

Fracture of the Upper End of the Humerus

DISCUSSION BASED ON THE FOLLOW-UP
OF 302 CASES

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p. t. forseti læknadeildar*

Snorri Hallgrímsson

PREFACE

When in June 1943 I joined the surgical staff of the Copenhagen City Hospital (Kommunehospitalet), Dept. V, I was struck by their way of treating fractures of the upper end of the humerus. Most patients were furnished with a light bandage: sling or collar-and-cuff sling, and at the end of a few days they were started on exercises and massage. The patients appeared to be satisfied, and we did not see them much. Previously, I had been in Danish hospital departments where the abduction splint was widely used in these fractures. Often, it had to be removed and re-applied. These manipulations involved great pain and inconvenience and in some cases required anaesthesia. This aroused my interest in investigating whether the results of these two opposed methods differed. I started writing to patients, asking them to appear for a follow-up examination, first patients from the City Hospital and later those from other hospitals. The follow-up study was finished and the material ready for analysis when I went back to Iceland about New Year 1946. My work here made it necessary for me to shelve this analysis for a period, until I could resume it a couple of years ago.

Since 1950 ever increasing numbers of publications have dealt with early operative treatment of fractures of the upper end of the humerus, while previously operation was generally reserved for fracture-dislocations. It would, therefore, seem worthwhile to present the results of a follow-up on a large series of patients treated by non-operative methods.

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Friðrik Einarsson

CHAPTER I

THE TREATMENT OF FRACTURES

HISTORICAL

A detailed review of the treatment of fractures through the centuries is outside the scope of this paper, but a brief survey will be given below on the basis of publications by *Lucas-Championnière* (1895), *Lane* (1905), *Lambotte* (1907), *Bardenheuer* (1907), *Collin* (1912, 1931), *Zuppinger-Christen* (1913).

Hippocrates (460–about 377 B.C.) reduced fractures by traction. In fractures of the humerus he used weight traction during healing of the bone and spring traction in fractures of the lower leg.

Celsus (30 B.C.–A.D. 50) treated fractures of the lower end of the humerus by bandages which he frequently changed, bathing the region with hot water and rubbing it with a wax ointment.

Permanent traction was used by Avicenna (Abu Ali al-Husain ibn Abdullah ibn Sina, 980–1037) and later by Guy de Chauliac (14th century) and v. Pfoltspeundt (15th century). After that time, permanent traction does not seem to have been used until it was re-introduced by American surgeons in the early 19th century. Instead, the fractured limb was kept in position, supported by oblique splints. The best known of these splints is Petit's, which was submitted to the Paris Academy in 1718 and later taken up in a modified form by e.g. Heister, Braun, and Böhler in fractures of the lower leg.

Galen(os) (131–210) used semiflexion to *reduce* fractures, but not during the after-treatment. Later, Percival Pott (1713–1788) introduced semiflexion in the *treatment* of fractures to obtain relaxation of the muscles. He stressed the importance of complete immobilization of the joints proximal and distal to the fracture. Pott's school, however, did not use traction. Prolonged semiflexion predisposes to muscular shortening and immobilization to atrophy of disuse. This was probably why Pott's method fell into discredit and was later consigned to oblivion.

Before the time of Hippocrates, Arabian physicians used bandages of various proteins to support a fractured limb. Later, other substances were introduced. The best ones were applied wet and stiffened on drying. Gelatin, resin, cellulose, dextrin, waterglass, and tripolite have been used. So have splints made of millboard, glass, porcelain, wood, tin, and other metals. It was not until the Dutch surgeon Mathijsen, in 1852, introduced plaster of Paris that a material fulfilling all the requirements of an immobilizing bandage became available.

During the latter half of the 19th century the treatment of fractures may be divided roughly into four categories:

(1) *Bandage treatment*: After more or less successful attempts at manual or instrumental reduction, a permanent bandage is applied and expected to keep the fragments in the position obtained until firm union has taken place. It is especially after the advent of plaster casts that this method has come into general use. Continued over a long period and as the sole treatment, however, this method has its disadvantages, as prolonged immobilization of joints and muscles entails a tendency to stiffness of the joints and atrophy of the muscles and bones.

(2) *Operative treatment*: Operative treatment of open fractures was known even before the introduction of antiseptic and aseptic wound treatment by Lister in 1867, but the results were often very poor. The wounds became infected, often the limb had to be amputated, and quite a number of patients died of "hospital gangrene". Better results were obtained after aseptic wound treatment became possible, and some surgeons, particularly Tuffier, Lane, and Lambotte went in for operative treatment, reduction and osteosynthesis, also of closed fractures. Lane and Lambotte emphasized, however, that it is extremely difficult to maintain asepsis in operations on bones. Infections were common even though the limb had been prepared for several days by daily shaving, cleaning, bathing with various substances, and wet dressings.

It is not until recently, after the advent of chemotherapeutics and antibiotics, that open reduction and osteosynthesis have come into ever increasing use.

(3) *Traction*: By permanent traction, by means of weights or springs, it is endeavoured to reduce the fracture and retain it until union is so firm that the danger of re-displacement is over.

Permanent traction was, as already mentioned, resumed by American surgeons, and it was introduced in France by Hennequin (1904) and in Germany by v. Volkmann. It was elaborated and systematized by Bardenheuer who has been its most ardent advocate. His first paper on traction treatment was published in 1886.

Bardenheuer reports that he was the first to use heavy weight for traction, applying up to 30 kg to extend a limb.

Fixation of the traction on the limb was first effected by bandages wrapped around e.g. the foot or the flexed knee, but later it was done by means of glues, e.g. mastisol or adhesive tape. Codivilla introduced nail traction in 1903, and Steinmann's nail was introduced in 1907. Nowadays, adhesive tape traction is most common, or a thin steel pin (Kirschner's pin) is drilled through the bone.

(4) *Functional or mobilizing treatment*, also called *Championnière's treatment*, stresses early training of function without paying attention to whether union takes place in the correct anatomical position. Towards the end of the eighteen-sixties Lucas-Championnière began treating fractures by early mobilization after having seen an old woman with a non-diagnosed radial fracture which had healed with excellent function, although she had been using her hand all the time. In 1884 his method had been elaborated and standardized in his own department.

Before Championnière, fractures had probably been treated without immobilization, when they had been erroneously diagnosed as sprains, but he was the first to use the mobilizing treatment in definitely diagnosed cases. The first fractures that he treated by immediate mobilization were juxta-articular fractures. Later, he extended the treatment to fractures of the shafts of the long bones, but he still stressed that juxta-articular fractures were the main range of indication. Championnière started with passive movements right to the pain limit and, some time later, active movements. An important link in this treatment was *massage*, given right from the outset, light and gentle, not painful, but comfortable to the patient.

Jonas Collin, the advocate of mobilizing treatment in Denmark, considered massage, correctly performed, to be the best remedy for pain. He emphasized that "its effect is mainly mechanical: Extravasated blood is distributed in the tissue so that its absorption is promoted, oedema is removed mechanically, thus facilitating the venous return and promoting circulation". He warns, however, against massage in

season and out. In the case of fractures, he finds it advisable only during the first two weeks.

Later, heat, in the form of hot baths and packs, light baths, and diathermy, has been included in the treatment.

In his book from 1895 Championnière stresses that

(a) Healing of the bone in the correct anatomical position is by no means necessary to obtain good function. Joints and muscles permit considerable deformity without impairing function. Complete mobility of the joints and preservation of muscular power are far more important than bony union without displacement.

(b) Immobilization does not afford the best conditions for bony union. It does not promote regeneration of the soft tissues. On the contrary, it will cause infiltration in tendons and ligaments, involving the risk of trophic disturbances of bones and soft tissues, cartilaginous changes, and muscular atrophy.

(c) *Correctly guided movements*, supported by *massage*, afford the best conditions for union which will take place more rapidly and better, with stronger callus than during complete immobilization.

It must be borne in mind that Lucas-Championnière is still thinking particularly of juxta-articular fractures.

More detailed mention has been made of the *functional method* than of the other three, because its basic principles are little known owing to the scant attention they have received in most textbooks and manuals of surgery.

During recent years, there has been an increasing tendency to combine the above-mentioned therapeutic methods.

SURVEY OF THE LITERATURE

FREQUENCY OF FRACTURES AT THE UPPER END OF THE HUMERUS

Fractures are common in this region. *v. Bruns* (quoted by *Bardenheuer*, 1907) collected statistics about 307,352 patients who had been involved in accidents and treated in the London Hospital during a period of 32 years. Of them one-seventh had fractures. Of the fractures, 50.1 % were of the arms, and of these 10.1 % affected the humerus.

Among 351 fractures of the humerus *Hitzrot* (cit. *Tanton*, 1915) found 141 at the upper end, 70 at the diaphysis, and 140 at the lower end.

Plagemann (cit. *Tanton*, 1915) has reported on 194 fractures of the humerus, 73 of the upper end, 18 of the diaphysis, and 103 of the lower end.

Roberts (1932) states that fractures at the upper end of the humerus account for about 2.2 per cent of all bony injuries.

Out of 696 shoulder injuries treated during the past 20 years at the Hospital of Rochester, New York, *Wentworth* (1940) found:

Fractures of the surgical neck	149
Fractures of the surgical neck with dislocation	6
Dislocation of the shoulder without fracture	89
Fractures of the greater tuberosity	17
Fractures of the greater tuberosity with dislocation	15

According to *Karcher* (1947) one-third of all humeral fractures are at the surgical neck.

INCIDENCE OF VARIOUS TYPES OF FRACTURES

Only a few publications include statistical analyses or data on which the incidence of the various types of fractures may be calculated. Some authors, e.g. *Kocher* (1904) and *Borchgrevink* (1908) merely state that fracture of the surgical neck is the most common type of fracture in the upper humerus.

At the surgical congress, Lyon 1894, *Poirier* (1895) submitted a series of 41 fractures at the upper end of the humerus found among 68 humeral fractures. Of these, 38 were at the surgical neck, 2 at the anatomical neck, and only one at the greater tuberosity. As regards this relatively high incidence of fractures of the upper end, he states: "Cette proportion n'est pas celle qui est généralement admise dans les livres classiques, où les fractures du corps tiennent le premier rang".

Among 73 fractures of the upper end of the humerus, *Plagemann* (cit. *Tanton*, 1915) found 4 of the anatomical neck, 10 through the tuberosities (fractures pertuberculaires), 22 surgical neck fractures (fractures sous-tuberositaires), 7 separations of the upper humeral epiphysis, and 30 fractures of the greater tuberosity.

Tanton (1915) has personally collected 79 cases of fractures of the upper humerus. Of them, 51 were at the surgical neck, 17 were "cer-

vico-trochitériennes", 5 at the greater tuberosity, 3 at the surgical neck, and 3 were separations of the epiphysis. In *Tanton's* opinion, fractures of the head and of the lesser tuberosity are very rare.

Ritter (1927) has published a series of 70 fractures, 42 of which affected the surgical neck, 21 also the greater tuberosity, 4 the lesser tuberosity alone, and 2 the anatomical neck.

Roberts' (1932) findings are as follows:

Transverse fractures of the surgical neck	26
Comminuted fracture	50
Greater tuberosity alone	4
Fracture dislocations	13
with fract. of the greater tub.	8
with fract. of the head and neck	5
Separation of the upper humeral epiphysis	3
Total	96

Brostrom (1943) has reported on the treatment of 91 fractures of the upper end of the humerus. There were 61 at the surgical neck, 17 at the greater tuberosity, 11 at the anatomical neck, and 2 at the lesser tuberosity (cf. Table 27).

TYPES OF FRACTURE IN RELATION TO AGE

Traumas of the same nature do not always result in a fracture at the same site; the site of the fracture depends to some extent on the patient's age.

The epiphysis ossifies about the age of 20, and separation of the epiphysis, therefore, only occurs below that age, most commonly between 9 and 17 (*Tanton*, 1915, *Scudder*, 1939).

On the whole, it may be said that the older the patient the more proximal the fracture. According to *Tanton* (1915) fractures at the surgical neck are the most common variety in youth and childhood, "fractures pertuberculaires" and "three-fragment" fractures in middle life, and fractures at the anatomical neck in old age. *Borchgrevink* (1907) and *Matti* (1931) state that fracture at the anatomical neck is rather uncommon, occurring mainly in old people with senile osteoporosis.

Roberts (1932) found that of the 26 patients with transverse fractures of the surgical neck none were over 45 years of age. Fourteen were under 20. Of the 50 patients with comminuted fractures, 44 were

about 45 years of age, the average age being 61 years. Only three were under 20.

In *Wentworth's* opinion (1940), the serious forms of fracture increase with advancing age. He found the *average age*

in 17 patients with fract. of the greater tub. alone to be . . .	47
„ 15 „ „ „ „ „ „ „ and dislocation to be	50
„ 149 „ „ „ „ the surgical neck to be . . .	59
„ 6 „ „ „ „ „ „ „ and dislocation to be	62

In 76 % of *Wentworth's* patients with shoulder injuries the average age was 65 years.

CLASSIFICATION OF FRACTURES

In comparing the different materials it is a disadvantage that the authors have differed in their choice of nomenclature. Below, a few of the most important classifications will be listed.

Kocher (1904) :

1. Fractures sus-tuberculaires.
2. Fractures pertuberculaires.
3. Fractures sous-tuberculaires.
4. Fractures de la grande tubérosité.

Borchgrevink (1908) :

1. Intrakapsuläre Brüche.
2. Pertuberkuläre Brüche.
3. Fractura colli chirurgici humeri.

Tanton (1915) set up the following types:

1. Fractures de la tête humérale.
2. Fractures du col anatomique ou fractures sous-capitales.
These two varieties are said to represent fractures of the articular portion of the upper end of the humerus.
3. Fractures du col chirurgical: (a) Fractures pertuberculaires; (b) fractures sous-tubérositaires.
4. Fractures cervico-trochitériennes.
5. Décollements traumatiques de l'épiphyse.
6. Fractures des tubérosités.

Matti (1931) :

1. Supratuberkuläre Frakturen.
 1. Frakturen des Humeruskopfes (isolierte Brüche des überknorpelten Humeruskopfes).
 2. Fraktur des anatomischen Halses.

2. Infratuberkuläre Frakturen.

1. Fractura pertubercularis und Epiphysenfraktur

a. Adductionsfraktur.

b. Abductionsfraktur.

3. Fractura subtubercularis (Fraktur des chirurgischen Halses).

a. Adductionsfraktur.

b. Abductionsfraktur.

4. Epiphyseolyse jugendlicher Individuen.

5. Oblique transitional forms, affecting in part the surgical neck and in part the region of the tuberosity.

Scudder (1939):

1. Fracture of the anatomical neck.

2. Separation of the upper humeral epiphysis.

3. Fracture of the surgical neck.

4. Fracture of the greater tuberosity.

5. Fracture of the lesser tuberosity.

Böhler (1941):

1. Brüche durch den anatomischen Hals.

2. Brüche durch die Rollhöcker oder unterhalb derselben und bei Jugendlichen durch die Wachstumsfuge.

a. Adductionsbrüche.

b. Abductionsbrüche.

3. Epiphysenlösungen.

4. Brüche der tubercula.

Watson-Jones (1946) does not think the usual classification into fracture of the anatomical neck and fracture of the surgical neck is of any practical significance; as "it does not accurately represent the types, it bears no relationship to the mechanism of injury, and it is of no value in determining treatment". He groups the fractures into:

I. Fracture of the greater tuberosity.

1. contusion fractures.

2. avulsion fractures.

II. Fracture of the neck of the humerus.

1. contusion crack fractures (a contusion fracture of the great tuberosity together with a crack across the neck of the bone).

2. Adduction fracture of neck of humerus.

3. Abduction fracture of the neck of the humerus. ("There is impaction of the fragments on the outer side. There is always a fracture of the great tuberosity which has been pinched off between the outer margin of the shaft and the outer part of the head").

According to *Watson-Jones* there are two other "relatively uncommon" varieties of abduction fracture:

- (a) Impacted fracture-dislocation of the humerus, (where the shaft is impacted in the head with 80°–90° abduction angulation. "When the humerus is brought down to the side, the head is pulled away from the glenoid fossa and a type of fracture-dislocation is produced").
- (b) Unimpacted abduction fracture of neck of humerus, (where the shaft is not impacted into the head, but is displaced below it).

Dehne (1945) claims that he is able to deduce the mechanism of the fracture from the clinical and radiological appearances:

- 1. Fractures caused by lateral mechanism, or "three-fragment fractures". (Fractures of the greater and lesser tuberosities are also said to be caused by lateral mechanism).
- 2. Fractures caused by the dorsal mechanism, or "two-fragment fractures".
- 3. Fractures caused by central mechanism, or "head-splitting fractures".

Madsen's (1949) classification is according to *Dehne's* pattern, naming the fractures according to the movements which, by being forced, broke the bone.

- 1. Abduction fracture, "three-fragment fracture".
- 2. Extension fracture, with posterior open angulation.
- 3. Adduction fracture.
- 4. Flexion fracture, with anterior open angulation.
- 5. Infraction fracture, with no or slight displacement.
- 6. Impression fracture, splintering of the head.
- 7. Crush fracture, due to direct violence, shot, etc.

METHODS OF TREATMENT

Previously, fractures of the upper end of the humerus were treated with enormous bandages wrapped around the shoulder and upper arm down to the elbow, fixing the arm to the side. The most common displacement in abduction fractures of the upper humerus is, however, *Malgaigne's*, i.e. adduction and elevation of the lower fragment into the axilla. A bandage like the one described above will press the fragment even further towards the trunk and increase the displacement. Thick pads were, therefore, placed in the axilla, but although they may be useful in decreasing the secretion of sweat and in preventing skin surfaces from rubbing against each other, they do not have much effect on the position of the fracture. The main types of these fixing bandages were *Desault's* (1744–1795) and *Velpau's* (1795–1867) which are still used in some places.

There is a more serious risk of shrinkage in the joint capsule and

subsequent articular stiffness in the shoulder than in any other joint. The joint capsule is so wide that it can house two articular heads (*Lanz & Wachsmuth, 1935*). It attaches itself around the anatomical neck. When the arm hangs down along the side, the capsule is tense laterally, but very flaccid medially, so flaccid that it forms folds. If the arm is fixed in adduction for a long time, these folds may shrink, not to be unfolded again. Another risk of prolonged fixation in adduction is atrophy of the deltoid muscle which undergoes atrophy more quickly than any other muscle (with the exception of the quadriceps femoris).

After these dangers were realized, bandaging of the arm in more or less abduction was introduced.

In the middle of the 19th century Middeldorpf introduced his triangle for treating fractures of the humerus. This triangle is fixed in the axilla, and it has a chest piece, an upper arm piece, and a forearm piece. It keeps the upper arm in slight abduction, but in pronounced internal rotation.

In the course of time, a number of abduction splints for the treatment of humeral fractures have been designed. These splints are, as a main principle, made of a triangle, one side of which is against the chest and fixed to it by a bandage around the trunk and a strap over the shoulder. From the bottom of the chest piece, a strap is passed over the opposite shoulder to keep the splint well up in the axilla. Another piece of the splint carries the upper arm which is fixed to it by plaster or a tight bandage. From the upper arm piece the third piece projects to support the forearm.

Some of the splints are very simple, only meant to keep the arm in abduction. Others are more complicated; the forearm piece may be elevated or lowered to increase or decrease the external rotation, and the abduction angle may be increased or decreased. *Semb (1927)* has designed a splint in which the upper piece is divided into two parts that may be shifted mutually to obtain traction. Other splints have a pulley device in continuation of the upper arm piece, so that traction may be exerted by means of weights, springs, or rubber drains.

The splints must support the arm whether the patient is confined to bed or ambulant. It must be well padded in places where there is a risk of pressure or chafing.

Silfverskiöld (1943) has designed an abduction splint with a ball-bearing device which may be loosened; it is said to permit free movement in the shoulder with the arm fixed to the splint.

In addition to traction on an abduction splint it is worth mentioning traction splints for traction on the hanging arm. Examples are Bardenheuer's and Borchgrevink's traction splints which are now of historical interest only.

Traction in bed may also be obtained with the arm suspended or in abduction over the side of the bed.

In 1933 Caldwell suggested treatment with "hanging cast". This is a modern version of Bardenheuer's and Borchgrevink's methods in which the traction is obtained by the weight of a plaster cast wrapped around the upper arm and forearm. The arm is kept in a sling passed from the wrist over the neck.

These methods aim at improving the position and at obtaining sufficient rest at the site of the fracture while union takes place. Complete immobilization is only obtainable with osteosynthesis or by an arm-chest plaster cast which must include, in addition to the chest and upper arm, also the forearm and hand down to the knuckles.

Operative methods will only be briefly mentioned, as the clinical series on which the present studies are based includes only three operated fracture-dislocations.

Championnière's mobilizing treatment has many adherents, either as the only method or as after-treatment following short or long immobilization. The most ardent advocate of this method is *Collin* who in 1912 published a thesis "on the treatment of fractures of the arm". *Collin* used it as the only treatment in practically all cases of fractures of the upper end of the humerus. It is a physical therapy: Exercises, massage, heat, in some cases also wand exercises, pulley exercises, crawling with the hands up walls, etc.

DISPLACEMENT AND TREATMENT OF VARIOUS TYPES OF FRACTURES

Any of the types of fracture mentioned above may be impacted or loose. They may be without displacement, showing up only as a barely visible fracture line through the bone. The displacement may be slight or so marked that no contact remains between the fractured surfaces. It may be lateral or longitudinal. In the latter case, it is invariably accompanied by shortening, the distal fragment over-riding the proximal one. There may be angulation between the fragments, rotation displacement or a combination of both.

1. *Fracture of the greater tuberosity.* The separated fragment may be small or large, without displacement or displaced backward or upward by the pull of the muscles.

(a) *Without or with slight displacement.*

Most authors recommend early movements and support of the arm in a collar-and-cuff sling (*mitella quadrangularis sive parva*) or sling (*mitella triangularis*). *Matti* (1931) advises a more active therapy, viz. bandaging in abduction and external rotation, and *Sever* (1923) treats these fractures by traction on an abduction splint.

(b) *With considerable or marked displacement.*

Such fractures were treated by *Collin* (1912) by means of massage and early exercises. *Tanton* (1915) and *Dehne* (1945) prefer traction in abduction and external rotation, the latter even keeping the patient in bed. *Bardenheuer* (1907), *Scudder* (1939), and *Miller* (1940) feel that it is necessary to reduce the fracture. This they try to obtain by traction on the arm in maximum elevation along the head during bed rest. *Garceau & Cogland* (1941) also state that the humerus must be abducted to where the greater tuberosity is and bandaged in this position. *O'Malley* (1940) uses an abduction splint, but *Eliason* (1945) applies an arm-chest plaster cast with abduction and external rotation of the arm. *Böhler* (1941) and *Watson-Jones* (1946), like all the other authors mentioned above with the exception of *Collin*, think it necessary to reduce the fracture. When the fragment is avulsed and retracted above the head of the humerus, *Watson-Jones* emphasizes the risk of a poor end-result with weakness of the shoulder and loss of active abduction beyond 50°–60°. *Böhler* applies an aeroplane splint for 3–6 weeks, whereas *Watson-Jones* uses an abduction frame or plaster spica with the humerus 90° abducted, 60° externally rotated, and 40° forwardly flexed until union is firm. After 6–8 weeks the first attempts are made to abduct the shoulder. *Matti* (1931) advises open reduction and fixation. *Scudder*, *Sever*, *Tanton* and *Eliason* recommend operation only if reduction is not successful in other ways.

