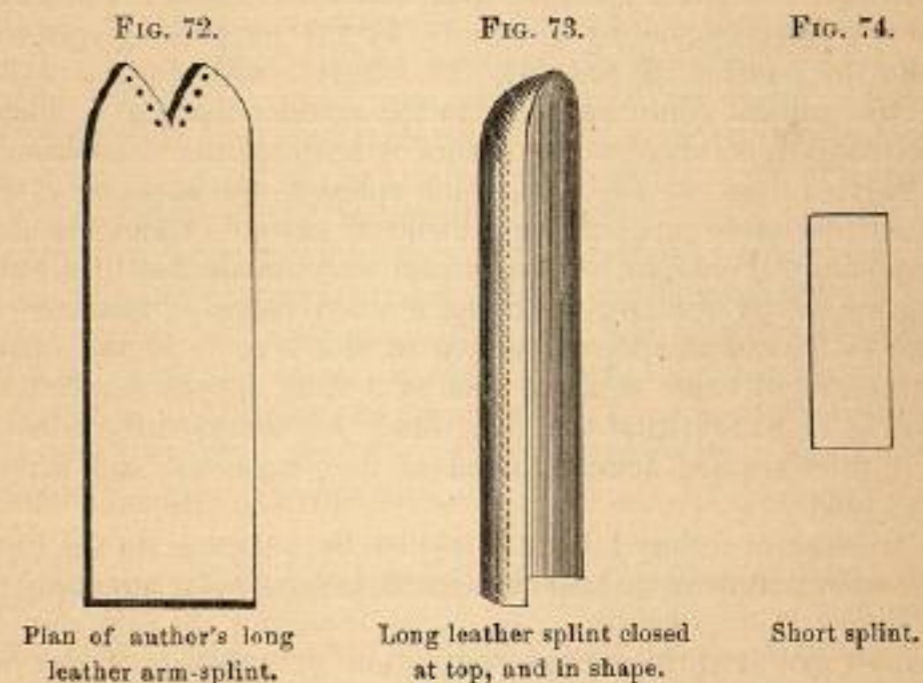
a clavicular bandage, and a sling; the sling being made to suspend only the wrist, and not the elbow, since he had observed that when the elbow was lifted the upper end of the shaft was inclined to fall forwards.

Mr. Tyrrel informed Mr. Cooper that in a similar case he had found the bone best maintained in its natural position by its being raised and supported at right angles with the side, by a rectangular splint, a part of which rested against the side, while the arm reposed upon the other part; and until he had made use of this plan, he could not succeed in removing the deformity, or in keeping the bone in its place.

The following is the plan which I have myself generally preferred:

Two splints are prepared, made of felt, gutta serena, gum-shellac cloth, or leather. The two latter are the most economical, generally most easily obtained, and answer the purpose as well as either of the others. The leather to be employed should be sole leather, of medium thickness, and hemlock tanned. (See General Treatment of Fractures, Chapter VI.)

The "long" splint must be long enough to extend from the top of the acromion process to a point just above the external condyle. The form of the leather splint, before it is moulded, is represented in the accompanying woodcut, Fig. 72. It is then to be bevelled or thinned along its edges



by shaving a thin ribbon from the margins on the side which is to be laid against the arm; a few holes are to be made with a brad-awl on the margins of the V-shaped section at the upper end. Having soaked the splint in water a few minutes, or until it is rendered slightly flexible, it is rolled up from its two sides until it has the natural curve of the circumference of the arm. If it is wet too much it will yield under the pressure of the bandages, and this is not desirable. It ought to be straight, or nearly so, in its longitudinal axis, except at the top, where it embraces the end of the shoulder; and it should be inflexible when applied, the splint touching the arm firmly only over the head and tuberosities, and along the lower portion of the humerus. The V-shaped

section at the top of the splint is then closed with strong linen, or shoemaker's thread; and in order to give it a more regular curve, and to render it smooth, it may be hammered.

Some of the splints which surgeons prepare, in imitation of this general plan, extend too far upon the shoulder, and are liable to be disturbed in the motions of the neck or of the arm. It is only necessary that the splint should embrace the shoulder sufficiently to prevent its sliding down. The splint will now be completed by inclosing it in a loose flannel sack, stitched on the outside. If the arm is swollen and tender, or the skin very delicate, a thin sheet of cotton wadding should be laid between the cover and splint.