2. *Fracture of the anatomical neck* is often impacted without displacement, only as a barely visible fracture line through the anatomical neck. In that case it is difficult to discover and is probably more common than is realized. The shell-shaped head may also be splintered into pieces, but usually without much displacement. Furthermore, the head

may, though rarely, be greatly rotated, although it is inside the joint capsule. The most marked displacements occur in the presence of fracture-dislocations which will be discussed later.

In most authors' opinion it is essential to avoid prolonged immobilizing bandage in these generally elderly patients. Frequently, a sling or collar-and-cuff sling and early exercises will be enough, if the position is satisfactory. *Miller* (1940) places a pad in the axilla, bandaging the arm to the side in a sling and applies a protective cap for the deltoid region. *Lamotte* (1907) suggests waiting for 10–15 days and then opening the joint. If the central fragment shows signs of necrosis, it should be removed. If not, he recommends nailing the fragments together.

Dehne (1945) is of the opinion that return to function usually is incomplete. He states that painless motion sufficient to permit feeding or brushing hair in women can be obtained in most cases by the use of early mobilization and suspension-traction of the arm and forearm.

If displacement is marked, but the head still within the joint capsule, reduction is attempted by traction in abduction and manipulation from the axilla (*Eliason*, 1945) or permanent traction on a splint with massage and early exercises. If such reduction fails and if the fragment is greatly rotated, *Tanton* (1915) advises open reduction or removal of the head. *Matti* (1931) states that reduction by external manipulations is impossible in fracture of the anatomical neck.

3. *Fracture of the surgical neck* (syn. *fractura pertubercularis*, *fractura subtubercularis*, *fractura infratubercularis*, "fractura colli humeri", "two-fragment fracture"). This type of fracture may be loose or impacted, without or with slight displacement, but it is very often displaced, especially in the form of angulation. According to the most common angles, various authors have tried to classify the fractures into *abduction fracture* (valgus) and *adduction fracture* (varus) on the basis of the X-ray appearances.

Böhler's (1941) definition is as follows: In abduction fracture the proximal fragment is adducted and externally rotated, the distal fragment abducted anteriorly and internally displaced and internally rotated. Between the fragments there is in the anterior view an angle which opens outward and in the axillary view (with the direction of the beam up through the axilla) an angle which opens backward. In adduction fractures the proximal fragment is abducted and externally rotated, the distal fragment adducted, internally rotated and displaced

internally and anteriorly. In the anterior view there is between the fragments an angle which opens inward and in the lateral view one that opens backward.

These angles and the rotation are described in very similar ways by most authors, e.g. *Bardenheuer* (1907), *Tanton* (1915), *Guleke* (1931), *Matti* (1931), *Lanz & Wachsmuth* (1935), *Scudder* (1939), *Arandes Adán & Caminal* (1942), *Watson-Jones* (1946). Others again, e.g. *Dehne* (1945) and *Erin Madsen* (1949), lay more stress on the commonly seen posteriorly open angle.

In addition, there may be lateral displacement of all degrees, from barely visible to so marked that the fractured ends are lying side by side. In such cases, shortening is common, either because of the pull of the muscles or erroneous bandaging.

(a) *Treatment when displacement is slight or none.*

Collin (1912) used collar-and-cuff sling, heat, and massage from the very outset and throughout the first two weeks. Energetic exercises from the beginning until complete function is regained. The patients are sent back to work as quickly as possible, as this is the best kinesi-therapy.

Gregersen (1933) has expressed the same opinion.

Caldwell (1943) uses a simple pad of cotton or felt in the axilla, a sling under the forearm, and a light bandage about the side of the body, early motion, heat and gentle massage daily to the shoulder to obtain relaxation. *O'Malley* (1940) uses a bandage to the side of the body for a few days and then a sling for about 10 days and active movements. At the end of two weeks, the sling is abandoned.

Scudder (1939), *Dehne* (1945), and *Watson-Jones* (1946) use a sling and early active motion. *Tanton* (1915) uses the same treatment for adults, but in children an immobilizing bandage for some time, as they are not cautious and careful enough.

Miller (1940) employs passive movements for three weeks and then active movements.

Bardenheuer (1907), *Borchgrevink* (1908), and *Matti* (1931) advise traction on the hanging arm and early, active motion. *Matti* places the arm in abduction at night.

Fabricius-Møller (1931) treats these fractures in an abduction splint. So does *Sever* (1923, 1932), but he admits that there may be a few exceptions that ought to be treated with a sling and active motion, especially in the case of elderly persons.

(b) *Treatment in the presence of considerable or marked displacement.*

Not all authors make a distinction between the treatment of abduction fractures and adduction fractures, and quite often they do not pay regard to whether angulation in other directions or rotation displacement is present. And not all make a therapeutic distinction between fractures through the tuberosities or through the actual surgical neck, talking about "fracture of the neck of the humerus" in either case.

Some surgeons believe that a good function is obtainable only if bony union takes place in an anatomical position as correct as possible. Others consider this of subordinate importance, early training of function being the main thing. This view of course decides the therapeutic method chosen and recommended by each individual surgeon.

*I. Authors Who Treat the Fracture with Hanging Arm, i.e.
Predominantly Functional Treatment*

(a) *Reduction only in exceptional cases.*

According to *Championnière* (1895) all non-impacted fractures of the neck of the humerus may be reduced by letting the arm hang down with the forearm supported in a sling. At the same time he used passive and later active movements and massage.

Collin (1912) based his experience on the treatment of 35 patients with fractures of the surgical neck. At the outset, he tried to reduce the marked displacements, either by manual traction and pressure with or without anaesthetic, or by means of pads and bandages. Gradually as his experience in the treatment of these fractures increased, he waived this principle. He found firstly that often it was very difficult to change the position in this way and secondly that better function was obtained more quickly by massage and early exercises. He supported the arm in a collar-and-cuff sling. By this method, function returned in most cases in from 2 to 4 weeks after the accident, although in some instances a longer period was required. *Collin* did not think that "any other method could give such good results".

Gergesen (1933) expressed exactly the same opinion after a follow-up on a series treated by *Collin's* method.

Donald (1940) uses the collar-and-cuff sling. From the second day massage two or three times daily. Active movements from the 5th–7th day. At the end of three weeks the patients generally have a full range of motion in the shoulder joint. "The whole secret of success lies with

the masseur". In young persons he loosened impaction, if any, and then treated them by the same method.

Aldredge & Knight (1940) reduce under an anaesthetic in cases of marked displacement. They then apply heat to the shoulder and light massage, the arm in a sling with a pad in the axilla. At the end of three days, relaxed motion as described by *Brostrom* (*vide infra*), and after three weeks active motion.

Moorhead (1941) is satisfied if there is 50–60 per cent end-to-end contact. He points out that fractures of the neck of the humerus belong to the "let-them-alone" group, where the formula *time plus rest* equals recovery. He found little tendency towards re-displacement—if the fractures were left alone. The patients carry the arm at the side with the forearm in a sling, and motion, massage, and heat were started immediately. The patient was cautioned to fasten the sleeve of the night clothing to the waist to prevent the arm-over-the-head position assumed by so many sleepers.

Geckeler (1941) points out that the previous arm-chest plaster cast with the arm in abduction to immobilize the fracture will make the muscles weak and the joints stiff. He therefore started treating first impacted fractures, and later also loose fractures, with hanging cast or merely with a sling and early motion. Even marked displacement was corrected by this method which also has the advantage of preserving muscular power and articular mobility. In a few cases of particularly marked displacement, he performed manipulations to correct the fracture, and then applied a sling and instituted early movements. He stresses that the pull of the longitudinal muscles keeps the fragments in contact, while the weight of the arm exerts a suitable, mild traction on the fracture. Only active and absolutely no passive movements are used.

Brostrom (1943) analysed 61 fractures of the surgical neck. In his opinion, reduction is required in some cases, but he lays the main stress on after-treatment which is purely functional. The arm is kept to the side for four days by a light bandage, and then a collar-and-cuff sling is applied. From the fourth day light massage of the entire limb, and from that day the patient starts moving it. Flexing his trunk forward, the patient permits the affected arm to fall forward completely relaxed to obtain passive abduction and forward flexion. He now moves the body in a circular motion, so that circumduction of the shoulder occurs. In bed the patient is placed with the body at an angle of 35°. Active motion from the 5th–7th day. *Brostrom* stresses the importance of letting a physiotherapist supervise the treatment.

(b) *Increasing the Weight of the Arm to Improve the Position.*

Borchgrevink (1908) used his own traction splint which exerts traction downward in the longitudinal direction of the body in ambulatory patients. According to *Borchgrevink*, this form of traction will always place the fragments in a good, and usually correct, position. He goes on to state that a possible rotation displacement will usually be corrected by itself.

Sewell (1947) states that regardless of whether there is comminution, angulation, over-riding, or any combination of the three, a trial with hanging cast often affords as early and as satisfactory reduction as any of the more involved forms of traction. In order to overcome the discomfort of the weight of the sling around the neck, he passes the supporting sling about the opposite shoulder, through a metal ring set at an angle in the cast.

Spotoft (1949) recommends this method for retaining and reducing these fractures. He had used it in 9 cases.

(c) *Primary Reduction in Most Cases.*

Savage (1935) reports 6 cases. He recommends reduction with traction along the side and manipulations from the axilla. Then a sling and early movements. In some instances attempts at reduction failed to affect the position, but the patients obtained excellent function. *Savage* points out that following reduction there is little tendency towards re-displacement except when the arm is in abduction which he therefore calls inadvisable.

Garceau & Cogland (1941) find it necessary to reduce fractures of the surgical neck by closed or open procedures. Thereafter, they retain them with a sling, swathe, and axillary pad. Passive movements are started at the end of a week and replaced by active movements after the third week. Then, increasing exercises, such as crawling with the hands up a wall and internal rotation by passing the hand behind the back. They state that this saves 50 % of the time required for treatment in an abduction splint.

Pickell (1942) has reported 19 cases of fracture of the neck and shaft of the humerus treated in his consultation room. Reduction was performed under local analgesia in 7, under anaesthesia in 2, and in the remaining cases merely with morphine sedation. He then treats his patients with a plaster hanging cast of which he has a very high opinion.

According to *Dehne* (1945) minor degrees of angulation and impaction become loosened and corrected by treatment in a sling or hanging cast. If there is no contact or if there is impaction with a marked posterior angulation, he recommends reduction under an anaesthetic, followed by treatment in a sling or hanging cast.

II. Authors Who Treat the Fracture Predominantly by Immobilization in Abduction.

Bardenheuer (1907) attaches most importance to accurate reduction, maintaining that this is a *sine qua non* to obtain good function. He recommends traction, even in impacted fractures without displacement. As time went by, his favourite method was traction in bed, the arm elevated 170–180° up along the head, particularly in fractures with marked displacement. Exercises from the first week. In cases of pronounced lateral displacement he also applied lateral traction. *Bardenheuer* reports the case of a 70-year-old woman who had fractured the surgical neck 30 years previously and had been treated only by a sling and early movements. X-rays showed that the joint surface had united with the fractured surface of the distal fragment, whereas the fractured surface of the proximal fragment articulated with the scapula. Even so, she had “good function” in the shoulder, elevation to 90°.

Zuppinger-Christen (1913) emphasizes only accurate reduction, insisting that a poor function cannot result, if the bone unites in an anatomically correct position. His method is reduction and traction in 90° abduction in bed, with the forearm suspended, i.e. practically in middle rotation in the shoulder joint.

Sever (1923, 1932) is of the opinion that fractures with displacement must be reduced, preferably by a closed procedure, but otherwise by operation, followed by bandage in abduction and external rotation, but *not* traction. He thinks that the disability seen after traction is due to distraction of the shoulder joint, weakness and even partial paralysis of the deltoid, stretching of the capsule of the shoulder, resulting in permanent weakness of the function at the shoulder.

Andler (1924) says that any displacement worth mentioning will, by a purely mechanical action, prevent a full range of movement in the shoulder joint. Union in an anatomically correct position must therefore be the aim. Reduction must be exact, either by applying an abduction frame with or without traction, by traction in bed, or by open reduction and fixation. Exercises should be instituted as soon as

possible to prevent muscular atrophy and stiffness. He had operated on a total of 9 cases. Where the fractured surfaces had to be fixed, he used a percutaneous pin which he removed at the end of two weeks. Abduction splint.

Ritter (1927) based his experience on 42 fractures of the surgical neck treated in hospital (26 of which were followed up) and 21 fractures through the tuberosities (11 followed up). It had been endeavoured to reduce the fracture under ethyl chloride, and traction with adhesive strips was applied for 3 or 4 weeks in 125–160° abduction in bed. Lateral traction was also employed, if it seemed indicated. Passive movements in the shoulder from the 2nd or 3rd day in case of impacted, but from the 2nd week in the case of loose fractures. From the third week active movements. When the traction was discontinued, massage, heat, and wand exercises.

Fabricius-Møller (1931) emphasizes the necessity of exact reduction, and then applies traction on an abduction splint, using early and energetic active movements in the other joints of the limb so far as it is possible.

Domrich (1931) agrees that all fractures of the neck of the humerus with pronounced displacement must be treated on an abduction splint after exact reduction, preferably closed, but if necessary open. He does not perform the open intervention until at the end of 8–10 days. His series consists of 70 cases treated during the period 1924–1929, 8 of which required open reduction. Thirty-eight were followed up.

According to *Miller* (1940) fractures of the surgical neck often require complicated dressings and possibly confinement to bed with pulleys and traction. The abduction splint with traction is probably the most comfortable dressing of this class, he thinks. Plaster-of-paris dressing may be used for the same position. Ordinary splints and fixation to the side are usually not satisfactory. He does not state his experience in the treatment of these fractures.

Böhler (1941) acts on his fundamental principle that a good result presupposes exact reduction of the fracture and continuous immobilization in a good position until firm union has occurred. He demands exact reduction of the fractures concerned, and then traction on an abduction splint. The arm is fixed to the splint by plaster bandages. *Böhler* has been one of the most ardent advocates of the abduction splint, and in this respect, as in the treatment of fractures on the whole, he has set an example to many surgeons who have adopted his schematic methods without criticism. Gradually, *Böhler* appears to admit

some of the disadvantages of the abduction splint. He admits "that many find it difficult to apply and that it often fits badly", so he leans more and more to Desault's bandage for a week after the reduction followed by exercises, but never massage which he considers harmful under any circumstances.

Arandes Adán & Caminal (1942) state that exact reduction is necessary, especially in young patients, less so in older people. They admit that in abduction fractures, reduction may be difficult, but state that it can always be effected by strong traction. After reduction they apply permanent traction by an abduction splint for three weeks by means of adhesive strips or a pin through the olecranon. They stress that the usual flexion of about 45° in the shoulder, when it is bandaged to the splint is not sufficient; the arm is to be at least 90° flexed, i.e. it should be at least in the sagittal plane or even more flexed. Such strong flexion they believe will invariably correct the posteriorly open angle. Their knowledge is based on the study of 100 fractures of the surgical neck treated at a University Clinic in Barcelona.

Laurence *Jones* (1946) reports one fracture with marked displacement which had been reduced and treated by Steinman's pin through the olecranon and traction by an abduction splint. The splint was not removed until at the end of three months, when X-rays showed bony union. In *Jones'* opinion 90 % of all fractures of the neck of the humerus may be treated "by this simple ambulatory method".

In juxta-articular fractures Karcher (1947) thinks exact reduction and retention until bony union a *sine qua non*. After reduction, he employs a plaster spica until union occurs—in young patients 4–5 weeks and in older patients 5–6 weeks. If closed reduction is unsuccessful, he operates. In 6 out of 30 cases it proved impossible to reduce the fractures by manipulations. In these cases, ulnar bone traction with a 4–6 kg weight in the horizontal or vertical direction in bed was applied, and this effected reduction. In a few cases the traction was substituted by a plaster spica at the end of 2 or 3 weeks, while in others the traction was continued until union occurred.

III. Other Authors.

According to *Lambotte* (1907) function will always be poor, if these fractures are not reduced. After waiting for two or three weeks, he performs open reduction fixing the fracture. Until 1907 *Lambotte* had only had occasion to operate in three cases. In the first case infection with

suppuration occurred, while the second case healed without complications, and both eventually obtained good function. In the third case re-displacement occurred, but the ultimate result is not reported.

Roberts (1932) states that in "transverse fractures of the surgical neck" exact reduction is necessary. In his series there were 26 cases of this type, 19 of which had to be reduced. Reduction was tried with traction in abduction and manipulation. If it was successful, most patients were treated with traction by adhesive strips in abduction for 2-4 weeks, and then active motion. Six patients required open reduction after traction in abduction for 4-7 days had failed to improve the position. There were 50 cases of comminuted fractures. In the presence of displacement *Roberts* tries to correct it, but in his opinion the correction is not as necessary as in the type just mentioned. 67 % were treated in a sling, 14 % on an abduction splint, and 15 % had traction. Active movements were started much earlier than in patients with pure surgical neck fractures, in 21 cases within 10 days and in 9 from the 10th to the 14th day. Only two of these 50 patients had open reduction. It was in this type of cases, *Roberts* says, that *Lucas-Championnière* had his best results. "It has taken us forty-five years to learn the lesson. Let us not forget it now".

For 20 years *Gurd* (1940) had used a thick and rather firm axillary pad, keeping the upper arm in 15° abduction in fractures of the neck and the shaft of the humerus. The pad is fixed to the side with adhesive strips carried over the shoulder. Then a plaster cast is applied over the shoulder, down to the elbow, and down below the axillary pad. A sling is passed from the wrist over the neck, and by shortening or lengthening the sling it is possible to increase or decrease the traction, the forearm acting as a lever against the enclosed axillary pad as a fulcrum. Felt may be inserted between the forearm and the moulded plaster on the lower border of the axillary pad to protect against pressure. One week later, movements of the elbow and hand are started. *Gurd* cannot see any reason to treat these fractures in abduction. In case of extreme deformity *Gurd* thinks open reduction should be undertaken after but a short attempt at reduction by traction.

Griswold (1932) is pleased to see the trend away from wide abduction in fractures of the upper third of the humerus.

O'Malley (1940) is of the opinion that previously much damage has been done by the routine use of an abduction splint. Forcible abduction increases the deformity in many cases and leads to permanent disability. In elderly patients with adduction fractures he recommends a

sling and active exercises, in young subjects reduction followed by exercises. In cases of impacted abduction fractures he recommends an arm-to-chest bandage for three weeks and then active movements. In non-impacted abduction fractures there is often a marked displacement which in his opinion must be corrected under an anaesthetic; he then applies a sling for three weeks after which movements are started. In some cases he finds continuous traction in abducted position to be necessary to overcome the deformity, but states that the use of an abduction splint without traction will increase the deformity.

Wentworth (1940) reports the treatment of 149 patients with fractures of the surgical neck who averaged 59 years in age. He stresses the importance of reduction in young people and in middle-aged patients under 50. The reduction is carried out under analgesia or anaesthesia, closed or open. In his opinion, there is less tendency to displacement in old patients, and even in the presence of displacement there is less need for exact reduction. The after-treatment varied. The spicas and abduction splints were almost all used before 1925. During the period of transition from immobilization to mobilization treatment (1925–1930), the patients were to a certain extent given the choice. They were told that it would be less uncomfortable to carry the arm in a sling, but that this would perhaps not give as good elevation as the treatment in an abduction splint or spica. Practically all of them preferred to take the chance of treatment in a sling. During this period of transition a moulded plaster-of-paris shoulder cap was sometimes applied "to impress the patient that protection was being provided as much as to provide protection". Since 1930 none of the patients over 50 years of age had been treated with spica.

Watson-Jones (1946) states as his opinion that adduction fractures in patients under 50 years of age should be reduced and then immobilized by means of an abduction splint for about 4 weeks. In patients over 50 impaction should not be broken down. *Watson-Jones* finds that these fractures are invariably impacted. In his experience the angulation seldom exceeds 30° . The patients rapidly recover when they do active exercises, whereas reduction followed by immobilization causes limitation of movements. In unimpacted abduction fracture reduction should be undertaken and the limb immobilized for three weeks by a collar-and-cuff sling. Movements of the shoulder after three weeks.

Madsen (1949) based his discussion on the study of 117 consecutive cases of all types of fractures of the upper end of the humerus. In his view, displacements amounting to less than half the width of the bone

and angulation of less than 30° hardly need any treatment except a sling and active motion. In about 20 % of the fractures, however, he finds the displacement to be so marked as to require reduction. This applies to the adduction fractures, but in his opinion it is particularly the "extension type" of fracture with a wide posterior angulation that needs reduction which he performs by powerful traction across the patient's chest, preferably under fluoroscopic control. Afterwards, most cases are bandaged in a plaster spica, but a few in a hanging cast.

4. *Fracture of the Surgical Neck and Greater Tuberosity*

(syn. "three-fragment fracture", "contusion crack fracture of neck of humerus", "abduction fracture of the neck of humerus").

This consists in two fractures, and the displacement varies; the greater tuberosity may be *in situ* or displaced up above the head. There may be a subperiosteal fracture line through the surgical neck, but also all degrees of displacement, lateral displacement, upward displacement of the distal fragment, and angulation. As a rule, however, the position of the fragments is good, unless the arm is placed in abduction which makes the position worse.

Dehne (1945) thinks the three-fragment fracture fares best if left alone. He advises a sling and early active exercises, and warns against bandage in abduction. In rare cases operation is required, especially if the position has been compromised by the use of an abduction frame.

Watson-Jones (1946) is of the opinion that there is always impaction between the head and the shaft fragment. He finds manipulation unnecessary; the limb is supported in a sling and early movements are started.

Madsen (1949) rarely found any reason to perform reduction, but if required it was done by traction on the forearm and in abduction of not more than 35° . Like *Dehne* and *Watson-Jones*, he warns against the use of the abduction frame in fractures of this type.

5. *Separation of the Upper Humeral Epiphysis.*

Frequently there is no or only slight displacement, but otherwise the same types of displacement as in fractures of the surgical neck.

All authors agree that exact reduction is necessary. *Tanton* (1915) and *Sever* (1923) bandage the arm in abduction after closed or open reduction. In *Roberts'* (1932) series there were three cases of epiphyseal separation, one without displacement treated with the arm in a sling and early active motion. The other two had open reduction and

traction in abduction for three weeks. All three patients obtained excellent end results.

Scudder (1939) and *Eliason* (1945) also consider exact reduction, closed or open, to be necessary. After reduction, *Eliason* has only found little tendency to re-displacement.

Of *Winnett Orr's* (1932) 15–18 patients with epiphyseal separation, none required open reduction.

Böhler (1941) has also been successful in his closed reductions, using local analgesia with the patient lying on the floor, exerting traction on the arm with the foot in the axilla.

Karcher (1947), on the other hand, states that since exact reduction is necessary and since it must be carried out as gently as possible, open reduction is frequently indicated. If epiphyseal separation is not reduced exactly, longitudinal growth is compromised, he says.

6. *Fracture of the Lesser Tuberosity.*

Isolated fracture of the lesser tuberosity is an avulsion fracture. The fragment will be pulled more or less medially by the m. subscapularis.

Matti (1931) advises mobilizing treatment. *Miller* (1940) and *Eliason* (1945) apply a sling, axillary pad, and fix the upper arm to the side for four weeks (*Eliason*). Then, they institute exercises and in some cases massage.

In the case of displacement, *Böhler* (1941) fixes the arm by means of an abduction frame.