The "short" splint made of leather, or gum-shellac cloth—binders' board will answer equally well—carefully trimmed, and covered with flannel cloth, must have sufficient length to extend from the free margin of the axilla to the internal condyle, taking care that it shall not touch either. The purpose of this splint is not to support the fragments, for it is apparent that it cannot extend so high, even, as the point of fracture; but it is solely to protect the delicate skin beneath the arm from the bandages, which are apt to form cords and cause excoriations. In this point of view it is of great importance, and cannot properly be omitted.

The splints being laid upon the arm, and while extension and counter-extension are maintained by assistants, for the purpose of restoring the fragments to position if possible, the surgeon will apply a roller, inclosing the splints, from the elbow to the axillary margins. This roller must be carefully stitched to the covers of both splints. A second roller is then carried from the top of the long splint to the opposite axilla, and by several successive turns the upper end of the splint and the shoulder are completely covered in. This is also to be made fast to the cover of the long splint, by stitches. Finally, a third roller is made to inclose both the body and the lower portion of the arm; and the forearm is secured at a right angle with the arm by a sling, looped under the forearm. It is important that the sling shall not embrace the elbow, since it will, if thus applied, tend to displace the fragments and drive them past each other.

The bandage or roller hitherto applied by surgeons to the hand and forearm, when dressing a broken humerus, is wholly unnecessary and often a source of annoyance. The roller inclosing the arm and splints will seldom give rise to serious congestion or swelling of the forearm and hand unless it is applied too tightly; and when swelling does occur it will be promptly relieved by a few hours' or days' confinement in the horizontal position. The most serious objection, however, to the roller applied to the hand and forearm, is not that it is unnecessary, but that it is, in most cases, injurious. It is exceedingly liable to become disarranged, especially if the patient is permitted to move the arm at the elbow-joint; and in most cases it will be soon found, by its unequal pressure, to cause those congestions and swellings which it was designed to prevent. Perhaps it will be sufficient for me to say that for many years I have rejected this bandage altogether in all fractures of the humerus, and that no harm has ever come of the practice.

It will be readily seen that the first roller performs the most important

function in this dressing. The long outer splint being firm and unyielding, and being supported above by the projection of the head of the humerus, the first roller draws the upper end of the lower fragment outwards, and thus, as far as possible, accomplishes its readjustment. The upper fragment is always beyond our control. The second roller is not of much use, inasmuch as it soon becomes loose; and in any event it can only hold the top of the splint a little more firmly against the head of the humerus. I occasionally omit it. The third roller insures quietude to the arm, in the best position, namely, beside the body.

When the patient is standing or sitting, the forearm needs to be suspended in the sling; but when reclining, the forearm may, if the patient chooses, be extended. If the entire dressing is well stitched it is not much liable to disarrangement, and may be worn two or three weeks at a time without removal; but from time to time, as the swelling subsides or the muscles atrophy, the bandages may need to be tightened by over-stitching, or by supplementary rollers.

I have been thus minute in my description of this dressing, because its value depends upon the care with which the details are carried out; and because, essentially, the same dressing is used by me in all fractures of the humerus occurring through its upper or middle thirds; moreover, I do not wish to be held responsible, in any case, for bad results when dressings are applied in an imperfect or slovenly manner.

If union takes place without overlapping, of course the arm is not maimed by the fracture; but even when the union occurs with considerable overlapping, the usefulness of the arm is seldom impaired.

In case the functions of the arm are seriously impaired in consequence of the displacement of the fragments, and many months or years have elapsed without any improvement, a result which, to say the least, is very uncommon, the surgeon might consider the propriety of surgical interference after the method of Lindner; who cut down and reduced the fracture, with the result of only a partial reduction, with fibrous union, but it is added, that the functions of the arm were restored. It is my opinion, however, that the discreet surgeon will not find satisfactory reasons for such a procedure.<sup>1</sup>

##### § 5. Shaft, below the Surgical Neck and above the Base of the Condyles.

*Causes.*—In a record of 36 cases in which the cause of the fracture is stated, I find this portion of the shaft broken from direct violence 21 times; from indirect blows, the concussion being received upon the elbow, 9 times; twice it was a consequence of tertiary lues, once it occurred during birth, and three times in the same patient it has been broken from muscular action alone, each consecutive fracture occurring at a different point. The records of surgery furnish many examples of fracture of the shaft of the humerus from muscular action, as in throwing a stone or snowball; but the most singular examples are those in which the bone has been broken in a trial of strength between two persons, by grasping the hands palm to palm, with the elbows resting

<sup>1</sup> Lindner, *Centralblatt für Chir.*, 1881, April 16.