Haas (1944) reports one case treated by operation and suture of the lesser tuberosity to the humerus. The end result was good.

COMPLICATIONS AND THERAPEUTIC RESULTS

Complications

Apart from fracture-dislocation, which will be discussed later, serious complications are not common in fractures in this region.

The axillary plexus and the great vessels are not particularly exposed to injury in accidents of this nature, but the axillary nerve is rather close to the surgical neck and is, therefore, at times damaged – with serious consequences to the deltoid muscle.

Andler (1924), however, has reported one case in which the distal fragment had damaged the axillary artery by its displacement into the axilla. This resulted in a rupture, 3 cm in length, of the intima and media. Resection of the artery and ligation resulted in necrosis which necessitated amputation of the forearm.

Sometimes, the anterior and posterior circumflex arteries are damaged, and large haematomas arise. These haematomas manifest themselves as discolourations down along the inside of the arm a few days after the trauma in contradistinction to the discolourations in contusions which appear earlier and on the outer side of the shoulder (*Borchgrevink* 1908).

Fairbank (1948) found subluxation downward in 12 out of 115 patients with fractures of the upper end of the humerus. In 6 this subluxation was noted the first time the patients were seen, whereas in the other 6 it did not supervene until a few days or weeks had elapsed. In *Fairbank's* opinion, this complication is more common than generally assumed. It is due to weakness or paresis of the longitudinal muscles which keep the shoulder in the joint, especially the long head of the biceps.

Cotton (quoted by *Fairbank*) is said to have observed this form of subluxation in 9 patients with humeral neck fracture. He attributed it to weakness of the muscles.

Dehne (1945) has also described this condition which he interprets as a result of fracture of the inferior margin of the glenoid fossa.

Sclerosing and necrosis of the head, due to nutritive disturbances, is not uncommon in fractures of the anatomical neck. A fracture distal to the anatomical neck, on the other hand, affects the most vascular part of the bone, so necrosis or non-union is hardly ever encountered (*Allredge & Knight*, 1940, *Donald*, 1940, *Caldwell*, 1943).

Muscular atrophy need not be considered in patients under 20 years of age (*Borchgrevink*, 1908). In patients under 40 it will readily regress, but in patients over 40 it presents a problem, the more serious the older the patient.

END RESULTS

Although quite a considerable literature has accumulated on fractures at the upper end of the humerus, there are not many analyses of the therapeutic results worked out in a way so that they can form the basis of a discussion or comparison of the results obtained by the different methods. Most authors report one or more cases which they have treated, perhaps with a "good result", but without stating at the same time how many cases with a fair or poor result they have seen.

Nor is it agreed what may be called a good, fair, or poor result, and this too makes any comparison rather difficult.

Roemer (1917) defines the results, according to *Schoch's* classification, as follows:

Very good: Perfect or almost perfect function.

Good: Restriction of one movement, particularly elevation or external rotation, or muscular weakness.

Fair: Marked restriction of one movement or 50 % restriction of several movements. Elevation abduction up to 90°.

Poor: Everything worse than fair.

In *Andler's* series 16 cases had been treated by abduction splint alone. The result was as follows:

TABLE 1
(after *Andler*)
Abduction splint.

No. of cases	Age	Position before	Position after	Functional result	Remarks
3	16, 17, 27	No displacement. Infraction.	Good	Very good	
5	6, 9, 18, 44, 56	Slight displacement. Angulation, no shortening.	Good	Very good	In 4 cases the position was improved by manipulation under anaesthesia.
4	61, 63, 65, 68	Slight displacement. No shortening.	Good	Good	
1	58	Slight displacement. No shortening.	Good	Fair	At the same time severely displaced supracondylar fracture treated by operation. Elevation and abduction up to 60°. Rotation restricted.
3	58, 79, 80	Poor	Poor	Poor	1 case delirium tremens. 2 senile patients.

Comments to Table 1:

The 58-year-old patient whom *Andler* classifies as fair seems to me to be poor. Elevation and abduction to 60° must, indeed, be considered

a poor function in the shoulder which normally allows elevation and abduction up to 180° .

Andler says that in this group there were some cases of infraction without displacement. In all the other cases impaction had occurred, and the head followed every movement. He has also reported on "3 Fällen von gutstehender eingekeilter Fraktur", treated with an abduction splint. At the end of one week the fracture was displaced to such an extent that two patients (aged 19 and 10) required open reduction, whereas the third one could be reduced by traction.

TABLE 2
(after *Andler*)
Traction treatment.

No. of cases	Age	Position before	Position after	Functional result	Remarks
6	8, 13, 14, 14, 16, 16	Moderate displacement without particular shortening	Good	Very good	
1	50	Moderate displacement without particular shortening	Good	Good	Abduction to 130° . Elevation to 122° . Rotation unhindered.
1	55	Moderate displacement without particular shortening	Unchanged	Fair	Discharged himself after 8 days.
4	4, 9, 10, 17	Marked displacement	Good	Very good	
3	9, 10, 12	Marked displacement	Essentially improved. No shortening	Very good	
1	64	Marked displacement	Improved, still a little shortening	Fair	
1	79	Marked displacement	No better	Poor	

Even despite this, in my opinion, very unfavourable experience, they continued using the abduction splint at the Chirurgische Universitätsklinik of Tübingen, also in the after-treatment of operated cases.

Seventeen cases were treated by traction, 6–12 pounds during bed rest, in an attempt to reduce the fracture. In case of success, the arm was placed on an abduction splint with traction. If, at the end of 10 days, X-rays failed to show any improvement of the position, operation was performed.

Comments to Table 2:

It is surprising how young these patients are. Their average age is 23.3 years; only 4 are over 17. It is a general experience that children obtain good function in the shoulder after fracture, almost irrespective of the treatment given.

Andler does not say whether these children and youths were pleased with the extension treatment or whether they complained of the abduction splint. In several instances, they had trouble with the skin on the arm, bullae and eczema appearing under the adhesive tape or mastisol traction.

In addition to these 17 patients included in Table 2, he had 4 (aged 18, 18, 33, and 58) in whom reduction by traction proved unsuccessful, so open reduction was performed.

Nine patients had operations.

One was a fracture-dislocation and in another one there was "clinically demonstrable interposition". The other 7 operations were performed to obtain an anatomically correct position. The results were as follows:

TABLE 3
(after *Andler*)
Open reduction.

No. of cases	Age	Anatomical		Functional result	Remarks
		Position before	Position after		
5	10, 17, 18, 18, 19	Marked displacement	Good	Very good	Including one case of epiphyseal separation.
4	33, 36, 45, 58	Marked displacement	Good	Very good	In one case complicated by dislocation of the head.

After open reduction three of the fractures were fixed with percutaneous nail removed at the end of two weeks, and one case with an ivory peg. The others had no fixation. All the patients had after-treatment with abduction splint. They returned to work 2-3 months after the operation.

Ritter (1927) has analysed the material from the surgical clinic of the Augusta- und Bürgerhospital of the Cologne University.

Out of 70 patients only 37 were followed up for more than 6 months after discharge. Nineteen could not be traced and 13 had died. Nearly all the patients had been treated by traction 125° - 160° in bed for 3 or 4 weeks.

21	obtained	excellent	function
22	„	good	„
12	„	satisfactory	„
5	„	unsatisfactory	„

The result was assessed in part at follow-up and in part at discharge.

In addition, the material included 5 patients with complicating dislocation, but they will be discussed in Chapter II (p. 52).

Domrich (1931) based his discussion on the follow-up of 38 patients out of 70 treated for fracture of the upper end of the humerus at the Surgical University Clinic in Berlin during the period 1924 to 1929. In his opinion, all fractures in an anatomically correct position will heal spontaneously, regardless of the treatment given, but union may be speeded up by motion, heat, and massage. He also sets up another two groups that obtain good function despite a poor anatomical position, viz. (a) fractures in young people, and (b) fractures at the lower end of the surgical neck, at the junction to the shaft. Out of the 38 patients who were followed up, 19 (50 %) had restriction of movement and/or other complaints. *Domrich* concludes that "all these restrictions of movement and complaints may be attributed to healing in bad position" after reporting the following case:

"Case 2. Georg K., aged 38, who had been attacked and thrown into a ditch. X-ray findings: Transverse fracture of the surgical neck with marked anterior displacement and less marked medial displacement of the distal fragment. Treatment: Triangle, at the end of two weeks again an attempt at reduction by manipulation, and then Desault's bandage. Follow-up at end of 5 years: The patient is able to move the arm freely, and he has no complaints. X-rays show that the original

displacement is still approximately the same, but even so the functional result is good".

Domrich arrived at the conclusion that all fractures of the surgical neck with marked displacement had to be accurately reduced, by a closed or open procedure, and that they must all be treated on an abduction splint. It does not appear from his paper *how* he has arrived at this conclusion. In addition to the operated cases, he only reports 8 case histories in 5 of which the treatment is stated. The one cited above is one of them. Another patient was a 12-year-old girl with a fracture of the surgical neck and lateral displacement of the distal fragment. She was treated with a plaster cast for 4 days, then attempt at reduction, and abduction splint for 8 days. Thereafter, sling, heat, and massage. The result was good. The third patient, aged 50, had fracture of the surgical neck and greater tuberosity, treated with a triangle for 10 days and then by exercises with the following result: Flexion 135° , abduction 120° . X-rays showed healing in unchanged position. The fourth patient, aged 62, had a fracture of the surgical neck with rotation displacement, treated by functional measures with the following result: Flexion 135° , abduction 120° . X-rays showed healing in unchanged position. Case No. 5 was treated by skin traction and obtained good function. The average age of these 8 patients was 47 years; only one was under 38.

Domrich does not define what he means by "restriction of movement and complaints", but it may be seen from his case reports that he includes in this category patients who are 20° – 30° short of complete elevation. In my opinion, this restriction of movement is of no account to most people.

Eleven patients had marked displacement. Closed reduction was successful in one, and he obtained good function. Another patient arrived too late, when too much callus had formed. (The end result is not mentioned). After an attempt at reduction in the third patient, he developed a pulmonary infarction, so no further treatment was tried. Eight of the 11 patients had open reduction. Of them 3 have no complaints and the function is satisfactory, 4 are completely stiff, and one died of sepsis. After the operation the patients were treated by wire traction through the olecranon, Middeldorpf's triangle, or abduction splint. The duration of the after-treatment is not stated for these cases or for any of the others.

Roberts (1932) has published an analysis of 96 cases of injuries to the upper end of the humerus treated at the Massachusetts General

Hospital, Boston. He grouped the results under three headings of anatomical (A), economical (E), and functional (F) result, rating them from 0 to 4, 4 being perfect or almost so, 3 around 75 %, 2 around 50 %, and 1 around 25 % of the desired result. 0 signifies virtual failure. A case rated A₄, E₄, F₄, therefore, means a wholly satisfactory result in all respects. *Roberts* stresses the importance of anatomical reduction, closed or open. In the case of children, however, he states that they usually obtain good function, even though the fracture heals in a poor position.

The types of fracture may be seen from Table 4.

TABLE 4
(after *Roberts*)
*Distribution of the different types of fractures of the upper end
of the humerus since 1923.*

Type of fracture	No. of cases
Transverse fractures of the surgical neck	26
Comminuted fractures	50
Greater tuberosity alone	4
Fracture-dislocations	13
with fracture of the greater tuberosity	8
with fracture of the head and neck	5
Separation of the upper humeral epiphysis	3
Total	96

Re Table 4: It is sometimes difficult to tell whether the fracture line is through the surgical neck or through the anatomical neck. *Roberts*, therefore, calls the first two types (a total of 76) "either surgical or anatomic neck injuries". Of them only 4 were diagnosed as fractures of the anatomical neck.

Re Table 5: Out of the 26 patients with fractures of the surgical neck 19 required manipulation under an anaesthetic. In case of success, the patient was after-treated with skin traction in abduction for three weeks.

Closed reduction failed in 6 cases. Traction in abduction was tried for 4-7 days, but without success, so open reduction was done. After-treatment: Traction in abduction.

Three patients, aged 15, 16, and 17 years, had epiphyseal separation. One, without displacement, was treated with sling, swathe, and early motion within one week. The other two had open reduction and after-

TABLE 5
(after *Roberts*)

Comparison of age incidence, treatment and time of starting active motion of transverse and comminuted fractures of the upper end of the humerus.

	Transverse fracture of surgical neck		Comminuted fractures	
Age of patients	Under 20 yrs.	16	Under 20 yrs.	3
	Between 20-45	0	Between 20-45	1
	Over 45	10	Over 45	46
Traction	48 per cent		15 per cent	
Airplane splint	12 per cent		14 per cent	
Sling and swathe	20 per cent		67 per cent	
Operations	20 per cent		4 per cent	
Age of patients operated on	Under 20 yrs.	5	Under 20 yrs.	0
	Over 45 yrs.	1	Over 45 yrs.	2
Time of starting active motion	Under 2 wks.	0	1 to 10 days	21
	2-4 wks.	7	10 days to 2 wks. ...	9
	Over 4 wks.	8	2-4 wks.	9
Miscellaneous	2 cases lost track of or died within a year.		9 cases lost track of or died within a year.	

treatment by traction in abduction for three weeks and then motion. The result was excellent in all three.

Comparing the two types, transverse fracture and comminuted fracture, we find how much fewer of the latter type were treated by traction and operation, a far larger proportion by sling and active motion. Only 2 of this latter group had operations.

TABLE 6
(after *Roberts*)

Comparison of the present-day treatment of transverse fractures of the surgical neck with the treatment seven years ago.

Years	Cases	Type of treatment					
		Traction	Airplane	Plaster shoulder cap	Sling and swathe	Motion within 2 weeks	Operation
1921-1924	19	20 %	37 %	12 %	5 %	None	20 %
1924-1930	26	48 %	12 %	...	20 %	None	20 %

Re Table 6: This table shows that as time goes by more patients at the Massachusetts General Hospital with fracture of the surgical neck are being treated by traction and sling and fewer by aeroplane splint and plaster shoulder cap.

TABLE 7
(after Roberts)

Comparison of present-day treatment of comminuted fractures of the upper end of the humerus with the treatment of seven years ago.

Years	Cases	Type of treatment					
		Traction	Airplane	Plaster shoulder cap	Sling and swathe	Motion within 2 weeks	Operation
1921-1924	28	4 %	69 %	10 %	17 %	1 case	...
1924-1930	42	15 %	14 %*	...	67 %	21 cases (all inside of 10 days)	4 %

* Since 1924 there had only been six fractures immobilized in an airplane splint, or about one a year.

Re Table 7: In the course of time, immobilizing bandage in aeroplane splint is being abandoned, ever more cases being treated by sling and early active motion.

The end results may be seen from Table 8.

At the Massachusetts General Hospital there is a definite trend away from apparatus and prolonged immobilization and towards the simpler forms of fixation and early active motion. This new form of treatment has given better end results.

Gregersen (1933) conducted a follow-up on 70 out of 130 patients treated during a 9-year period at the Surgical Out-patient Department of the Municipal Hospital, Copenhagen. These patients had been treated by the method of Championnière which was introduced in Denmark by *Collin*. The arm is supported in a sling, and massage and motion are employed from the outset, first passive motion, but at the end of two weeks active motion and pulley exercises.

Out of the 70 patients 7 had marked displacement, 33 less marked displacement, 30 slight or none. Reduction was tried in a few adults with very marked displacement, but usually without much success, and on the whole displacement was not considered of much importance. In children there was a more marked tendency to reduce with more success than in adults. The average period of treatment was 5½ weeks. At follow-up all the patients had full or almost full movements. This series comprises only out-patients, and it is, therefore, selected in the sense that it does not include the most severe cases which were admitted as in-patients. In addition, the assessment of the

result is weakened by the fact that only about 54 % of the patients were followed up.

TABLE 8
(after Roberts)

End results of the different types of fractures of the upper end of the humerus treated over the past seven years at the Massachusetts General Hospital.*

Types	Anatomic					Economic					Functional					
	4	3	2	1	0	4	3	2	1	0	4	3	2	1	0	
Transverse, surgical neck, 26 cases	18	3	2	1		20	2	1	1		19	3	1	1		2 cases lost
Comminuted, 50 cases	41	2				43					39	4				3 cases lost; 4 cases ended fatally
Greater tuberosity, 4 cases	3					3					3					1 case ended fatally
Dislocation with A, fracture of greater tuberosity, 8 cases	7				1	6	0	1	1		6			1		Ao, Eo, Io 6 mos. old case in a patient too aged to cooperate;
B, head and neck, 7 cases	4	1				4	1				3	1		1		1 patient dead, 1 discharged against advice.
Epiphyseal separation, 3 cases	3					3					3					

* The results are graded from 0 to 4, the latter being perfect.

TABLE 9
(after Wentworth)

Fractures of the surgical neck of the humerus.

Age grouping	Number of cases	No final disability, percentage	Final disability	Percentage of disability when last seen	Weeks to maximum improvement
Up to 20 yrs. (av. 10)	15	100 %	None		6.7
20 to 50 yrs. (av. 41)	20	75 %	25 % had	15 %	13.0
Over 50 yrs. (av. 65)	114	31 %	16 % had	20 %	53 % had 20 % at 8 wks.
Total	149				Unknown

76 % of the patients averaged 65 years of age.

TABLE 10
(after *Wentworth*)
Humeral neck fractures. Fifteen cases under 20 years of age.

Number of cases	Anaesthetic	Type of immobilization	No disability Percentage	Weeks to maximum improvement
4	None	Sling 3½ wks.	100 %	4
11	General	Spica 4½ wks.	100 %	8
(Two open operations)				

Wentworth (1940) had 149 fractures of the surgical neck in the Hospital of Rochester, New York. In patients under 50 years of age, much value is placed on accurate reduction, and in those over 50 on early mobilization.

Re Table 10: The choice in method of treatment was based exclusively on stability, or lack of it, of the fragments after reduction.

TABLE 11
(after *Wentworth*)
Humeral neck fractures. Twenty cases between 20 and 50 years of age.

Number of cases	Anaesthetic	Type of immobilization	No disability	Final disability	Weeks to maximum improvement
7	None	Sling 3 wks.	5 or 71 %	2 or 29 % had 35 %	10
2	2 general	Traction 4½ wks.	1 or 50 %	1 or 50 % had 20 %	10
2	1 general	Abduction splint 4 wks.	1 or 50 %	1 or 50 % had 5 %	17
9	9 general	Spica 5 wks.	8 or 88 %	1 or 12 % had 10 %	15
(Two open reductions)			2 or 100 %		12

Re Table 11: Twenty patients, ranging in age from 20 to 50. The choice of treatment after reduction was based on the stability of the fracture. Traction was applied, if the patient had to be confined to bed for other reasons. In this group the result proved to depend more on accurate reduction than on early mobilization. As an end result,

75 % of the patients had no complaints, whereas in 25 % there was on an average 15 % disability.

TABLE 12
(after *Wentworth*)
Humeral neck fractures. Seventy-three cases over 50 years of age.

Number of cases	Type of immobilization	No disability Percentage	Final disability	Disability when last seen
40	Sling 2½ wks.	42 %	3 % had 25 %	55 % had 20 % at 8 wks.
13	Traction 3 wks.	None	46 % had 20 %	54 % had 20 % at 12 wks.
6	Abduction splint 4 wks.	16 %	34 % had 25 %	50 % had 30 % at 7 wks.
14	Spica 4½ wks.	35 %	30 % had 20 %	35 % had 25 % at 6 wks.

Re Table 12: Out of the 114 patients over 50 years of age, 41 were only seen once, i.e. for diagnosis and reduction. Seventy-three were followed up. The older the patient, the more stress was laid on mobilizing treatment. At this hospital, mobilizing treatment is on the whole on the increase. In many of the elderly patients reduction was not even tried.

Brostrom (1943) briefly reports the treatment and therapeutic results in 97 fractures at the upper end of the humerus from the Charity Hospital, New Orleans. In some instances reduction was performed, and then, or without preceding reduction, the arm was kept in a sling, lightly fixed to the side. At night the patient is positioned with the trunk in 35° elevation. Heat, massage, and motion from the outset. First passive, but from the 5th–7th day active movements. In analysing the results *Brostrom* does not pay any regard to the site of the fracture. The results were as follows:

Poor	6 cases
Fair	17 "
Good	32 "
Excellent	27 "
Undetermined	15 "

CHAPTER II

FRACTURE-DISLOCATION

NOMENCLATURE

There is some disagreement as to what is to be called fracture-dislocation of the shoulder, no doubt because this joint is not comparable with any other joint owing to the lax joint capsule. It permits marked displacement between the joint surfaces of the humerus and scapula without bursting. In any other joint, displacement of any extent will burst the joint capsule, and the joint surface will slip out of the capsule.

In reviewing the literature the author has to include those cases which have been classified as fracture-dislocation by the reporters, even though the head has been within the joint capsule. Bardenheuer's "Umkehrungsluxation" is in fact only a displacement of the fracture, which may be so gross that the joint surface of the humerus faces the distal fragment, whereas the fractured surface of the upper fragment faces the glenoid cavity.

In *Watson-Jones'* impacted fracture-dislocation, the fragments are impacted with an 80°–90° abduction angulation. With the arm at the side, the head is pulled away from the glenoid fossa, and a "type of fracture-dislocation" is produced.

Silfverskiöld (1928), discussing the diverse nomenclature suggests the following definition: "Fracture-dislocation is a dislocation, complete or partial (subluxation), combined with one or more intra- or para-articular fractures". He also mentions the intra-articular dislocation described in the literature ("rotary dislocation" "Umkehrungsluxation").

In the present series, *fracture-dislocation refers only to the condition in which a fracture of the upper end of the humerus co-exists with dislocation of the head of the humerus, so that the joint surface must be assumed to be outside the joint capsule*. Whenever the head is within the joint capsule, no matter how marked its rotation, I shall speak of *displacement of the fracture*.

FREQUENCY

Fracture-dislocation is fortunately rather uncommon. From his studies of the literature *Silfverskiöld* concluded that even experienced surgeons seldom had seen more than 10 cases.

From the literature up to 1861 *Thamhayn* (quoted by *Robert Jones*) collected 68 cases, 14 of which were fractures of the anatomical neck.

Among 200 complicated dislocations of the shoulder *Robert Jones* (1906) found 16 fractures of the surgical neck.

Roemer (1917), searching the literature 1900–1913, found 48 fracture-dislocations (with exclusion of comminuted fractures) 17 of which were at the anatomical neck, 8 through the greater tuberosity region, and 18 at the surgical neck.

Without doubt, fracture of the greater tuberosity is a more common complication of dislocation of the shoulder than generally recognized. When the dislocation has been reduced, the greater tuberosity generally returns to its anatomical site, and a fracture is then perhaps not demonstrable on the X-ray film, if it is not taken until after the reduction.

According to *Watson-Jones* (1946) nearly 30 % of dislocations of the shoulder are complicated by fracture of the greater tuberosity.

TREATMENT

The following general considerations are based particularly on the publications of *McBurney & Dowd* (1894), *Schoch* (1901), *Robert Jones* (1906), and *Silfverskiöld* (1928).

The treatment of fracture of the greater tuberosity complicated with dislocation seldom causes much difficulty. As already mentioned, the greater tuberosity usually returns to its anatomical site, when the dislocation is reduced. If not, the treatment is the same as in fracture of the greater tuberosity without dislocation.

As regards the treatment of dislocation complicated by fracture of the anatomical or surgical neck, however, opinions are divided.

Robert Jones reports that the occurrence of fracture-dislocation was well known and described by many of the older surgeons. He writes: "Indeed, fifty years before the Christian era, Pasicrates (quoted by *Malgaigne*), in describing the injury, expressed his opinion that he preferred first to reduce the dislocation, and then to allow union of the humerus. *Ariston*, on the contrary, endeavoured so to arrange traction that it would act upon both head and shaft simultaneously, which

presumably involved waiting for union before any attempt at reduction. Heliodorus supported the contention of Pasicrates; and so it will be noticed, that in older times, just as nowadays, schools existed, the one in favour of immediate reduction, and the other in favour of allowing the shaft to unite before proceeding with the displacement of the head. In the latter half of the fourteenth century Guy de Chauillac laid down precisely the law that, if a fracture of the shoulder is complicated by a dislocation, the dislocation should be first reduced, if possible; if it is not possible, then the fracture should be allowed to become firm, and the dislocation be subsequently reduced”.

Petit, in 1725, suggested that the fracture should first be allowed to heal, before the dislocation was reduced. He said that this procedure was not always successful, but he did not think there were other ways of reducing these dislocations. *Oger* collected all cases treated by this method up to 1894. He found a total of 10; 7 were absolute failures and 3 doubtful successes.

In the pre-antiseptic era only a few operative interventions were carried out. According to *Schoch* the first open reduction was performed by Wattman in 1820 on a sub-coracoid dislocation of 11 months' standing. This operation resulted in prolonged suppuration and a poor function. From about 1880, operative intervention gained ever increasing ground, first resections—especially in long-standing cases—and later ever more arthrotomy combined with reduction and in some cases osteosynthesis. After the advent of chemotherapy and antibiotics, these operative procedures have become even more common.

THERAPEUTIC METHODS AND RESULTS OF INDIVIDUAL SURGEONS

McBurney & Dowd, in 1894, collected 117 fracture-dislocations from the literature and discussed the treatment. In 69 cases the fracture was at the surgical neck, in 27 at the anatomical neck, and in 11 through the tuberosities. In 6 instances there was fracture of the surgical as well as the anatomical neck. One was comminuted. The “upper part” of the humerus was fractured in 3 cases.

Riberi (quoted by *McBurney & Dowd*), in 1843, reported a case which he had treated by passive motion in order to establish a false joint at the point of fracture, the dislocated head of the humerus being left unreduced.

McBurney states that although this injury has been known from olden times, it is rare, and no surgeon has seen more than 5 cases. Discussing the various methods of treatment, he reports a case operated on with excellent result by the method which has ever since borne his name. Through a small incision on the lateral aspect of the shoulder he exposes the central fragment, boring a hole in it with the drill which he had designed. Into this hole he inserts a rectangular hook and exerts traction on the central fragment until it has become reduced—in the reported case at the first attempt. Previously, *McBurney* had found it extremely difficult to obtain good results. Energetic attempts were made to reduce by manipulations. *McBurney* mentioned 6 cases in which such prolonged, violent, and energetic attempts at reduction had resulted in death.

Schoch (1901), analysing 54 fresh cases (treated within one month) and inveterated cases from the literature, arrived at the result that if closed reduction proves unsuccessful, open reduction is indicated in fresh cases. In cases of inveterated dislocation with fracture, there is an indication for arthrotomy and reduction, if the proximal fragment and other factors appear to be suitable, but he does not recommend reduction at all events. Resection in suitable cases is more likely to lead to a good result. *Schoch* demonstrated that operation should not be deferred too long. Out of 18 fresh cases infection occurred in 2, whereas of 36 “inveterated” fractures infection occurred in 7.

Robert Jones (1906) reported his experience based on 22 personal cases and gave an interesting historical survey. He emphasizes the importance of reduction as early as possible, but goes on to say that reduction may be extremely difficult. “Of 80 recent cases, where manipulation, gentle and forcible, was tried, only thirty-six reductions were accomplished, while forty-four failures occurred”. According to *Jones*, excision of the head should only be performed in old cases in which pressure or obstructive symptoms demand it. *McBurney*’s operation should be performed in all other cases, where manipulation has failed. If reduction has been accomplished, the after-treatment does not give rise to any difficulty. The patient can be allowed to sit in order thereby to exert the most gentle traction on the distal fragment. Massage and systematic passive motion are started from the 4th to 8th week.

In fracture and dislocation of the central fragment outside the capsule *Bardenheuer* (1907) recommends closed reduction, if possible, otherwise open. In cases of “Umkehrungsluxation” of the head with the fractured surface against the articular surface of the scapula *Barden-*

TABLE 13
(after *Mason*)
Recent dislocation with fracture at surgical neck. (Number of cases 29).

Treatment	No.	Result					
		Good	Fair	Impr.	Bad	Died	Not stated
Arthrotomy and reduction	18	12	1	1	2	2	
Reduction	4		1	2	1		
Rest and massage	2		1	1			
Excision	4		3			1	
Not stated	1						1
Total	29	12	6	4	3	3	1

One case is counted twice, primary arthrotomy with reduction, and secondary excision.

TABLE 14
(after *Mason*)
Old dislocation with fracture at surgical neck. (Number of cases 9).

Treatment	No.	Result					
		Good	Fair	Impr.	Bad	Died	Not stated
Excision	5		1	3			1
Dislocation untreated	2		1		1		
Massage and electricity	1				1		
Riberi	1				1		
Total	9		2	3	3		1

TABLE 15
(after *Mason*)
Recent dislocation with fracture at anatomical neck. (Number of cases 13).

Treatment	No.	Result					
		Good	Fair	Impr.	Bad	Died	Not stated
Excision	6		3	2		1	
Arthrotomy and reduction	3	1	2				
Reduction	2	1					1
Rest and massage	2			1	1		
Total	13	2	5	3	1	1	1

TABLE 16
(after *Mason*)
Old dislocation with fracture at anatomical neck. (Number of cases 13).

Treatment	No.	Result					
		Good	Fair	Impr.	Bad	Died	Not stated
Excision	6		2	3			1
Arthrotomy and reduction	2	1					1
Linear arthrotomy (?) Riberi	1						1
Not clearly stated	4						4
Total	13	1	2	3			7

TABLE 17
(after *Mason*)
Condensed summary of all cases. (Number of cases 63).

Treatment	No.	Result					
		Good	Fair	Impr.	Bad	Died	Not stated
Arthrotomy reduction	23	14	3	1	2	2	1
Excisions	21		9	10		2	
Reduction by manipulation ...	6	1	1	2	1		1
Rest and massage	5		1	2	2		
Dislocation not treated	2		1		1		
Riberi method	2				1		1
Not stated	5						5
Total	64	15	15	15	7	4	8

(See note at foot of table 13, one case counted twice).

heuer tries traction for 8 days. In case of failure, he thinks that open reduction and osteosynthesis is the method of choice.

Mason (1908) analysed 63 cases with fracture at the neck of the humerus and 21 with fracture of the greater tuberosity reported since 1894. There were 37 surgical neck fractures and 26 anatomical neck fractures.

In *Mason's* terminology recent cases are cases treated within a month of the accident; the others are old cases. *Mason* concludes that first closed reduction by gentle manipulations should be tried and, in case of failure, open reduction. Excision of the head should only be performed (1) if open reduction fails, (2) in the presence of strong ad-

hesions around the head, and (3) if the proximal fragment is not believed to be in a condition in which it can heal. This is particularly in fractures of the anatomical neck. As far as dislocation complicated by fractures of the greater tuberosity is concerned, *Mason* states that the separated tuberosity often prevents reduction of the dislocation. Even though the dislocation is reduced, the tuberosity will, in his opinion, often heal in a wrong site, leading to restricted movements. It is, therefore, important to make sure that the tuberosity is *in situ*, even if this requires an operation and nailing. *Mason* emphasizes that excision of the head should be preferred to letting the case end in ankylosis. The result after excision, however, cannot be more than good, never very good.

In fracture of the anatomical neck with dislocation of the head outside the joint capsule, any attempt at closed reduction is, according to *Tanton* (1915) and *Matti* (1931) useless, and may even be dangerous.

In fracture of the surgical neck with dislocation, *Tanton* thinks closed reduction will be successful in most cases, especially fresh ones. He prefers Richet's method, viz.: "Under anaesthesia an assistant exerts a mild and progressive traction of the arm which he brings into a position of more and more abduction so that the end of the diaphysis comes to face the glenoid cavity. The surgeon working towards the axilla and its anterior boundary now manipulates the head toward the glenoid cavity. Reduction accomplished, traction is applied". If closed reduction fails, open reduction must be done with fixation in abduction, but excision of the head should only be done as the last resort.

Roemer (1917) analysed 76 cases of operated fracture-dislocations of the upper end of the humerus from the literature 1900–1913, adding 3 operated on by his chief, Hofmeister of Stuttgart. Like *Mason*, he thinks that the results of resection can never become very good, but only good. *Roemer* includes only fresh cases, i.e. those operated upon within a month of the accident. Nor does he include fractures of the greater or lesser tuberosity or comminuted fractures, as "no general plan can be fixed for the treatment of these fractures", but only transverse fractures at the upper end of the humerus with dislocation. This gave 48 fracture-dislocations:

23 cases treated by open reduction: 13 very good = 56.5 %.

25 cases treated by primary resection: 7 good = 28 %.

Roemer came to the conclusion that closed reduction was to be done, if possible, otherwise open reduction. If the latter procedure fails, or

if the surgeon forms the opinion, during operation, that the fracture will not heal, the proximal fragment must be removed.

After reduction which, according to *Sever* (1923) and *Eliason* (1945), must be done, closed or open, *Sever* applies traction on an abduction splint, while *Eliason* uses a plaster spica in abduction.

In his series from Cologne *Ritter* (1927) has 5 fracture-dislocations. In two the fracture was at the anatomical neck and the head was in the axilla in one, while it was below the coracoid process in the other patient who was 80 years of age. Both obtained a good result from closed reduction. One of the patients, with a fracture of the surgical neck, was 81 years of age. After an unsuccessful attempt at reduction the proximal fragment was removed. Ankylosis resulted. There were 2 patients with fractures through the anatomical as well as the surgical neck. One of them was treated with traction during bed rest with a "good result", but the patient was not followed up. In the other case resection of the head was done towards the end of the second week. At discharge there was 45° active abduction. The patient was not followed up.

TABLE 18
(after *Silfverskiöld*) (1928)

	Number of cases	Very good	Good	Mode- rate	Bad
Primary resect.	2			1	1
Open reduction	12*	5	3	3	1

* In three of these secondary resection was done.

Gerard-Marchant (1928) has reviewed the different methods of treatment in detail: (a) The oldest method of allowing the fracture to heal and then trying reduction of the dislocation, is now of historical interest only. (b) Mobilization, in which the fracture and dislocation are disregarded, and it is endeavoured to produce pseudarthrosis or nearthrosis. (c) Reduction, closed if possible, but otherwise by operation. As the routine method he recommends operative reduction, immobilization in abduction for 12–15 days, followed by motion, massage, and heat.

Silfverskiöld (1928) has given an excellent review of the literature adding 16 recent cases of fracture-dislocation 15 of which were operated on by various Stockholm surgeons, whereas closed reduction proved sufficient in one. One of the patients had 3 operations. Five had pure anatomical neck fractures. In 3 the head proper was frac-

tured. No case was a pure surgical neck fracture; as a rule the fracture was pertubercular and comminuted. After open reduction (in most cases without osteosynthesis) and resection of the head, most cases were bandaged with the arm abducted on a splint or in a plaster cast. The patients were kept in hospital for 4–8 weeks, and then given after-treatment for from 6 to 12 months. The end results may be seen from Table 18:

(One of the 15 operated patients had gone abroad and could, therefore, not be after-examined). *Silfverskiöld* considers it "very possible, though not proved, that the stripped, displaced head-fragment is always capable of entering into bony union, that is to say that union or non-union after reduction exclusively depends upon the treatment". In his opinion, attempts at closed reduction should only be made in the presence of a general contra-indication to operation. He says that the routine method must be operation as early as possible, preferably reduction, but otherwise in exceptional cases resection of the head. Then bandage in abduction for a minimum of three weeks.

TABLE 19
(after *Wentworth*)

Six cases of dislocation with fractured surgical neck.
(Average age 62, 10 years older than in uncomplicated dislocation).

Number of cases	Treatment	External fixation	Percentage loss of use, final	Remarks
3	Closed reduction	Sling	20 %	No nerve injury or circulatory damage.
1	Removal of head	Sling	25 %	Failure in attempt at closed reduction.
1	Open reduction internal fixation	Sling	50 %	Infection and ankylosis. Refused treatment.
1	Untreated		75 %	No scapulohumeral motion.

Roberts (1932), in his material of 96 fractures of the upper end of the humerus, has 5 fracture-dislocations with fracture of the head and neck. One patient left the hospital without treatment. Another patient had a dislocation of 6 weeks' standing when he first arrived. Traction in abduction was tried as the first step of reduction, but at the end of

two days the patient refused further treatment. The 3rd patient had open reduction of a fracture-dislocation of 2½ months' duration. He developed secondary osteomyelitis and ankylosis. The fourth patient had fracture of the anatomical neck with dislocation. The proximal fragment was removed with a good functional result. The 5th patient had a fracture-dislocation of 3 months' standing which was reduced by an open procedure. Re-dislocation occurred at the end of two weeks, but closed reduction proved successful, and the patient obtained excellent function.

Wentworth (1940) had 6 dislocations with fractured surgical neck. The results may be seen from Table 19.

The first three were reduced under an anaesthetic, with traction first in adduction, carried gradually into abduction with simultaneous cautious manipulation and pressure into the axilla and external and internal rotation of the arm. One of these patients weighed 300 pounds. It is impossible to tell in advance which fractures will be amenable to closed reduction. According to *Wentworth* there is no danger in trying to reduce, if only it is done gently, and the results prove to be better after closed than after open reduction or after removal of the head.

In addition to these 6 fractures of the surgical neck *Wentworth* had, among 110 humeroscapular dislocations, 15 with fracture of the greater tuberosity (cf. Table 20).

TABLE 20
(after *Wentworth*)
Fifteen cases of dislocation with fractured greater tuberosity.
(Average age 50, same as in uncomplicated dislocations).

Number of cases	Type of immobilization	No disability	Final disability
12	Swathe for 2 wks.	4 or 33 %	3 had 20 % at 8 mos.
3	Spica in 50° abduction, 30° flexion 4½ wks.	2 or 66 %	1 had 25 % at 4 mos.
			5 unknown.

Displacement of the tuberosity occurred after reduction in one case. In all the others the tuberosity returned to its anatomical site, when the dislocation had been reduced. Operative fixation was not required in any case. One-third of the patients were only seen once, so the end results are not known. One-third had no complaints at follow-up.

Böhler (1941) reduces with a 10–20 kg gentle traction in an inter-

mediate position in the shoulder (90° abduction and 45° flexion), preferably in traction apparatus and with manipulations, or with the foot in the axilla. Then, skin traction on an abduction splint. It does not appear to be so difficult for *Böhler* to reduce fracture-dislocations, but *Andler* (1924) doubts that one case published by *Böhler* in 1923 was dislocated at all. According to *Böhler* it is sometimes impossible, however, to reduce fractures of the anatomical neck by a closed procedure. He had previously used open reduction in such cases, but this frequently resulted in necrosis of the head and stiffness of the shoulder. He has, therefore, gradually become more reserved in regard to operation, and he has also seen fairly good functional results, even when the dislocation is left untreated. If the central fragment is pressing upon vessels or nerves, it must be removed. In *Böhler's* opinion, this gives a better result than open reduction.

Gerhardt & Grolitsch (1941) had 18 fracture-dislocations in a series of 135,684 injuries, 22,156 of which were fractures, at the Surgical University Clinic in Vienna. There was not in any case damage of the nerves or vessels. Their treatment was as follows: (1) Local analgesia. Attempt at reduction by traction and manipulations. In case of failure, a wire is applied through the ulna. Then (2) attempt at reduction in local analgesia in *Böhler's* traction apparatus. If this is not successful, (3) attempt at open reduction under local analgesia in the apparatus. If this too fails, (4) excision of the head. After-treatment in all cases: Traction on an abduction splint with fixing bandage for 4 weeks, followed by heat and motion. In very old patients in a poor general condition they abstain from any intervention, placing the shaft of the humerus instead into the glenoid fossa. I have tried to tabulate *Gerhardt & Grolitsch's* results in the following tables:

TABLE 21
Fracture of the surgical neck with dislocation.

Treatment	Number of cases	End results				
		Very good	Good	Mod- erate	Bad	? or †
Closed reduction	5	5				
Open reduction	1					?
Primary resection	2				2	
Abduction splint only	2				1	?
Total	10	5			3	2

TABLE 22
Fracture of the anatomical neck with dislocation.

Treatment	Number of cases	End results				
		Very good	Good	Moderate	Bad	? or †
Closed reduction	1				1*	
Primary resection	2				2	
Total	3				3	

* Necrosis of the head.

TABLE 23
Comminuted fracture of the upper end of the humerus with dislocation.

Treatment	Number of cases	End results				
		Very good	Good	Moderate	Bad	? or †
Closed reduction	2	1				†*
Primary resection	1				1	
No treatment	1					†**
Total	4	1			1	2

* Developed pulmonary abscess and died. ** Died within follow-up period.

TABLE 24
Longitudinal fracture of head and shaft with dislocation.

Treatment	Number of cases	End results				
		Very good	Good	Moderate	Bad	? or †
Closed reduction	1	1				
Total	1	1				

Madsen (1949) discussed fracture-dislocations in detail on the basis of the literature and on 8 cases from the University Hospital, Copenhagen, Department D, and the Hospital at Kolding, Denmark. He included only the serious varieties with fracture of the anatomical or surgical neck or comminuted fractures, excluding fractures of the greater tuberosity with dislocation. Closed reduction was accomplished in two cases, with a good result in one and a poor result in the other.

Excision of the head was performed in further two patients, with a good functional result in one and a fair result in the other. Open reduction was resorted to in 4 cases. Two obtained good function, one fair, and one poor.

Michaelis (1944) has reported on 2 cases of comminuted fracture of the upper end of the humerus with dislocation. He obtained good function after removal of all loose fragments and bandaging on an abduction splint for 4 weeks in one case and for 2 weeks in the other. He prefers excision to reduction and advises against attempts at closed reduction. If the patient is too debilitated to tolerate this small operation, it may be necessary to support the arm in a sling and wait and see what result can be obtained.

During the period 1933–1934 *Dehne* (1945) carried on a follow-up study of “over 300 fractures of the head of the humerus and 37 with fractures of the great tuberosity”. In his series there were 17 fracture-dislocations. Two were treated by closed reduction with full recovery of function. Five were treated by open reduction, with a good functional result in 3, but poor in 2 “because of inadequate anatomical reduction”. Eight had removal of the head, 2 with a good and the others with a poor functional result. Two received no treatment. They had painful shoulders, and both died within 18 months of the accident. *Dehne* concludes that anatomical reduction alone, preferably by closed manipulations, leads to a completely satisfactory result. In his opinion, removal of the head is an unsatisfactory method of treatment, but better than poor reduction or no treatment at all. He described *R. T. McElvenny's method of closed reduction*: Under an anaesthetic the shaft is brought up to the head and impacted into the latter. Then, traction in a “Soutter apparatus”, slowly increased to 35 pounds. At the end of 5 minutes, the traction is released. This is repeated after a short rest, until the head slips into its correct position in the socket. In 3 out of 4 cases McElvenny is said to have succeeded in reducing dislocations by this method.

Watson-Jones (1946) discusses the three available methods of manipulative reduction (1) Hippocrates' 2000 year-old method of traction down along the side with the surgeon's foot in the axilla (Fig. 1). (2) Böhler's traction in abduction (Fig. 2), and (3) Robert Jones' traction in 140°–150° abduction (Fig. 3).

In *Watson-Jones'* opinion the two first methods involve the greatest danger of reducing the head of the humerus upside down, but in the third method there is a still more serious danger of damaging vessels

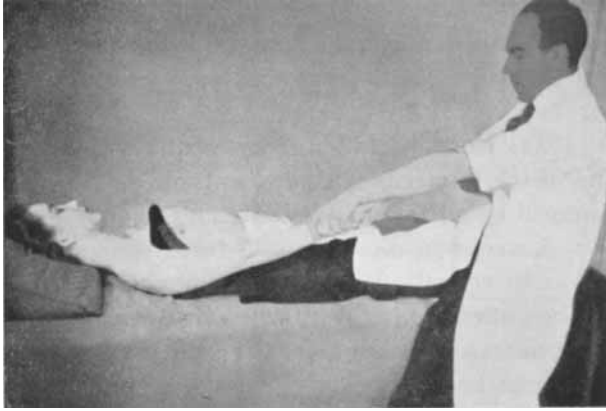


Fig. 1.

Hippocrates' method of reducing dislocations of the shoulder (after Watson-Jones).

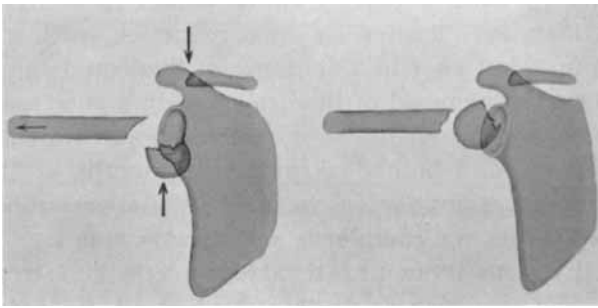


Fig. 2.

Böhrer's method of reducing dislocations of the shoulder (after Watson-Jones).

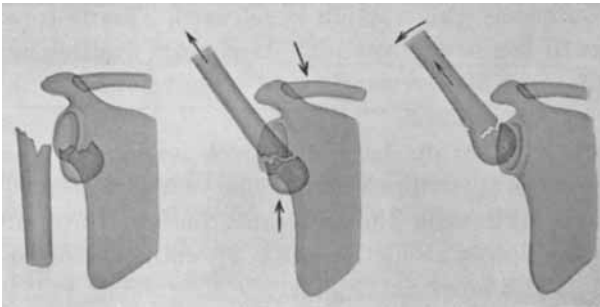


Fig. 3.

Robert Jones' method of reducing a fracture-dislocation of the shoulder (after Watson-Jones).

and nerves. He finds Hippocrates' method the most gentle one and therefore recommends trying it first. If closed reduction fails, open reduction should be done, but it involves a great risk of impairing the blood supply to the proximal fragment, resulting in avascular necrosis. In "impacted fracture-dislocation" he recommends in elderly patients 30° abduction in a light bandage with a large axillary pad and movements after 3 or 4 weeks. In younger patients open reduction, possibly fixing the stability as in Nicola's operation. If avascular necrosis supervenes, and pain in the shoulder persists, arthrodesis is recommended.

Sgrosso (1948) points out the difficulties of closed reduction, which is dangerous and must be performed very gently owing to the risk of damaging vessels and nerves. In his opinion, open reduction is particularly indicated in distal fractures, i.e. fractures of the surgical neck. He had performed this operation in only one case, a 20-year-old patient, in whom it resulted in ankylosis due to a bony bridge between the head and the edge of the glenoid fossa, but the patient was able to abduct up to 90°. Resection of the head had been done by *Sgrosso* in 3 instances with good functional results. After the operation, he fixed the arm in a plaster spica. *Sgrosso* concluded that in ankylosis in a good position or in arthrodesis, rotation is abolished, but good power in the arm is preserved, and abduction is possible to the horizontal position or even more. After resection of the head, on the other hand, rotation is better and abduction good, but there is little strength in the arm.

Tabanelli (1949) reports 14 fracture-dislocations: 10 with fracture of the anatomical neck, 3 with fracture of the surgical neck, and 1 with fracture of the greater tuberosity. He advises first an attempt at reduction by the Hippocrates method, then by a wire through the olecranon on Böhler's splint or in Christen's apparatus. If this fails, then open intervention, preferably reduction, but otherwise removal of the head. Out of his 14 cases closed reduction without wire traction was successful in 8 cases, with ulnar bone traction in 4. In 2 cases the head was excised after unsuccessful attempts at reduction.

CHAPTER III
MATERIAL
TREATMENT AND RESULTS IN SOME
COPENHAGEN HOSPITALS

The present series was investigated in the endeavour to answer the following three questions:

- (1) What is the prognosis of fracture of the upper end of the humerus?
- (2) Is union in an anatomically good or correct position necessary to obtain good function in the shoulder?
- (3) Which method is preferable as the routine treatment of these fractures?

DEFINITION, TRAUMA, SYMPTOMS AND
SIGNS, DIAGNOSIS

DEFINITION

The series includes only closed fractures of the upper end of the humerus, no open fractures, gunshot wounds, or the like.

In fact, the *upper end of the humerus* is not a well-defined, anatomical concept. All surgeons are agreed that fracture of the surgical neck is the lowest fracture of this region, so the question is: Where is the limit between the surgical neck and the shaft of the humerus?

In his thesis "On the Treatment of Fractures of the Arm" *Collin* calls all fractures of the upper third of the humerus "fractures of the upper end".

According to *Matti*, the surgical neck extends from the area of the tuberosities down to the insertion of the m. pectoralis and the m. teres major. *Scudder* calls a fracture below the epiphyseal line affecting the upper $\frac{1}{4}$ of the humerus a fracture of the surgical neck.

This latter classification is also used by the present author who considers the insertion of the pectoralis and the teres major to be at the upper end of the humerus and that of the deltoid on the shaft of the humerus.

Fracture of the upper end of the humerus is, therefore, taken to mean a fracture of its upper $\frac{1}{4}$.

TRAUMA

As a rule, the patient's history is a fall or a blow on the shoulder directly or he may have fallen on the outstretched hand or on the elbow. In the two latter instances, the blow will be transmitted up through the humerus.

The type of fracture will depend, to some extent, on the nature of the accident and on the position of the arm when it is hit by the blow, i.e. whether it is adducted, abducted, extended, or flexed.

It is usually difficult to elicit the exact history, when the patient comes to the doctor. Often, it is merely stated that the patient has had a fall on the outstretched hand or that he has fallen and hurt his shoulder.

Fracture of the upper arm may also be due to a missed blow in the air, or by the pull of the muscles, when two people are "trying strength", viz. sitting at a table with the bent elbow resting on the table, they grasp each other's hands and try to force the dorsum of the opponent's hand down to the table-top. These fractures are of a typical appearance, being spiral-shaped and affecting the middle third of the humerus.

Gurlt (quoted by *Bardenheuer*) found 57 fractures of the humerus due to stone throwing. According to *Matti* fractures of the surgical neck *may* be due to a blow in the air, stone throwing etc., but he points out that such fractures caused by muscular exertion usually affect the transition between the middle and upper third of the humerus. *Herzmark & Klune* (1952) have reported 4 fractures of the shaft caused by baseball-throwing.

This is mentioned merely for the sake of completeness, because fractures of the upper end of the humerus are very seldom, if ever, due to this cause.

SYMPTOMS AND SIGNS—DIAGNOSIS

When the patient comes to see the doctor, he generally keeps the injured shoulder hanging to relax the muscles and thus avoid pain, the upper arm in slight abduction and internal rotation, the elbow in flexion, and the forearm against the abdomen, supported by the well hand.

The diagnosis may be easy, difficult, or impossible without the aid of X-rays. At the outset, there is no swelling. Tenderness is present, but this is also the case in contusion. In subperiosteal fracture of the surgical neck, separation of the epiphysis without displacement, or impacted fracture of the surgical neck in a good position, it may be diffi-

cult to distinguish between fracture and contusion of the region. Active movements may be surprisingly easy, and passive movements do not give rise to more pain than in contusion, if the head of the humerus accompanies the movements.

As pointed out by *Matti* (1931), it is worth bearing in mind that in impacted fracture with easy active motion, the patient has more difficulty in moving against resistance, be it ever so slight, than one who has only sustained contusion.

In cases of unimpacted fracture or impacted fracture with marked lateral displacement, the diagnosis is generally easy. There is often visible deformity, the distal fragment pointing past the articular cavity, very often with inward and upward displacement (*Malgaigne's displacement*), and usually anteriorly in the axilla, whereas the head may be palpated *in situ* below the acromion. If dislocation is present, the curve of the shoulder may be seen or felt to be abolished, the acromion projecting laterally, so that a finger can be inserted below it which is not possible, when the head is in the glenoid cavity.

The interpretation is more difficult, when fracture and dislocation co-exist.

When the fracture is unimpacted, crepitation may at times be felt in attempts at passive movements, or it is evident that the head does not follow the movements of the arm. This is easiest to see, when standing behind the patient, grasping his elbow with the homonymous hand, and moving the arm, while grasping the shoulder joint antero-posteriorly with the other hand.

Sometimes, it is impossible to distinguish by clinical examination between contusion, fracture, and dislocation. *X-ray films* should, therefore, always be taken, if at all possible, before the treatment is instituted. The views should be at right angles on each other or stereoscopic. The most common procedure is first a view in which the beam is directed antero-posteriorly with the arm hanging down in the sling position. The arm is then abducted, and a lateral view taken with the direction of the beam up through the axilla, the film resting on top of the shoulder. This procedure entails the disadvantage that the position of the arm has to be changed between the two views, and this may displace a loose fracture or even break up an impaction.

Erin Madsen (1949) has suggested a method which appears to be good: The films are taken in two views at right angles on each other without any need to change the position of the arm which rests in a sling during both exposures.

As the author has no experience of this method *Erin Madsen's* own drawing is shown below.

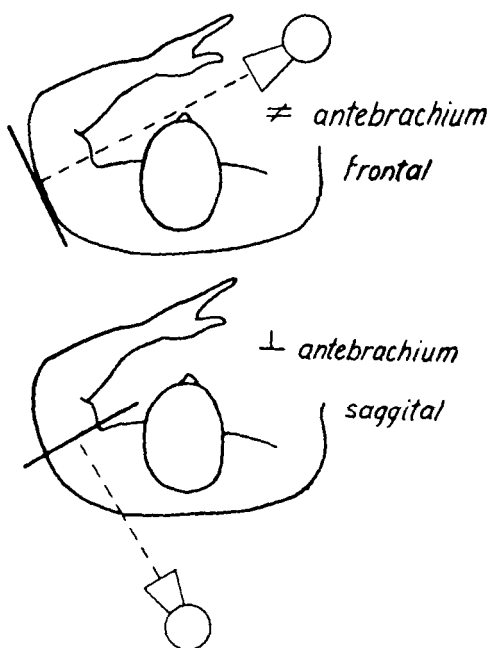


Fig. 4.
Procedure of X-ray exposures (after *Erin Madsen*).

MATERIAL

The material is derived from the University Hospital (Rigshospitalet), Departments C and D, the Copenhagen City Hospital (Kommunehospitalet), Departments I and V, and surgical out-patient department, and from the Orthopaedic Hospital in Copenhagen. It comprises all patients treated in these departments during the period 1938–1942 inclusive.

University Hospital, Surg. Dept. C	57 cases
University Hospital, Surg. Dept. D	56 „
City Hospital, Surg. Dept. I	97 „
City Hospital, Surg. Dept. V	81 „
City Hospital, Surg. Out-patient Dept.	121 „
Orthopaedic Hospital	69 „

Total 481 cases

Out of these 481 patients 88 are known to have died of irrelevant causes after discharge. Twenty had to be ruled out because of complicating conditions, such as fracture of the scapula, fracture near the elbow or of the forearm, tuberculosis or malignant tumor of the arm, or severe rheumatic lesion which has prevented the planned treatment or influenced its results.

Twenty-seven patients had moved to provincial towns. As they were not after-examined by the author, they are not included in the analysis of the end results.

Seventeen patients had fled from Denmark or kept in hiding from the national registry. (The follow-up study was carried out during the years that Denmark was occupied by German troops, and large numbers of people had to fly the country or "go underground").

This leaves 329 patients that might be expected to be included in the follow-up study, but 27 refused or maintained that they could not subject themselves to the follow-up examination, so the final number was 302 (91,8 %).

All the follow-up examinations were carried out by the author.

Even though these 27 patients had been included, they would probably not have changed the therapeutic result one way or the other. Their refusal was not due to particularly good or particularly poor results or to any dissatisfaction with the treatment they had received in hospital. I learnt this by visiting a large proportion of these patients. Some of them were willing to show me their mobility, but refused to take off their clothes for a thorough examination, so they are not included in the material.

The after-examined patients are distributed as follows by department:

University Hospital, Surg. Dept. C	35 cases
University Hospital, Surg. Dept. D	31 „
City Hospital, Surg. Dept. I	53 „
City Hospital, Surg. Dept. V	45 „
City Hospital, Out-patient Dept. of Surgery	92 „
Orthopaedic Hospital (in-patients)	27 „
Orthopaedic Hospital (out-patients)	19 „
Total	302 cases

TYPES OF FRACTURE

As already mentioned, the nomenclature has differed in classifying fractures of the upper end of the humerus. This is a disadvantage, especially in comparing therapeutic methods and results.

The following nomenclature will be used in the present study:

- (1) Separation of the upper humeral epiphysis.
- (2) Fracture of the anatomical neck.
- (3) Fracture of the surgical neck.
- (4) Fracture of the surgical neck and greater tuberosity.
- (5) Comminuted fracture of the upper end of the humerus.
- (6) Fracture of the greater tuberosity.
- (7) Fracture-dislocation.

Nos. 1 and 3-5 may present themselves as

- (a) Valgus fracture (abduction fracture) with lateral open angulation.
- (b) Varus fracture (adduction fracture) with medial open angulation.

In some cases it may be difficult to decide where exactly the fracture line is. Its course may be so as to combine two or more of the types mentioned.

Diagnosis is made in order to be able to institute the best possible treatment and to foretell the prognosis. While we do not yet know whether the different types of fracture call for different forms of treatment, it seems most reasonable to classify the fractures in this anatomical way, if the films give sufficient information.

Accordingly, the fractures will be named according to the course of the main fracture line. In fractures of the anatomical neck, for instance, there may also be fracture lines through the head fragment, but if the fragments are in a good position – as they usually are – I shall call this merely fracture of the anatomical neck, since it is the fracture through the anatomical neck which is most important, as it impairs or interrupts the blood supply.

In “comminuted fracture of the upper end”, on the other hand, the greater part of the upper end of the humerus is splintered. A fracture will not be designated as comminuted merely because it has some small chips between the fragments, as this is considered of no therapeutic or prognostic significance.

Abduction fractures and adduction fractures are named according to their appearance in the antero-posterior view.

This appears to be more logical than calling the abduction fracture “a fracture caused by lateral mechanism” (*Dehne* 1945). This author *imagines* the arm in 90° abduction and maximum internal rotation, stating that upon a further forced abduction there will be fracture of

the surgical neck as well as of the greater tuberosity. In my opinion, however, the mechanism is not always so schematic.

In the first place, fractures of the surgical neck and greater tuberosity with valgus displacement are not uncommon when the patient has fallen with adducted arm, receiving a blow directly on the outside of the shoulder. In the second place, there has perhaps not been any valgus displacement at the outset, possibly even varus, but by the erroneous movements made by the patient himself or others who have come to his aid, the arm has been brought into abduction, and a valgus deformity is the result. The present series includes several examples that a non-displaced fracture or a varus fracture may be converted into valgus, by abducting the arm, e.g. for the X-ray examination, or by bandaging on the often harmful abduction frame.

In most instances it seems to me to be merely theoretical speculation to try to reconstruct the history of the fracture on the basis of its X-ray appearance. It is true that in some cases it is possible to guess at the handling of the fracture before it was X-rayed, but as already mentioned, the displacement may have occurred after the bone was fractured.

Nor do I agree with *Dehne, Madsen, and Watson-Jones* that abduction fractures always co-exist with fracture of the greater tuberosity. This must depend on the extent of the trauma and the resistance of the bone. Valgus position is seen at times in fracture through the surgical neck alone and in other instances in fracture of the surgical neck and greater tuberosity.

It seems reasonable to name the fracture according to its localization in the bone and according to the displacement rather than after the mode of injury which cannot always be reconstructed.

Isolated fracture of the lesser tuberosity did not occur in this series of 481 fractures of the upper humerus. Perhaps insufficient attention was given to this possibility in examining patients with shoulder injuries. The fact is that this fracture is only detected, if a special search is made for it, because the X-ray films have to be taken in a special way. It is not visible on the ordinary view with the beam of an antero-posterior direction, when the arm hangs down along the side. Nor is it visible on the ordinary lateral view with abducted arm and the direction of the beam up through the axilla, the film resting on top of the shoulder, unless the arm is at the same time in external rotation, and this is rarely done.

ROTATION DISPLACEMENT

Practically all the authors who have mentioned rotation of the proximal fragment in fractures of the upper end of the humerus state that the proximal fragment is in external rotation in valgus as well as in varus fractures (*Bardenheuer* 1907, *Tanton* 1915, *Guleke* 1931, *Lanz & Wachsmuth* 1935, *Scudder* 1939, *Böhler* 1941, *Watson-Jones* 1946, *Karcher* 1947).

Only two of the authors whose publications I have been able to study have mentioned any other form of rotation displacement. *Dehne* (1945) has reported a case in which the head fragment was held in maximal internal rotation by the subscapularis muscle. But this is all he says about rotation displacement. *Poirier* (1895) reported 38 fractures of the surgical neck. He says: "Dans tous les cas, il y avait rotation de la tête en arrière", but he also does not dwell on the rotation.

Among the 136 surgical neck fractures in my series there was definite internal rotation of the proximal fragment in 19, but external rotation in 7. Among 99 patients with fracture of the surgical neck and greater tuberosity, there was internal rotation of the proximal fragment in 12 and external rotation in 1. In these 235 patients the X-ray films revealed rotation in 42 cases, but it was impossible to decide whether the head fragment was internally or externally rotated. A number of the patients were only X-rayed in one projection, anteroposterior, on arrival at the hospital, and this view does not show whether the rotation of the head is internal or external.

In order to assess the rotation displacement, X-rays were taken of a normal shoulder in various positions of rotation and these views were used to compare with films of the fractured shoulder (Fig. 5-8).

At the hospitals from which my series is derived, the lateral views were practically always taken with the arm almost 90° abducted and the forearm in the horizontal position, as in Fig. 6. So, if the lateral view of a fractured shoulder is taken with the arm in this position, while the head presents itself as on Fig. 5, the proximal fragment must be 50° internally rotated (and in the "40° position"). On the other hand, if the head presents itself as seen on Fig. 7 or 8, it must be in external rotation. *By this procedure I have only observed external rotation in 8 cases, while internal rotation was found in 31.*

Which forces cause the rotation displacement of the proximal fragment in these fractures?

It must be the difference between the power of the internally and

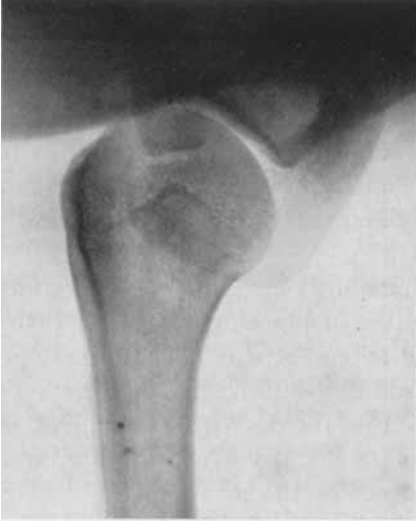


Fig. 5.

Lateral view of normal shoulder in maximum internal rotation (40°).

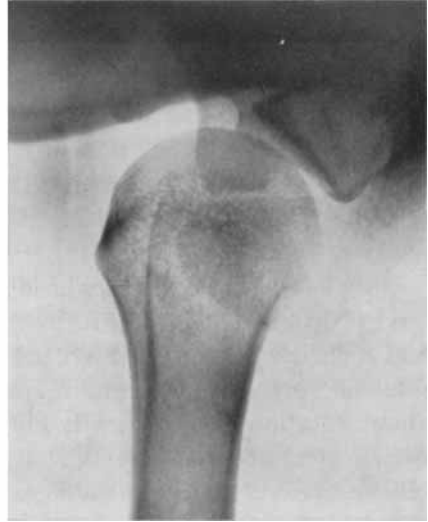


Fig. 6.

Lateral view of normal shoulder in 90° abduction in the shoulder and the forearm horizontal (90°).



Fig. 7.

Lateral view of normal shoulder in *Erin Madsen's* "mean position" (120°).



Fig. 8.

Lateral view of normal shoulder in maximum external rotation (200°).

externally rotating muscles that insert themselves on the proximal fragment. It is unlikely that it is the mechanism of the fracture which has had a rotating effect on the proximal fragment at the moment the fracture took place; exogenous action upon this small, often almost round, fragment, protected by thick bundles of muscles below the acromion, is out of the question.

External Rotators.

According to *Lanz & Wachsmuth* (1935) the following external rotators are the only ones that insert themselves on the upper end of the humerus (the greater tuberosity and the bone just below it):

The supraspinatus muscle which rotates with a power of 0.4 kg/metre						
„	infraspinatus muscle	„	„	„	„	4.5 kg/metre
„	teres minor muscle	„	„	„	„	0.8 kg/metre

Externally rotating power in all 5.7 kg/metre

The other external rotators, the spinous part of the deltoid (0.6 kg/metre) and the long head of the triceps (0.2 kg/metre) have their insertions further down the humerus.

Internal Rotators.

The subscapularis muscle, inserted on the lesser tuberosity		7.3 kg/m
The teres major muscle inserted on the crest of the lesser tuberosity		1.1 kg/m
The latissimus dorsi muscle, inserted on the same site		0.4 kg/m
The pectoralis major muscle, inserted on the crest of the greater tuberosity		2.1 kg/m

Internally rotating force in all 10.9 kg/m

The other internal rotators: long head of the biceps (1.3 kg /metre) and clavicular part of the deltoid (0.8 kg/metre) need not be considered in fractures of the upper end of the humerus, as they are not inserted on the proximal fragment.

If the fracture is very high on the surgical neck, only the upper part of the three last-mentioned internal rotators can act upon the proximal fragment. But even if they are left entirely out of consideration, the m. subscapularis alone is capable of internal rotation with a force of 7.3 kg/metre against the 5.7 kg/metre exerted by all the external rotators together.

In view of this description of the anatomical and functional features, it seems unlikely that the m. subscapularis will permit external rotation of the proximal fragment, if this muscle and the lesser tuberosity are intact.

In the common combination of fracture of the surgical neck and fracture of the greater tuberosity, there is no possibility of external rotation of the proximal fragment by the pull of the muscles.

CHAPTER IV

FOLLOW-UP

The patients were followed up for from 1 to 8 years, average 3 years 7 months, after the trauma. Two were only followed up for one year and twelve for less than 18 months.

When re-examined the patients were questioned regarding after-treatment, if any, its nature and duration. When could the patient dress and undress and do his/her hair without help? How long after the accident could the patient start working, what is his work, or has he been obliged to change over to a physically less strenuous occupation? Is the patient fully or only partially capable of working or is he unable to work? In the latter case, has the patient been receiving a disablement pension because of the accident? Does the patient suffer from pain in the shoulder or arm?

At the *objective examination* the fractured shoulder was compared with the intact shoulder. It was noted whether visible or palpable *deformity* existed at the site of the fracture, and shortening, if any, was measured. The patients were also examined for sequelae of *neurological or vascular disturbances* (hypaesthesia, atrophic skin, cyanosis), *swelling, oedema, or atrophy of the muscles* of the shoulder, arm, or hand.

The position of the joints was examined and their mobility measured by Moeltgen's protractor: flexion, extension, abduction, and rotation.

Studying the mobility of the shoulder *Hvorslev* (1927) found that in the physiological resting position the humerus is in 7° abduction, but in 0° as regards flexion-extension. He reported that on the average extension is 0°–53°, flexion 0°–176° and abduction 7°–174°, but some of the subjects could flex and abduct to 180°.

The shoulder has combined mobility. In addition to the movements of the humero-scapular joint, the scapula moves towards the chest, thus increasing the movements of the arm. According to *Hvorslev* the mobility of the scapula decreases after the age of 30.

The terms flexion, extension, abduction, and adduction *Johnston*

(1937) takes to mean the position of the arm in relation to the scapula (and so does Gray's Anatomy). Clinicians do not as a rule describe the movements in this way, but in relation to the trunk. It must be emphasized, therefore, that in my follow-up study the movements are stated in relation to the trunk. Flexion and extension are carried out in the sagittal plane, abduction and adduction in the frontal plane.

The important thing in practice is the total, active mobility in the shoulder, i.e. the backward, forward-upward, and outward-upward range of the movement. In order to ascertain also whether the movements of the humero-scapular joint proper are restricted, I examined passive motion with fixed scapula. This value is recorded within brackets in the case histories. For instance, in "abduction (70°) 130° " 70° means the range with fixed scapula and 130° the total active abduction with free scapula.

In examining the shoulder it was noted also whether crepitation was present in the joint, indicating arthritis or periarthrititis. It was also investigated whether the patient could place his hand on top of the opposite shoulder, on the nape of his neck with head raised, or behind his back above the waist.

The mobility in the elbow, wrist, and fingers was examined, and so was the strength of the shoulder, the patient lifting both arms at the same time against resistance. The strength of the hand was measured with Krogh's squeeze dynamometer.

ROTATION

As a rule, rotation is measured by letting the patient keep the arm in the sling position, the upper arm close to the side, the elbow flexed about 90° , and the forearm resting against the abdomen. External rotation may then be measured by moving the hand outward, the upper arm remaining in its position close to the side. Internal rotation is generally measured by letting the patient move the arm from the sling position to behind his back. This is, however, a combined movement of abduction, internal rotation, and extension, so the method does not measure internal rotation alone.

Erin Madsen (1939), studying the rotation in the shoulder, has advocated an excellent method for measuring rotation alone: The upper arm is kept in 90° abduction and 40° flexion in the shoulder, and the elbow in 90° flexion. The forearm is used as the hand of a dial on which vertical is 0° . By this method *Madsen* found that in women the average

total rotation was 168° and the mean position 126° . In men the average total rotation was 150° and the mean position 120° . He states that the total rotation decreases somewhat with advancing age in both sexes, whereas the mean position remains fairly constant.

For practical reasons no distinction was made between male and female patients, the total rotation being considered 160° and the mean position 120° in both sexes, i.e. 30° above the horizontal plane. In normal internal rotation the forearm is lowered 80° from the mean position, and thus points at 40° on the dial. In normal external rotation the forearm is raised 80° above the mean position, and thus points at 200° on the dial (cf. Fig. 9).

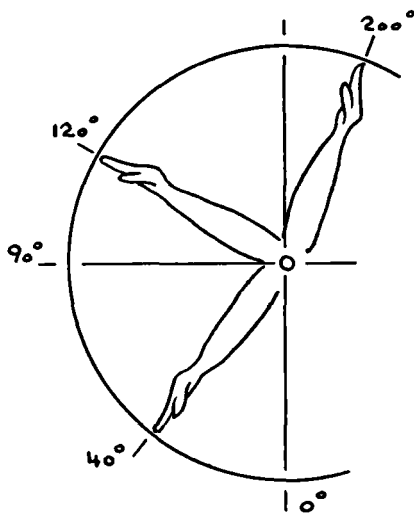


Fig. 9.

The forearm as the hand of a dial in measuring normal rotation in the shoulder.

In the present study, therefore, normal rotation will be designated $40^{\circ}/200^{\circ}$. A patient who is e.g. 20° short of normal internal rotation, but whose external rotation is complete, will be designated as $60^{\circ}/200^{\circ}$. If internal rotation is normal, but he is e.g. 10° short of complete external rotation, this will be designated as $40^{\circ}/190^{\circ}$, etc. etc.

X-RAY FINDINGS

On an X-ray film of a normal humerus in optimum projection, the angle between the axis of the anatomical neck and the axis of the shaft

of the humerus may be measured. According to *Schinz* (1932) it is 130° – 140° . *Schinz* states that it is apparently increased upon internal rotation and apparently decreased upon external rotation. It is said to be better (*Schinz* quoting *Ewald*) to draw a line between the upper end of the greater tuberosity and upper edge of the head. Normally, such a line forms an angle of 130° with the humeral axis.

Since, however, fractures of the upper end of the humerus often involve avulsion of the greater tuberosity, this procedure is not applicable for measuring the angle in fractures.

In the present follow-up study the X-rays were nearly always obtained in two views, anteroposterior with the beam directed anteroposteriorly, and lateral with the beam directed up through the axilla. The patients were X-rayed at the hospital where they had originally been treated, and as far as possible the shoulder was X-rayed in the same projection that was used at the previous examination in order to permit evaluation of the effect of the treatment on the position of the fracture. Nearly all the previous films were available for review and were viewed by the author. In cases where it was impossible to procure the old films, the X-ray reports are given in inverted commas.

It proved difficult to find a reliable method for measuring the angle in these fractures. The literature was non-contributive. In the, rather few, follow-up studies on fractures at the upper end of the humerus, none of the authors appear to have tried measuring the angle of displacement in degrees.

My attempts at reporting the size of the angle in degrees must, therefore, be taken only as an approximation. Exact measurement is impossible, because the proximal fragment is always short, often even rounded and as a rule displaced.

I tried to measure the angle of displacement by drawing a line at right angles on the articular surface of the head and another line along the shaft of the humerus. On a normal humerus the angle is about 140° (cf. Fig. 10). Where this angle is decreased, the position is described as varus, or inward open angle, where it is increased as valgus or outward open angle.

In the same way, the lateral views were compared with radiographs of a normal shoulder. Posterior angulation (angle opening backward) and anterior angulation (angle open forward) indicate deviations from normal.

If there is a combination of varus or valgus with anterior or posterior angulation, this is emphasized in the case reports.

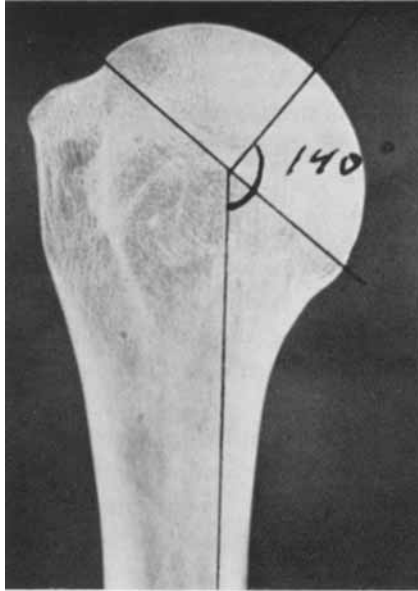


Fig. 10.

The angle which the axis of the anatomical neck forms with the shaft of the humerus.

EVALUATION OF RESULTS

The author evaluated the subjective as well as the objective result (making together the functional result), and also the radiological appearances. The findings are designated as good, fair, and poor.

Subjective.

Good: Usual work without essential complaints.

Fair: Usual work with complaints, or the patient has had to change over to physically less strenuous work.

Poor: Pain even in doing light work, or the patient requires help for dressing and undressing and/or doing his/her hair.

Objective (active movements).

Good: Abduction of at least 130° and external rotation of at least 140° , and the patient can move his hand to the nape of the neck with his head raised.

Fair: Abduction 100° – 130° or external rotation 120° – 140° . In addi-

tion, the patient must be able to move his hand to the nape of his neck with his head raised.

Poor: Abduction less than 100° or external rotation less than 120° .

Or: The patient is unable to carry his hand to the nape of his neck with head raised.

Fracture at the upper end of the humerus often occurs in elderly or old people whose mobility is restricted also in the "well" shoulder. This classification into degrees cannot always be adhered to rigorously, therefore, as there would be no sense in demanding more mobility in the fractured than in the other shoulder. In such instances, the result was assessed on the basis of an estimate after comparing the two shoulders.

In assessing the functional result, most stress was laid on the objective findings, i.e. mobility. Of secondary importance were the subjective complaints which could only deteriorate, never improve the "functional result". In my opinion this is justified, as a poor mobility can never be anything but a poor result. If a patient with poor mobility has no subjective complaints, this can only be because little demands are made on the shoulder.

Radiological.

Good: Angulation up to 10° . (In the case reports this is also indicated as "small", "slight", or "negligible" angulation).

Fair: Angulation 10° – 19° . (Indicated in the case histories also as "rather marked" or "considerable" angulation).

Poor: Angulation of 20° or over. (Indicated in the case reports also as "marked" angulation).

Furthermore, regard was paid to healing with lateral displacement, shortening, displacement or prominence of the greater tuberosity, exostoses, rough or sclerotic contours of the bone, osteoarthritic changes. – These abnormalities were assessed at an estimate in each individual case, as the author did not find it possible to set up any fixed rules.

AGE DISTRIBUTION AND SEX RATIO

The youngest patient was 7 and the oldest 86 at the time they sustained their fractures.

In Fig. 11 the patients are divided into three age groups 7–29 years, 30–59 years, and 60 years and over.

This age grouping was done on the following grounds:

Below the age of 30 there should be the greatest chance of recovering completely from a fracture of the shoulder (cf. *Hvorslev* who found that the mobility of the scapula decreases after the age of 30).

The age from 30 to 59 represents the mature, active period of life, during which most people carry out the greater part of their work. After passing 60, part of the population at least begin to retire from the most strenuous physical work. In Denmark women could obtain old age pension from the age of 60 and men from the age of 65. (Now these ages are 62 and 67 respectively).

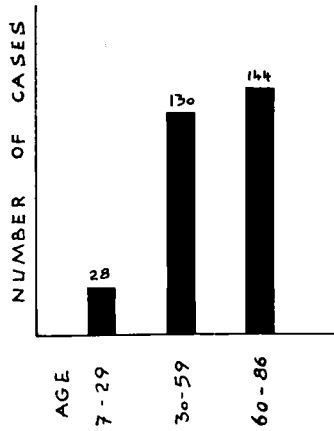


Fig. 11.

The patients divided into three age groups.

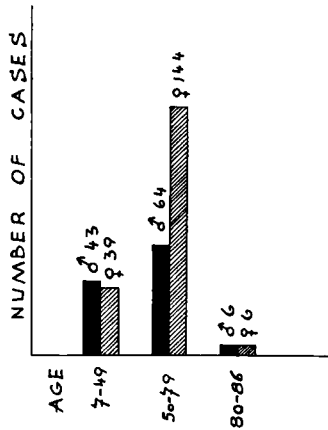


Fig. 12.

Sex ratio in the three age groups.

The paucity of young people in the present series is striking. Only a little over 9 % were under 30, whereas e.g. in *Andler's* series (Tables 1-3) 57 % were under 30.

Fig. 12 shows the sex ratio in the present series when divided into three age groups and Fig. 13 when it is divided into 8 age groups.

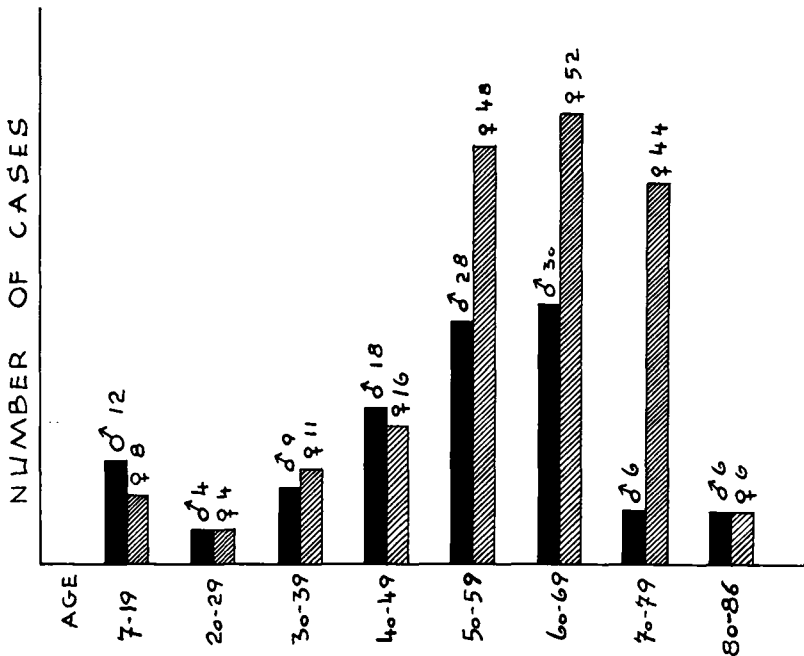


Fig. 13.

Sex ratio in the series when divided into 8 age groups.

TYPES OF FRACTURE

1. Separation of the upper humeral epiphysis	1
2. Fracture of the anatomical neck	2*
3. Fracture of the surgical neck	136
4. Fracture of the surgical neck and greater tuberosity	99
5. Comminuted fracture of the upper end of the humerus	9
6. Fracture of the greater tuberosity	25
7. Fracture-dislocation	
with fracture of the head and neck or comminuted	13
with fracture of the greater tuberosity	17
	30
Total	302

* One with co-existing fracture of the greater tuberosity.

TABLE 25
Types of fracture in various age groups.

	7-29 years	30-59 years	60 yrs. and over	Total
1. Separation of the upper humeral epiphysis	1			1
2. Fracture of the anatomical neck			2*	2
3. Fracture of the surgical neck	25	52	59	136
4. Fracture of the surgical neck and greater tuberosity	1	42	56	99
5. Comminuted fracture of the upper end of the humerus		5	4	9
6. Fracture of the greater tuberosity		17	8	25
7. Fracture-dislocation				
with fracture of the head and neck or com-				
minuted		6	7	13
with fracture of the greater tuberosity	1	8	8	17
Total	28	130	144	302

* One with co-existing fracture of the greater tuberosity.

A total of 245 patients had the four types of fracture which may present themselves as valgus or varus fractures. Of them 88 had valgus fractures and 31 varus fractures. In other words, nearly half the patients presented either valgus or varus displacement.

Table 26 gives the age distribution of patients with valgus or with varus displacement.

TABLE 26

Type of displacement	Number of cases	7-29 years	30-59 years	60 yrs. and over
Valgus fracture	88	5	32	51
Varus fracture	31	6	11	14
Total	119	11	43	65

In Table 27 an attempt is made to calculate the percental distribution of the types of fracture found by various authors. This is rather difficult owing to the varying nomenclature. *Brostrom* (1943), for instance, reports that almost 50 % of the cases were comminuted, but even so he does not set up comminuted fracture as a special type. "Pertubercu-

TABLE 27
Comparison of number of fracture types reported by some authors.

Author	Total	Fract. surg. neck (fract. pertuber- cul. fract. sububer- cul.)	Fract. anatomi- cal neck	Fract. greater tuber- osity	Fract. surg. neck and greater tuber- osity	Separ- ation of upper hum- eral epiphysis	Fractures of cervico- trochi- terienness	Commin- uted frac- ture of the upper end	Frac- ture-dis- location	Fracture of the lesser tuber- osity
Poirier, 1895	41	92.6	5.0	2.4						
Plagemann (cit. Tanton, 1915)	73	43.8	5.6	41.0		9.6				
Tanton, 1915	79	64.6	3.8	6.3		3.8	21.5			
Ritter, 1927	70	60.0	2.9		30.0				4.1	
Roberts, 1932	96	27.0*		4.2		3.1		52.0*	13.5	
Wentworth, 1940	187	79.7		9.1					11.2	
Brostrom, 1943	91	67.0	12.1	18.7						2.2
Present material	302	45.0	0.7	8.6	32.5	0.3		3.3	9.6	

* There were 4 fractures of the anatomical neck, but they are included in either fracture of the surgical neck or comminuted fracture.

lar" and "sub-tubercular" fractures are listed with fracture of the surgical neck, whereas "fractures cervicotrochitériennes" (*Tanton*) are listed separately. Thus, the figures are only partially comparable.

TREATMENT

Since *Collin*, in 1912, wrote his thesis "On the Treatment of Fractures of the Arm", functional treatment has been widely used in Denmark, especially in fractures at the upper end of the humerus. It is practically the sole method in some hospitals, e.g. at *Collin's* old hospital, the Copenhagen City Hospital, while in others it is somewhat less used.

The therapeutic methods may be divided into *immobilizing* and *functional* treatment, although in some instances it is a matter of discussion where to draw the line.

If the fractured limb is, from the outset, supported in a sling or a collar-and-cuff sling and the patient has exercises and perhaps massage as well as other forms of physiotherapy from the very first days until he can move the arm completely, he is receiving purely functional treatment.

Similarly, if, on arrival at the hospital, the arm is fixed on an abduction frame, perhaps with traction, or in a plaster spica, and this bandage is maintained until firm union has taken place, this can only be called a *purely immobilizing treatment*.

There are borderline cases, however. An abduction frame with traction on the arm may have been applied, but the position proves to be worse. All sorts of efforts are made for a few days, perhaps a week or two, without any improvement in the position, so this form of treatment is discontinued and replaced by a supporting bandage, collar-and-cuff sling or a sling, and the patient is encouraged to move his arm actively as much as possible. In such instances, it may be doubtful whether the patient belongs to one group or the other.

In the present paper the author will talk about functional treatment, if systematic exercises have been instituted within two weeks of the accident, even though an abduction frame has been carried in the meantime, with or without traction, with traction in bed, or a plaster spica. In my opinion, such short-lived immobilization cannot harm the muscles or the joint capsules so as to cause permanent stiffness. In most cases massage and in some cases heat, short wave treatment, or diathermy has been given at the same time.

On the other hand, I shall talk about immobilizing treatment, if the arm has been immobilized in a bandage for at least 3 weeks, be it an abduction frame, with or without traction, or with traction in bed, or with a plaster spica for a minimum of 3 weeks, i.e. the period ordinarily required for fragments in this region to become "sticky". This sort of immobilizing treatment invariably means fixation in abduction. Although the patient does exercises on the abduction frame, this will be considered immobilizing treatment, because the arm is fixed in abduction the greater part of the day and night.

Cases that cannot be classified with either group will be called *mixed treatment*, i.e. if physiotherapy is not started until two weeks after the accident or if the arm has been resting on an abduction frame for less than 3 weeks.

Closed reduction refers to reduction by manipulation under an anaesthetic, no matter what the after-treatment, in contrast to operation i.e.

open reduction, which was only performed in 3 cases of fracture-dislocation in this series.

CHAPTER V

SEPARATION OF THE UPPER HUMERAL EPIPHYSIS

TABLE 28

Case No.	Age and sex	Pre-reduction position	Post-reduction position	Post-reduction treatm.	Primary result	Follow up	End result	
							Anat.	Funct.
1	15 ♀	In adduction: Fair. In abduction: Poor.	Poor	Abduction splint & traction for 35 days	?	6 yrs.	?	Good

This is the only case of separation of the upper humeral epiphysis, or 0.3 % of all cases followed up as compared with *Plagemann's* 9.6 %, *Tanton's* 3.8 %, and *Roberts's* 3.1 %.

Regrettably, this patient refused to return for an X-ray examination, but when the traction was removed at the end of 35 days, there was a 30° posterior angulation.

According to the literature, it is generally believed that cases of this category do not obtain good function unless they heal in an almost anatomical position. This patient had good function in the shoulder at follow-up.

CHAPTER VI

FRACTURE OF THE ANATOMICAL NECK

TABLE 29

Fracture of the anatomical neck. Two cases. Treatment and result.

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
2	67 ♀	Good	Functional	"Recovered very quickly"	3 yrs. 4 mos.	Good	Good
3	71 ♀	Poor*	Sling. From 16th day functional treatm.	Poor	3 yrs. 8 mos.	Fair	Poor

* The fracture of the anatomical neck was in a good position, but the patient also had a fracture of the greater tuberosity in a poor position.

The series only includes these two cases of this rather uncommon fracture.

Most authors are agreed that it is to be treated by early mobilization, and in the former case this treatment was successful in every respect. In the latter case, the condition was complicated by the fracture of the greater tuberosity. Despite repeated attempts, it proved impossible to obtain an applicable lateral view at follow-up, but the anteroposterior view shows a subluxation of the head which may be seen below the acromion. The shoulder is subjectively and functionally poor.

CHAPTER VII

FRACTURE OF THE SURGICAL NECK

There were 136 cases of fracture of the surgical neck, but one of them had to be ruled out because of a pathological condition of the shoulder prior to the accident (Case 302). The discussion is, therefore, only based on 135 cases.

Cases 4-138, 78 females and 57 males. Table 30 shows the age distribution of females and males.

TABLE 30

	7-29	30-59	60 and over	Total
Females	10: 12.8 %	31: 39.7 %	37: 47.5 %	78
Males	15: 26.4 %	20: 35.0 %	22: 38.6 %	57

The average age in this group was 55 years 6 months for females and 47 years 9 months for males.

Among these fractures 27 had varus and 45 valgus deformity.

Closed reduction, using anaesthesia or analgesia, was performed in 11 cases. This does not include cases in which attempts were made to improve the position by manipulations without anaesthetic when the fracture had become displaced by treatment, e.g. on an abduction splint. Nor does it include cases in which "attempts at reduction" were done without an anaesthetic. Manipulations of a fractured shoulder cause the patient great pain, and although the position of a very loose fracture may be changed slightly by such manoeuvres, I do not think there can be any question of *reduction* without using an anaesthetic.

Table 31 gives abstracts of the records for these 11 cases.

The average age in this group of patients is 49½ years.

One patient was treated on an out-patient basis, while 10 were admitted for from 5 to 40 days, averaging 26⅓ days.

Six patients had recovered or returned to work within 2 months of the accident. One patient, an 11-year-old girl, did not consider herself well until one year after the accident. The remaining 4 were unable to give definite information about the primary result.

TABLE 31
Fracture of the surgical neck, 11 cases Closed reduction. Result.

Case No.	Age and sex	Pre-reduction position	Post-reduction position	Treatment after reduction	Primary result	Follow-up period	End result	
							Anat.	Funct.
4	11 ♀	Fair	Bad	Middeldorpf 10 days, sling 3 wks., then funct. treatm. Abduction splint 4 wks.	Recovered in 1 year	4 yrs. 7 mos	Good	Good
5	11 ♂	Good	I. Bad II. Good	Abduction splint 4 wks.	Returned to work in 2 mos.	2 yrs.	Good	Good
6	13 ♂	Good	Very bad (repeated attempts)	Abduction splint + tract. 4 wks.	Recovered in 2 mos.	4 ½ yrs.	Good	Good
7	15 ♂	Bad	Good (repeated attempts)	Abduction splint + tract. 4 wks.	Recovered in 6 wks.	5 yrs. 5 mos.	Good	Good
8	65 ♂	Bad (30° varus)	Fair (10° valgus, rotation)	Abduction splint + tract. 5 wks.	?	8 yrs.	Fair	Good
9	67 ♂	Bad	I. Bad II. Bad	Abduction splint + tract. 15 days, then funct. treatm.	?	4 yrs.	Poor	Good
10	67 ♂	Bad	Worse	Arm-chest plaster cast 15 days, then funct. treatm.	Recovered in 2 mos.	5 yrs.	Poor	Good
11	70 ♂	Bad	Worse	Abduction splint + tract. 3 wks. Funct. treatm.	?	3 yrs. 10 mos.	Fair	Good
12	70 ♀	Bad	Bad	Abduction splint + tract. 3 wks. Funct. treatm.	Recovered in 1 mo.	3 yrs.	Poor	Good
13	73 ♀	Bad	Bad (12 days later good)	Tract.-abduct. in bed 16 days, then abduct. spl. + tract. 10 days.	?	5 mos. 1 ½ yrs.	?	Poor
14	82 ♂	Fair	I. Bad II. Good	Abduction splint + tract. 4 wks.	?	4 yrs. 5 mos.	Fair	Good

End result:

Anatomical:	Functional:
Good: 4	Good: 10
Fair: 3	Fair: 0
Poor: 3	Poor: 1
Not stated: 1	

This shows that union in an anatomically correct position is not necessary for obtaining good function in the shoulder.

A number of these cases are extremely instructive.

Case 4 had a displacement of only 10° varus. After "reduction", Middeldorpf's triangle, and sling, Malgaigne's displacement and neurological disturbances occurred. The fracture must still have been loose 3 weeks after the trauma, when the sling was replaced by a collar-and-cuff sling, since it could reduce itself by the weight of the arm.

The arm (of an adult person) weighs 10–15 pounds (*Lovett*, 1922). This is no slight traction, when it is allowed to act in the normal resting position of the shoulder: with the arm hanging down along the side.

Case 5 was in a good and Case 6 in an ideal position, when they were "reduced" and the arm bandaged on abduction splint, resulting in displacement of the fracture in both. In Case 6 many efforts were made, first skin traction on abduction splint, then ulnar bone traction and repeated "reduction". Comparing Figs. 16 and 17, it may be seen that the fracture had not united firmly 28 days after the accident, since it could reduce itself, when the arm was returned to its normal position down along the side.

All these three cases belonged to Moorhead's "let-them-alone" group.

Displacing a fracture is by no means an indifferent matter, since, although it may be able to assume a good position again, there is a risk of tearing the vessels and thus compromising the blood supply which is so important a factor in the healing process.

The danger of using a sling is that the sling may be applied too tightly, so that it lifts the distal fragment too high up, thus displacing the fracture or counteracting traction on the arm. This occurred in Cases 4 and 12. A comparison of Figs. 18 and 19 in the latter case shows how well the fracture can reduce itself by traction by the mere weight of the arm, aided by physical therapy. In such cases a collar-and-cuff sling is preferable as a supporting bandage, because it only elevates the forearm slightly, leaving the main weight of the arm to exert traction.

Case 13 had rotation displacement, but during treatment the fracture assumed a good position. At follow-up 18 months after the accident,

the joint was almost ankylosed. True, it was a severe fracture, but we are without a definite explanation of the poor function. The patient was unable to appear for follow-up X-ray examination.

Out of the 135 patients with fracture of the surgical neck 25 were under 30 years of age. Four of these have already been mentioned (Cases 4, 5, 6, and 7). From among the remaining 21, 12 received functional treatment (Table 32), 3 immobilizing treatment in abduction for 3 weeks or more, and 6 mixed treatment.

TABLE 32
*Fracture of the surgical neck. 12 cases under 30 years of age.
Functional treatment. Result.*

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up period	End result	
					Anat.	Funct.
15	7 ♂	Fair	Managed at end of 3 mos.	4½ yrs.	Good	Good
16	11 ♀	Good	Free mobility in 3 wks.	5 yrs.	Good	Good
17	14 ♂	Good	Recovered in 6 wks.	2 yrs. 8 mos.	Good	Good
18	15 ♂	Good	Managed at end of 4 wks.	4 yrs. 8 mos.	Good	Good
19	15 ♂	Bad	Normal mobility 9 wks.	2 yrs. 9 mos.	Poor	Good
20	15 ♂	Good	Hard work at end of 1 mo.	2½ yrs.	Good	Good
21	16 ♂	Good	Managed at end of 1 wk.	2 yrs. 5 mos.	Poor	Good
22	17 ♂	Good	Working as errand-boy at end of 2 wks.	4 yrs. 2 mos.	Good	Good
23	17 ♀	Good	Almost free mobility in 3 wks.	3 yrs. 7 mos.	Good	Good
24	23 ♀	Good	Working as seamstress at end of 2 mos.	4 yrs. 9 mos.	?	Good
25	25 ♂	Good	Back as textile worker in 3 wks.	3 yrs. 1 mo.	Good	Good
26	29 ♀	Bad	Back to clerical work in 6 wks.	2 yrs. 8 mos.	Poor	Good

The youngest patient in Table 32 is 7 and the oldest 29 years of age. The average age is 17 years.

Eleven patients were treated on an out-patient basis, whereas one was admitted to hospital for 18 days.

Nine patients had started working or had recovered an average of 5 weeks after the accident. The other 3 had been able to eat, dress and undress without help 1 week, 4 weeks, and 3 months after the accident.

The end results was as follows:

Anatomical:	Functional:
Good: 8	Good: 12
Fair: 0	Fair: 0
Poor: 3	Poor: 0
Not stated: 1	

Although 25 % of the cases united in an anatomically bad position, 100 % had good function in the shoulder.

Case 15 had a 15° angulation and a 1 cm lateral displacement, but it reduced itself, so that at follow-up the fracture was in the anatomically correct position.

Case 24 shows the danger of passive movements. As late as 4½ weeks after the trauma, the fracture in this 23-year-old patient had not united so firmly that it could not be completely displaced by "forced abduction". In treating fractures at the upper end of the humerus, therefore, only active, no passive movements, should be allowed until the fracture is completely firm.

Three patients were treated by immobilization in abduction (Tbl. 33).

TABLE 33
*Fracture of the surgical neck. 3 cases under 30 years of age.
Immobilization in abduction. Result.*

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up period	End result	
						Anat.	Funct.
27	12 ♀	Fair	Abduction splint 5 wks.	Recovered in 6 wks.	7 yrs. 7 mos.	?	Good
28	16 ♂	Good	Abduction in bed 3 wks.	Recovered in 3-4 wks.	5 yrs. 11 mos.	Good	Good
29	20 ♂	Fair	Traction-abduct. 3 wks.	Recovered in 3 mos.	5 yrs. 10 mos.	Good	Good

The average age was 16 years. All three patients were admitted. One of them had concussion of the brain. The other two were discharged at the end of 37 and 23 days respectively. They had all recovered an average of $7\frac{1}{2}$ weeks after the accident.

End result:

Anatomical:
Good: 2
Not stated: 1

Functional:
Good: 3

In Cases 27 and 28 the fractures must have been impacted, since abduction without traction did not result in displacement. If functional treatment had been used, the stay in hospital, of 37 and 23 days respectively, could have been avoided.

Case 29 was admitted due to concussion. He had an injury of the brachial plexus and exhibited hypotonia, muscular atrophy, and abolished mobility. His recovery was rather slow. He reported that most improvement had occurred in the shoulder when, 4 years after the accident, he was given a garden to mind.

"Work is the best kinesitherapy" (*Collin*).

Six patients in this age group were given mixed treatment.

TABLE 34
*Fracture of the surgical neck. 6 cases under 30 years of age.
Mixed treatment. Result.*

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up period	End result	
						Anat.	Funct.
30	10 ♀	Good	Hanging cast. 3 wks.	Free mobility in 3 wks.	2 yrs. 5 mos.	Good	Good
31	10 ♀	Good	Sling 3 wks.	Recovered in 1 mo.	5 yrs. 8 mos.	?	Good
32	11 ♂	Good	Abduction splint (2 wks.?)	Recovered in 2 wks.	6 yrs. 9 mos.	?	Good
33	11 ♀	Bad	Abduction splint with tract. 12 days. Sling 1 wk., then funct. treatm.	Free mobility in 4 wks.	4½ yrs.	Good	Good
34	22 ♂	Fair	Bed rest 16 days	Free mobility in 16 days	5 yrs. 7 mos.	?	Good
35	27 ♀	Good	Abduction splint 16 days	Free mobility in 5 wks.	6 yrs. 5 mos.	Good	Good

The average age of the patients in Table 34 was 15 years 2 months. Three were treated as out-patients and 3 as in-patients, but one of the latter had concussion. The other two stayed in hospital for 8 and 21 days respectively.

All 6 patients had free mobility in the shoulder or had recovered an average of 24 days after the trauma.

End result:

Anatomical:	Functional:
Good: 3	Good: 6
Not stated: 3	

Case 30 was treated by the "hanging cast" suggested by *Caldwell* in 1933 to increase the weight of the arm, and thereby the force of the traction.

Case 34 was confined to bed for 16 days because of concussion.

All 6 patients obtained good function and recovered rapidly.

Four of these patients were children. It may be said that almost regardless of the treatment, children always obtain good function in the shoulder.

Among the 135 patients with fracture of the surgical neck 51 were in the age group 30-59. Table 35 gives extracts of the case records for those who received functional treatment, a total of 35.

TABLE 35

Fracture of the surgical neck. 35 patients aged 30-59. Functional treatment. Results.

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
36	30 ♀	Good	Resumed work at chocolate factory at end of 2 mos.	1 yr. 9 mos.	Good	Good
37	33 ♀	Fair	Working at florist's at end of 2 mos.	3 yrs. 9 mos.	Good	Good
38	38 ♂	Bad	Working as decorator at end of 1 mo.	2 yrs.	Fair	Good
39	39 ♀	Bad	Domestic work at end of 2½ mos.	2 yrs. 2 mos.	Poor	Poor

TABLE 35 (cont.)

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
40	40 ♂	Fair	Working as tramway employee at end of 3 mos.	1 yr. 7 mos.	Good	Good
41	42 ♂	Fair	Fit after 2 mos.	2 yrs.	Good	Good
42	43 ♂	Good	Scaffold worker at end of 11 mos.	4½ yrs.	Good	Good
43	45 ♂	Fair	"Recovered quickly"	2½ yrs.	Good	Good
44	45 ♀	Good	Managed all the time	2 yrs. 4 mos.	Good	Good
45	45 ♂	Good	Free mobility at end of two wks.	3 yrs.	Good	Good
46	47 ♀	Good	Domestic work at end of 1 mo.	5 yrs. 8 mos.	Good	Good
47	48 ♂	Fair	Managed at end of 2 wks.	2 yrs.	Good	Good
48	51 ♂	Bad	Working as painter at end of 2 mos.	4 yrs. 5 mos.	Fair	Good
49	52 ♀	Fair	Interior decorating at end of 2 mos.	2½ yrs.	Good	Good
50	53 ♂	Fair	Managed at end of 1 mo.	3 yrs.	Poor	Good
51	54 ♀	Bad	Managed at end of 6 mos.	2 yrs. 4 mos.	Fair	Good
52	55 ♂	Good	Working as tobacconist at end of 3 wks.	1 yr. 9 mos.	Good	Good
53	55 ♂	Good	Working as tramway employee at end of 2½ mos.	3 yrs. 3 mos.	Good	Good
54	55 ♀	Good	Managed at end of 1 mo.	3 yrs. 1 mo.	Fair	Good
55	56 ♀	Fair	?	3 yrs. 10 mos.	Poor	Fair

TABLE 35 (cont.)

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
56	56 ♀	Fair	No complaints at end of 2 mos.	2 yrs.	Fair	Good
57	56 ♀	Bad	Managed at end of 6 wks.	4 yrs. 7 mos.	Fair	Good
58	56 ♂	Good	Working as hairdresser at end of 2 mos.	2 yrs. 11 mos.	Good	Good
59	57 ♂	Good	Working as post office clerk at end of 3 mos.	3 yrs.	Poor	Fair
60	57 ♀	Good	Clerical work at end of 3 wks.	1 yr. 10 mos.	Fair	Good
61	57 ♀	Good	(Disabled for other reasons)	4 yrs.	Good	Fair
62	57 ♂	Good	Working as plumber at end of 4½ mos.	2 yrs. 5 mos.	Good	Good
63	57 ♀	Fair	?	2 yrs.	Good	Good
64	57 ♀	Good	Managed at end of 3 wks.	3 yrs. 9 mos.	?	Good
65	58 ♂	Fair	Managed at end of 1 mo.	4 yrs. 10 mos.	Good	Good
66	58 ♀	Bad	Managed at end of 2½ mos.	4 yrs. 5 mos.	Poor	Fair
67	58 ♀	Bad	No complaints at end of 3 mos.	2 yrs. 11 mos.	Fair	Good
68	58 ♀	Good	Managed at end of 26 days	6 yrs.	Good	Fair
69	59 ♂	Bad	Poor	2½ yrs.	Poor	Poor
70	59 ♀	Good	Managed at end of 3 wks.	2 yrs. 2 mos.	Good	Good

The average age was 51 years.

Fourteen have been admitted to hospital for an average period of 14½ days. Another 4 were admitted for other reasons: 2 due to concussion, one had fracture of the ribs with pneumothorax, and one

patient was in hospital because of osteomyelitis of the spine, when she sustained a fracture of the surgical neck on stepping out of her bed.

Seventeen patients were treated on an out-patient basis all the time.

Nineteen had returned to work an average of $2\frac{1}{2}$ months after the accident, whereas the other 16 could not remember when they started working or they were out of work. Of them, 11 reported that they had been able to manage simple duties (such as eating, dressing and undressing, etc.) without help from 0 to 184 days, average 43 days, after the accident.

End result:

Anatomical:	Functional:
Good: 20	Good: 28
Fair: 8	Fair: 5
Poor: 6	Poor: 2
Not stated: 1	

Two had poor function in the shoulder at follow-up. One of them (Case 39) was a 39-year-old woman whose fracture was in a very bad position, although it improved somewhat during treatment. She has no subjective complaints, but movements are restricted. There is no definite explanation of the poor result in this case, unless it might be the bad position. It must be borne in mind, however, that a number of patients with good function exhibit an equally bad position of the fracture as this patient. The case record does not mention anything about the period of after-treatment.

The functional result depends to a great extent on the patient's energy. All these patients should, therefore, be followed closely and for a long time, preferably by an experienced physiotherapist who can stimulate those who do not possess the necessary energy. Some patients require a year or more to get well, and throughout that period they must be under supervision and treatment.

The other poor result was in Case 69, a 59-year-old waiter. There was pronounced displacement of the fracture which united in this bad position. Despite massage and exercises for a year, he had subjective complaints and a poor function.

Case 40 illustrates how a loose fracture of the surgical neck becomes displaced when bandaged on an abduction splint. When the splint was removed at the end of 4 days, the fracture re-assumed its previous, fairly good, position in which it united.

In Case 50, there was at the outset a slight valgus deformity, but during treatment the fracture united in about 30° varus. The only

possible explanation is that the sling has elevated the distal fragment too much and thus displaced the fracture, a contingency that has been pointed out above.

This group includes a number of patients in whom the position of the fracture improved during the treatment, most strikingly in Case 67.

Table 36 gives extracts of the case records of 10 patients, aged 30-59 years, with fracture of the surgical neck treated by immobilization in abduction for 3 weeks or over.

TABLE 36
Fracture of the surgical neck. 10 patients aged 30-59 years, treated by immobilization in abduction for 3 weeks or longer. Results.

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
71	34 ♀	Fair	Skin traction in abd. in bed 5 wks.	Back to nursing after 3 mos.	3 yrs. 11 mos.	Fair	Good
72	37 ♀	Good	Abd. splint 5 wks.	Managed at end of 5 wks.	4 yrs. 7 mos.	Good	Good
73	39 ♀	In abduct.: Good. In abduct.: Bad.	Abd. splint & traction 30 days	Domestic work at end of 6 wks.	5 yrs. 2 mos.	Poor	Good
74	47 ♀	Good	Abd. splint 5 wks.	Managed at end of 5 wks.	3½ yrs.	Good	Good
75	51 ♀	Bad	Abd. splint 3 wks.	Textile worker at end of 4 wks.	3 yrs. 3 mos.	Good	Good
76	52 ♂	Bad	Abd. splint 4 wks.	Painter at end of 3 mos.	5 yrs. 2 mos.	Poor	Good
77	54 ♀	Bad	Abd. splint & traction 3 wks.	?	3 yrs. 4 mos.	Good	Good
78	54 ♂	Fair	Abd. splint 10 wks.	Fit at end of 6 mos.	1 yr. 7 mos.	Good	Good
79	56 ♂	Bad	Abd. splint & traction 4 wks.	Fit at end of 6 wks.	1 yr. 10 mos.	Poor	Good
80	58 ♀	Fair	At end of 11 days, tract. in abduct. in bed.	Back to work as matron at end of 4½ mos.	6 yrs. 8 mos.	Poor	Good

The average age of these patients was 48 years.

Seven had been admitted for from 3 to 58 days, average $31\frac{1}{3}$ days. One patient was in hospital for 82 days, but that was because of concussion and various other fractures, and this long duration cannot be attributed to the surgical neck fracture. Two patients were treated as out-patients all the time.

Seven patients returned to work or declared that they had recovered an average of $12\frac{1}{2}$ weeks after the trauma. One of them was an 80-year-old matron who was in hospital for 82 days with concussion, fracture of the radius, metacarpal bones, sacrum, coxae, and the surgical neck. Even so, she was capable of working $4\frac{1}{2}$ months after the accident. Two patients managed without help 5 weeks after the accident, whereas one patient could not remember.

End results for this group of patients:

Anatomical:	Functional:
Good: 5	Good: 10
Fair: 1	
Poor: 4	

In Case 73 there was an excellent position at the site of the fracture on films taken with hanging arm, but when the arm was abducted, the fracture became displaced. An abduction splint was applied, but as traction was exerted at the same time, the position became nearly as good as if no abduction had been used. Even so, there is still posterior angulation which could not be corrected.

Many authors have claimed that healing of surgical neck fractures in varus deformity is a serious complication which will compromise the abduction-elevation of the arm. This need not be so, as shown by Case 80 in which the fracture had healed in pronounced varus position, but there was no abnormality upon active movements of the shoulder.

Abduction in the humero-scapular joint can only be effected up to about 90° without simultaneous external rotation of the arm. At about 90° the greater tuberosity bumps against the acromion and cannot pass it without simultaneous external rotation of the arm. Therefore, an abduction of more than 90° is invariably an abduction-external rotation. When the fracture has healed in varus position, the arm must start the external rotation a little earlier, and this is of no significance in everyday life.

Six patients in the 30–59 age group had mixed treatment. Their data are summarized in Table 37.

TABLE 37
*Fracture of the surgical neck. 6 patients aged 30-59 years.
Mixed treatment. Results.*

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
81	53 ♀	Bad	Abd. splint & tract. At end of 18 days sling. Exercises from 1 mo.	Managed at end of 5 mos.	5 yrs. 5 mos.	Good	Good
82	54 ♀	Bad	Bed rest 2 wks. Funct. treatm. from 3rd wk.	Managed at end of 6 mos.	2 yrs. 3 mos.	Poor	Good
83	56 ♀	In ad-duct.: Good. In ab-duct.: Bad.	13 days after accident: Attempt at re-duction. Abd. splint for 8 days.	Managed at end of 2 mos.	6 yrs. 4 mos.	Good	Good
84	56 ♀	In ad-duct.: Fair. In ab-duct.: Bad.	Abd. splint. (5 days). Velpeau's bandage until 3 wks. after accident.	Domestic work at end of 3 wks.	1 yr. 10 mos.	Good	Good
85	57 ♀	?	Bed rest 17 days, then funct. treatm.	?	4 yrs. 9 mos.	Poor	Poor
86	59 ♂	Bad	Thomas' splint & tract. 17 days + exercises.	Managed at end of 17 days	3 yrs. 2 mos.	Poor	Good

In this group the average age was 56 years.

All 6 were admitted to hospital. One had dislocation of the elbow and fracture of the olecranon process which required osteosynthesis a few days after admission. One patient had concussion and fractures of both radii. The other 4 were in hospital for from 8 to 35 days, average 26 days.

One patient went back to domestic work 3 weeks after the trauma, whereas the others could not remember when they had started working.

End results for these 6 patients:

Anatomical:

Good: 3

Poor: 3

Functional:

Good: 4

Poor: 2

In one of these cases (No. 81) the position of the fracture greatly improved by the use of the abduction splint, whereas in another one (Case 83) marked displacement occurred when the arm was abducted. In both instances the fracture was loose, when abduction was abandoned, and at follow-up it had united in a good position.

Case 84 exemplifies a typical displacement of a loose surgical neck fracture, when the arm is bandaged on an abduction splint. The splint was, therefore, removed at once, and the fracture united in a good position.

In Cases 83 and 84, there is nothing to indicate that an equally good function could not have been obtained by functional treatment from the outset. In that event the patients could have avoided the major part of the stay in hospital, 34 and 8 days respectively.

Case 86 is a fine example of how much the functional end result depends on the patient's energy, and how much more important it is than union in an anatomically correct position.

In the over-60 age group there were 59 patients (average age 70 years) with fracture of the surgical neck. Of them 7 have already been

TABLE 38
*Fracture of the surgical neck. 40 patients 60 years and over.
Functional treatment. Results.*

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
87	60 ♂	Good	Postman at end of 3 mos.	6 yrs.	Fair	Fair
88	60 ♂	Fair	Poor	5 yrs.	Poor	Poor
89	60 ♂	Good	Clerical work at end of 2 mos.	3 yrs. 8 mos.	Good	Good
90	61 ♂	Good	Managed at end of 2 wks.	4 yrs. 5 mos.	?	Good
91	61 ♀	Bad	"Recovered very slowly"	4 yrs. 7 mos.	Poor	Good
92	61 ♀	Good	Managed at end of 2 wks.	3 yrs. 4 mos.	Poor	Fair

TABLE 38 (cont.)

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
93	61 ♂	Good	Fit at end of 3 mos.	4 yrs. 6 mos.	Good	Good
94	61 ♂	Good	Managed at end of 4 wks.	1 yr. 11 mos.	Good	Good
95	62 ♀	Bad	Managed at end of 3 mos.	4 yrs. 4 mos.	?	Good
96	62 ♀	Good	Fit at end of 4 mos.	3 yrs. 3 mos.	Good	Good
97	62 ♀	Good	Fit at end of 1 mo.	2 yrs. 8 mos.	Good	Good
98	63 ♂	Fair	Clerical work at end of 3 wks.	4 yrs. 5 mos.	?	Good
99	63 ♀	Bad	Telephone operator at end of 3 mos.	1 yr. 8 mos.	Good	Good
100	64 ♀	Fair	Fit at end of 2 mos.	2 yrs. 7 mos.	Fair	Good
101	65 ♀	Good	Working as housewife at end of 2½ mos.	1 yr. 9 mos.	Good	Fair
102	66 ♀	Fair	Managed at end of 3 mos.	4 yrs. 7 mos.	Fair	Poor
103	66 ♂	Bad	Fit at end of 6 mos.	2½ yrs.	Good	Good
104	67 ♀	Bad	Domestic work at the end of 3 mos.	1 yr. 4 mos.	Poor	Fair
105	67 ♂	Fair	Coachman at end of 2½ mos.	5 yrs. 2 mos.	?	Good
106	68 ♀	Bad	Managed at end of 1 mo.	4 yrs. 5 mos.	Good	Good
107	69 ♂	Good	Office messenger at end of 2 mos.	2 yrs. 5 mos.	Good	Good
108	69 ♀	Bad	Domestic work at the end of 17 days	3 yrs. 4 mos.	Poor	Good
109	70 ♀	Good	Fit at end of 4 mos.	2 yrs. 2 mos.	Good	Good

TABLE 38 (cont.)

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
110	70 ♀	Good	Managed at end of 4 mos.	1 yr. 3 mos.	Poor	Good
111	72 ♀	Fair	Managed at end of 6 wks.	1 yr. 10 mos.	Fair	Good
112	72 ♀	Good	Managed at end of 1 mo.	5 yrs. 1 mo.	?	Good
113	72 ♀	Good	Managed at end of 2 wks.	5 yrs. 7 mos.	?	Good
114	73 ♀	In ad- duct.: Fair In ab- duct.: Bad	Domestic work at the end of 6 wks.	3 yrs. 8 mos.	?	Good
115	73 ♀	Good	?	5 yrs. 8 mos.	?	Fair
116	73 ♀	Bad	Managed at end of 3 mos.	4 yrs. 8 mos.	Poor	Good
117	74 ♂	Bad	Cobbler at end of 3 mos.	2 yrs. 2 mos.	Fair	Fair
118	76 ♂	Good	No complaints at end of about 2 mos.	1 yr. 4 mos.	Poor	Fair
119	77 ♀	Good	?	4 yrs. 10 mos.	?	Good
120	79 ♀	Good	Managed at end of 2 wks.	3 yrs. 4 mos.	Poor	Good
121	80 ♀	Good	Domestic work at the end of 6 wks.	4 yrs. 11 mos.	Good	Good
122	81 ♀	Bad	Managed at end of 2 mos.	4 yrs.	Poor	Poor
123	81 ♀	Good	Managed at end of 2 wks.	1 yr. 10 mos.	?	Good
124	83 ♀	Good	Managed at end of 6 wks.	2 yrs. 9 mos.	Fair	Good
125	85 ♂	Good	Managed at end of 2 mos.	2 yrs. 5 mos.	Fair	Good
126	86 ♀	Good	Managed at end of 2 wks.	2 yrs. 8 mos.	?	Fair

mentioned in Table 31 (closed reduction). This leaves 52 patients of whom

40 had functional treatment,

8 immobilization in abduction for 3 weeks or longer,

and 4 had mixed treatment.

Table 38 gives abstracts of the case records for the patients who received functional treatment.

The average age was 69 years.

Twenty-two patients were admitted to hospital. One of them had concussion and various contusions, so the time spent in hospital cannot be attributed to the surgical neck fracture. The other 21 patients were in hospital for an average period of $18\frac{1}{2}$ days.

Eighteen patients received out-patient treatment all the time.

Nineteen patients reported that they had returned to work or recovered an average of $10\frac{1}{2}$ weeks after the accident.

End results for the 40 patients receiving functional treatment:

Anatomical:	Functional:
Good: 12	Good: 29
Fair: 7	Fair: 8
Poor: 10	Poor: 3
Not stated: 11	

Three of the patients had poor function. Case 88 had for many years been suffering from "fainting spells". In addition to rotation of the head fragment there is only a slight displacement of the fracture. At follow-up the shoulder joint had fused to a big, dense mass of bones. The cause of the "fainting spells" is unknown. It was not investigated, and particularly the patient did not have any tests for syphilis. Case 102 did not seem to be a particularly serious fracture, and it united in a fair position. During the past 2 years there had been increasing "rheumatism" in the fractured shoulder, but since the opposite shoulder is normal, the poor result must be assumed to be due to the fracture. Case 122 had a very serious displacement, the head fragment showing "dislocation or subluxation downward and forward". The fracture had united in a bad position, and at follow-up this 85-year-old patient exhibited poor function.

These were the poor results, but this group of 40 patients, among whom there were 16 fair or poor positions prior to treatment, also includes some very fine results of the treatment.

Case 99 had a very bad position of the fracture which was, however, entirely corrected by functional treatment.

In *Bardenheuer's* opinion the traction must be increased by hanging a weight from the elbow. As a rule, this is not necessary, particularly not if the wrist is supported by a collar-and-uff sling, so that the weight of the arm acts as traction in the ambulatory patient.

Case 103 is an example of how good a reduction may be obtained by this treatment. Cases 104 and 105 also obtained marked improvement.

A comparison of Figs. 40 and 41 in Case 117 shows how long after the accident the fracture can continue to be corrected. The first picture was taken about a month after the trauma and the other one at follow-up.

Table 39 gives the abstracts from the case records of 8 patients aged 60 or over who were treated by immobilization in abduction.

TABLE 39
Fracture of the surgical neck. 8 patients 60 years and over. Immobilization in abduction for 3 weeks or longer. Results.

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
127	60 ♂	Bad	Abduct. splint. & ulnar bone tract. 4 wks.	Managed at end of 4 wks.	5 yrs. 8 mos.	Good	Good
128	63 ♀	Good	Abduct. splint 28 days.	Managed at end of 2 mos.	6 yrs. 9 mos.	Poor	Good
129	63 ♀	Fair	Abduct. splint 3 wks. & tract. 17 days.	Fit at end of 6 wks.	3½ yrs.	?	Good
130	64 ♀	Good	Tract.-abduct. 26 days.	Fit at end of 4 mos.	1 yr. 9 mos.	Good	Good
131	68 ♀	Bad	Ulnar bone tract. 25 days on Thomas' splint and abduct. splint.	Managed at end of 6 wks.	2 yrs. 10 mos.	Poor	Good
132	69 ♂	Bad	Ulnar bone tract. 4 wks. Abd. splint 5 wks.	Managed at end of 2 mos.	2 yrs. 11 mos.	Poor	Fair
133	71 ♂	Bad	Tract.-abduct. 25 days.	No complaints at end of 6 mos.	1 yr. 10 mos.	Poor	Poor
134	77 ♀	Bad	Traction 3 wks. Abd. splint 37 days.	Managed at end of 2½ mos.	4 yrs. 10 mos.	Good	Good

The average age was 67 years.

All patients were admitted to hospital. One had concussion, whereas the other 7 spent an average of 30 days in hospital.

Three of these elderly patients reported that they had recovered completely within 6 weeks, 4 months, and 6 months respectively. The others stated that they had managed without help from 1 to 2½ months after the accident.

End result:

Anatomical:	Functional:
Good: 3	Good: 6
Fair: 0	Fair: 1
Poor: 4	Poor: 1
Not stated: 1	

In 5 cases there were serious fractures with marked displacement. Of them, 2 obtained a good position, whereas 3 remained bad. One patient who had a good position at the outset got a poor final position.

In Case 128 the arm was bandaged on an abduction splint for 28 days, although the position was good. As a result, the fracture became severely displaced. Despite union in 60–70° valgus, the function is good.

According to the description, a good effect of traction on abduction splint appears to have been obtained in Case 134, and Case 132 is a fine example of how good a position is obtainable by this treatment, when it is carefully performed. Nevertheless, this case developed atrophy of the head, but the function in the shoulder is fair.

Apart from Case 128 the patients of this group received good treatment.

Table 40 gives abstracts of the case records for 4 patients of this age group who received mixed treatment.

The average age was 66 years.

Two patients were treated on an out-patient basis (Cases 135 and 138), while the other two were admitted for 23 and 38 days respectively.

One patient went back to work 3 months after the trauma, one managed without help all the time, and a third patient managed 2 months after the accident. The fourth patient of this group (Case 138) is an invalid because of the shoulder, and *the only patient of the series with non-union*.

End result:

Anatomical:	Functional:
Good: 1	Good: 3
Fair: 1	Fair: 0
Poor: 2	Poor: 1

TABLE 40
Fracture of the surgical neck, 4 patients 60 years or over.
Mixed treatment. Results.

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
135	61 ♀	Good	Sling	Managed all the time	4 yrs. 7 mos.	Good	Good
136	62 ♂	Bad	Bed rest 4 days, sling 8 days, tract.-abduct. 19 days.	Managed at end of 2 mos.	4 yrs. 10 mos.	Poor	Good
137	66 ♀	Bad	Sling 1 month. Abduct. splint 1 month.	Clerical work at end of 3 mos.	3 yrs.	Fair	Good
138	74 ♀	Bad	Sling & axillary pad 6 wks.	Poor	3 yrs. 11 mos.	Poor	Poor

Although Case 135 was not under systematic treatment, she really gave herself functional treatment, as she did her own housework all the time without help.

Case 136 presented the condition which is often called dislocation, i.e. "rotary dislocation" ("Umkehrungsluxation"). The position was worse with the arm in abduction, but improved by traction on abduction splint. Although the upper end of the humerus looks grotesque after healing, function is good.

Case 138 is a 74-year-old woman who came for treatment 2 days after the accident. She had a low serrate surgical neck fracture with pronounced displacement, but contact was obtained. An axillary pad was applied and the arm was carried in a sling for 6 weeks. It was not until these 6 weeks had elapsed that massage and exercises were started. The patient was X-rayed on admission, and no further X-rays were obtained until at follow-up. Ten weeks after the accident the case record reports quite good *passive* movements. At follow-up there was non-union. At least three mistakes have been made in the treatment of this patient:

- (1) No X-ray control during the treatment.
- (2) Physical therapy was not started until 6 weeks after the accident.
 No reason is stated.

Exercises ought to be started as early as possible, preferably during the first days after the accident.

(3) Passive movements were used.

It is not likely that the axillary pad can have displaced the fracture; at least, it would have to be very large and firm. As mentioned above, however, a sling can displace a fracture, if it is too tight and elevates the arm too much. At all events, this fracture, like any other fracture, ought to have been controlled during the treatment.

The results of all the therapeutic methods are compared in Table 41 which lists the 135 cases.

TABLE 41
*Fracture of the surgical neck. 135 patients.
Treatment and functional results.*

Treatment	Number of cases	Functional end result		
		Good	Fair	Poor
Functional treatment	87	69: 79.3 %	13: 15.0 %	5: 5.7 %
Immobilization in abduction .	21	19: 90.4 %	1: 4.8 %	1: 4.8 %
Mixed treatment	16	13: 81.2 %		3: 18.8 %
Closed reduction	11	10: 90.9 %		1: 9.1 %
Total	135	111: 82.2 %	14: 10.4 %	10: 7.4 %

According to Table 41, functional treatment results in good function in 79.3 % as compared with 90.4 % after immobilizing treatment. Function was poor in 5.7 % after functional and in 4.8 % after immobilizing treatment. In other words, the analysis shows the results of functional treatment to be inferior to those of immobilization in abduction and closed reduction. The figures in this table are not statistically significant, however, according to information from Guðjón Hansen, actuary, Reykjavik.

“Good” and “fair” combined make up 94.2 % after functional and 95.2 % after immobilizing treatment in abduction.

It must be pointed out that to designate the function as fair I demand considerably better function than most previous authors. *Schoch* (1901) set up the classification (cf. p. 34) which has later been used by e.g. *Roemer*, *Andler*, *Silfverskiöld*, and *Madsen* who define a fair result as one in which "one movement is greatly restricted or several movements restricted by one-half. Elevation, abduction up to 90°". In Table 1, for instance, *Andler* has a patient whose function is interpreted as fair with "Elevation und Abduktion bis 60° Rotation eingeschränkt".

When a patient is to be capable of physical work, and those were the patients I always had in mind in evaluating the results, a movement as important as abduction to only 60° cannot be called a fair result. In my opinion it is poor. It seems to me that in order to be fair, abduction of 100° must be a minimum requirement. Otherwise the function is poor.

Therefore, the patients which I have classified as fair are considerably better off than patients included in this group by the authors mentioned above.

To-day we are, incidentally, not content with the therapeutic results of fifty years ago. Now is the time to change the classification of the therapeutic results in this condition too.

CHAPTER VIII

FRACTURE OF THE SURGICAL NECK AND GREATER TUBEROSITY

A total of 99 patients had fracture of the surgical neck and greater tuberosity (Cases 139–237), 70 women and 29 men. Among them there were 4 with varus and 41 with valgus deformity. Table 42 shows the age distribution of men and women.

TABLE 42
Fracture of surgical neck and greater tuberosity. Age distribution.

	7-29 years	30-59 years	60 years and over	Total
Women	1: 1.4 %	27: 38.6 %	42: 60.0 %	70
Men		15: 51.7 %	14: 48.3 %	29

The average age was 61 years for the women and 58 years for the men.

Among these 99 patients 5 were treated primarily by closed reduction under anaesthesia (cf. Table 43).

The average age was 57 years in this group.

All the patients were admitted to hospital. Case 139 arrived in a state of shock with fracture of the pelvis in addition to the fracture of the upper end of the humerus, so the time spent in hospital is of no interest. Case 143, who was treated with the arm in adduction, was in hospital for only 3 days, the others for 25, 35, and 14 days.

Three patients reported that they had returned to work an average of 12 weeks after the trauma. One could manage without help 12 weeks after the trauma, while one is still unable to dress without help 3 years 1 month after the accident.

End result:

Anatomical:	Functional:
Good: 2	Good: 4
Poor: 3	Poor: 1

In Case 141 there was good position in adduction, but marked displacement occurred when the arm was abducted for the X-rays. The

TABLE 43
*Fracture of the surgical neck and greater tuberosity.
 5 patients who had closed reduction.*

Case No.	Age and sex	Pre-reduction position	Post-reduction position	Post-reduction treatment	Primary result	Follow-up	End result	
							Anat.	Funct.
139	43 ♀	Bad "rot. disloc."	I. Bad II. Bad III. Bad Good	Abd. splint & traction 1 mo.	Poor	3 yrs. 1 mo.	Poor	Poor
140	56 ♂	Bad	Good	Abd. splint 6 wks. & tract. 20 days	Working as hawker at end of 3 mos.	6½ yrs.	Good	Good
141	58 ♂	In adduct.: Good. In abduct.: Bad	I. Worse II. Still worse	Abd. splint 29 days & tract. 23 days	Working as joiner at end of 10 wks.	4 yrs.	Poor	Good
142	60 ♂	Bad	I. Worse II. Bad	Abd. splint 55 days & tract. 34 days	Clerical work at end of 3 mos.	4 yrs. 10 mos.	Poor	Good
143	70 ♀	Bad	Good	Axillary pad & adduct. 4 wks.	Managed at end of 3 mos.	4 yrs. 7 mos.	Good	Good

more attempts were made to reduce the fracture on the abduction splint, the worse the position. Eventually, a good function was obtained.

It is difficult to see any reason why a case like this had to be treated on an abduction splint, and the patient had to remain in hospital for 35 days.

All the other fractures showed marked displacement when they were first seen. In 3 the position remained bad despite repeated attempts at improving it, or it became even worse after "reduction".

In 2 instances reduction resulted in a good position. One of these patients had after-treatment on an abduction splint with traction and the other one immobilization of the arm to the side and axillary pad. Both obtained good results.

Case 139 had "rotary dislocation" which remained in a bad position despite repeated manipulations. The end result was poor, both from the anatomical and functional point of view. As to function, the movements of rotation are particularly restricted.

These cases of "rotary dislocation" are very serious. The fractured surfaces have lost contact with each other. This contact must be re-established, and this is often difficult without open reduction, as the head fragment rotates like a ball inside the spacious joint capsule.

Only one of the patients with fracture of the surgical neck and greater tuberosity was under 30 years of age (Table 44).

TABLE 44
Fracture of the surgical neck and greater tuberosity. One patient under 30 years of age. Functional treatment. Results.

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
144	27 ♀	Good	Fit at end of 3 wks.	3 yrs. 10 mos.	Good	Good

The patient remained in hospital for 10 days.

There were 42 patients in the age group 30–59 years. Three of them have already been listed in Table 43. Of the others

24 had functional treatment
10 immobilization in abduction, and
5 mixed treatment.

Table 45 gives abstracts of the case records for those patients who received functional treatment.

TABLE 45
*Fracture of the surgical neck and greater tuberosity. 24 patients aged 30-59 years.
Functional treatment. Results.*

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
145	34 ♀	Bad	Fit at end of 6 mos.	2 yrs. 7 mos.	Poor	Good
146	43 ♂	Good	Fit at end of of 2-3 wks.	5 yrs. 1 mo.	Good	Good
147	44 ♂	Bad	?	1 yr.	Poor	Good
148	45 ♂	Good	Working as telephone fitter at end of 3 mos.	5 yrs.	Poor	Good
149	45 ♀	Fair	Fit at end of 3½ mos.	4 yrs. 1 mo.	?	Good
150	47 ♀	Good	Working as dressmaker at end of 10 wks.	4 yrs. 5 mos.	Good	Good
151	47 ♂	Good	Working as labourer at end of 3 mos.	2 yrs. 8 mos.	?	Good
152	49 ♀	Good	Fit at end of 6 mos.	5 yrs. 11 mos.	Good	Good
153	50 ♀	Bad	?	1 yr. 11 mos.	Poor	Good
154	50 ♂	Good	Working as painter at end of 7 mos.	4 yrs.	Good	Good
155	51 ♀	Good	Managed at end of 8 days	4 yrs. 2 mos.	Good	Good
156	52 ♀	Good	Managed at of 1 mo.	2 yrs. 2 mos.	Good	Good
157	53 ♀	Good	Fit at end of about 2 mos.	4 yrs. 10 mos.	Good	Good
158	53 ♀	Fair	Working as business woman at end of 2½ mos.	4 yrs. 4 mos.	?	Good

TABLE 45 (cont.)

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
159	54 ♀	Good	Working as brewery hand at end of 6 mos.	3 ½ yrs.	Fair	Good
160	55 ♂	Good	Clerical work at end of 2 mos.	2 yrs. 5 mos.	Good	Good
161	55 ♀	Good	"Recovered quickly"	5 yrs. 2 mos.	Good	Good
162	56 ♀	Fair	Working as seamstress at end of 6 mos.	4 yrs. 7 mos.	?	Good
163	56 ♀	Fair	Working as housewife at end of 3 wks.	3 yrs. 5 mos.	Good	Good
164	57 ♀	Fair	?	2 yrs. 9 mos.	Good	Good
165	57 ♀	Fair	Dairy work at end of 3 mos.	2 ½ yrs.	?	Good
166	58 ♀	Good	Working as housewife at end of 2 wks.	1 yr. 9 mos.	?	Good
167	59 ♀	Bad	"Recovered quickly"	4 ½ yrs.	Good	Good
168	59 ♂	Good	Working as weigher in central meat market at end of 1 mo.	2 yrs. 5 mos.	?	Good

The average age of these patients was 51 years.

Ten patients spent from 2 to 33 days in hospital, average 14 days.

Fourteen were treated as out-patients all the time.

Seventeen patients reported that they had returned to work or recovered an average of 14 weeks after the accident.

Three were unable to remember anything about the primary result. Two said that they "recovered quickly" and two that they had been able to manage for themselves 8 days and one month respectively after the trauma.

End result:

Anatomical:	Functional:
Good: 12	Good: 24
Fair: 1	
Poor: 4	
Not stated: 7	

Nothing much is to be said about this group. It shows how good a function may be obtained in the shoulder despite a poor anatomical position, such as e.g. 30° posterior angulation or union in 35° valgus deformity. Case 148 has good function despite severe osteoarthritis in the shoulder joint. In Case 167 the angulation has straightened satisfactorily and in Case 153 partially.

Cases 164 and 159 exemplify the typical displacement when the arm is bandaged on an abduction splint and how this displacement can be corrected, when the abduction splint is removed. In the latter case it was only gradually that the greater tuberosity returned to almost its proper site.

Ten of the patients in this age group were treated by immobilization in abduction. Table 46 gives the abstracts of their case records:

The average age was 49 years.

Nine patients were admitted to hospital. One of them had concussion and developed a pulmonary infarction while he was in hospital. The remaining 8 spent an average of 5 weeks in hospital.

Six returned to work or had completely recovered an average of 14 weeks after the trauma. Two "recovered quickly". One patient managed without help 5½ weeks after the accident, whereas one could not remember anything about the primary result.

End result:

Anatomical:	Functional:
Good: 2	Good: 8
Fair: 4	Fair: 1
Poor: 3	Poor: 1
Not stated: 1	

In several of these cases the position became worse, when an abduction splint was applied. This is true of e.g. Cases 169 and 175 and also Case 170 in which, however, the position improved again, when the splint was removed at the end of 4 weeks, because at follow-up the fracture had united in the position seen prior to abduction. In Case 172 too, the position became considerably worse. Then, skin traction was tried, but it only made matters worse.

TABLE 46

*Fracture of the surgical neck and greater tuberosity. 10 patients aged 30-59 years.
Immobilization in abduction. Results.*

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End results	
						Anat.	Funct.
169	30 ♂	Bad	Abd. splint 4 wks.	Dairy work at end of 1 mo.	5 yrs.	Poor	Good
170	40 ♀	Good	Abd. splint 4 wks.	"Recovered quickly"	4 yrs. 11 mos	Fair	Good
171	43 ♀	Good	Abd. splint 5 wks.	"Recovered quickly"	7 yrs. 2 mos.	?	Good
172	47 ♂	Fair	Abd. splint 4 wks. Skin tract. 24 days	Working as tele- phone fitter at end of 4 mos.	2 yrs. 2 mos.	Fair	Good
173	49 ♂	Bad	Skeletal tract. in abduct. in bed 25 days.	Working as to- bacconist at end of 6 wks.	5 yrs. 5 mos.	Fair	Good
174	54 ♀	Good	Abd. splint 4 wks.	Working in milliner's shop at end of 2½ mos.	2 yrs. 7 mos.	Good	Good
175	54 ♀	Bad	Abd. splint 10 wks.	Secretarial work at end of 4 mos.	5½ yrs.	Poor	Fair
176	56 ♀	Fair	Abd. splint 1 mo.	Managed at end of 5½ wks.	5 yrs. 8 mos.	Poor	Poor
177	57 ♀	Bad	Tract. abduct. in bed 6 wks.	Working as ironer at end of 6 mos.	3 yrs. 7 mos.	Fair	Good
178	58 ♂	Good	Abd. splint 3 wks.	?	1 yr. 7 mos.	Good	Good

In this case as well as in Case 171 it is difficult to see any reason for using abduction splints.

In Case 175 and probably also in Case 174 the position was worse after abduction splint.

Case 173 was kept in bed with skin traction in abduction for 25 days, and during this entire period the position was poor, but immediately improved, when the patient was allowed out of bed with a collar-and-cuff sling. Function also became good.

Case 176 had almost ankylosis in the humero-scapular joint at follow-up, and X-rays show a broad bony bridge between the head and the acromion. When this patient was first X-rayed the fracture of the

surgical neck was in a good position, but the greater tuberosity was severely displaced upwards. At follow-up, however, it had returned to its proper site. This patient is one of the very few of the present series who did not receive any physical therapy at all and who was not followed after discharge.

Five patients of this age group received mixed treatment:

TABLE 47
*Fracture of the surgical neck and greater tuberosity. 5 patients aged 30-59 years.
Mixed treatment. Results.*

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
179	47 ♂	Bad	Sling for 6 wks., then physiotherapy.	Working as labourer at end of 5 mos.	3 yrs. 4 mos.	Poor	Good
180	49 ♀	Good	Abd. splint 13 days. Physiotherapy end of 4 wks.	"Took a long time recovering"	4 yrs. 9 mos.	Good	Good
181	52 ♀	Bad	Sling. Physiotherapy at end of 2 mos.	?	2 yrs. 2 mos.	Good	Poor
182	52 ♀	Bad	Sling. Physiotherapy at end of 3 wks.	?	2 yrs. 8 mos.	Good	Good
183	55 ♂	Good	Sling. Physiotherapy at end of 5½ wks.	Managed at end of 2 mos.	3 yrs. 5 mos.	Good	Good

Average age 51 years.

Two patients were admitted for 4 and 39 days respectively. Three had out-patient treatment.

One patient returned to work 5 months after the accident, while the others could not state anything regarding the working capacity immediately after the accident.

End result:

Anatomical:

Good: 4

Poor: 1

Functional:

Good: 4

Poor: 1

Only one patient of this group had poor function. Flexion and abduction are satisfactory, however, and so is isolated rotation in the shoulder, but the patient cannot carry her hand to the nape of her neck or behind her back. She was very interested in whether she could obtain disablement pension or compensation, and speculations of this nature have a bad influence on the energy and thereby the function. By treatment in a sling, however, the position of the fracture had been corrected from "bad" to "good".

In another case too (No. 182) the fracture had been corrected from "bad" to "good" by a sling and by physiotherapy from 3 weeks after the trauma.

Case 179 had excellent function despite a poor position and severe osteoarthritis of the shoulder joint.

Out of the patients with fracture of the surgical neck and greater tuberosity 56 were 60 years of age or over. Two of them have already been listed in Table 43 (closed reduction). This leaves 54 of whom

- 42 had functional treatment,
- 10 immobilization in abduction for 3 weeks or over, and
- 2 mixed treatment.

Abstracts of the case records for the patients who received functional treatment are given in Table 48.

TABLE 48
*Fracture of the surgical neck and greater tuberosity. 42 patients aged 60 or over.
Functional treatment. Results.*

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
184	60 ♀	Bad	?	2 yrs. 1 mo.	Fair	Good
185	60 ♀	Bad	?	3 yrs. 8 mos.	Good	Good
186	60 ♀	Good	Managed at end of 6 wks.	3 yrs. 2 mos.	Good	Good
187	61 ♂	Good	Working as tobacconist at end of 9 days.	5 yrs.	?	Good
188	61 ♀	Good	Fit at end of 6 mos.	4 yrs. 9 mos.	?	Good
189	62 ♀	Bad	Managed at end of 6 mos.	4 yrs. 9 mos.	Poor	Good

TABLE 48 (cont.)

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
190	62 ♀	Good	Managed at end of 2 mos.	3 yrs. 11 mos.	?	Good
191	62 ♂	Bad	Managed at end of 4 wks.	5 yrs. 5 mos.	?	Good
192	63 ♀	Good	"Recovered quickly".	3 yrs. 7 mos.	Good	Good
193	63 ♀	Good	Managed at end of 2 mos.	2 yrs.	Good	Good
194	63 ♀	Good	Fit at end of 3 mos.	3 yrs. 4 mos.	Good	Good
195	63 ♀	Good	Fit at end of 6 mos.	4 yrs.	Good	Good
196	63 ♂	Good	Working as parcel post foreman at end of 3 mos.	2 yrs. 3 mos.	Good	Good
197	64 ♂	In ad- duct.: Fair. In ab- duct.: Bad	Working as painter at end of 8 mos.	1 yr. 7 mos.	Poor	Fair
198	66 ♀	Bad	Managed at end of 2½ mos.	4 yrs. 10 mos.	Poor	Good
199	66 ♀	Bad	Managed at end of 1 mo.	2 yrs. 11 mos.	Poor	Fair
200	67 ♀	Good	Managed at end of 2 mos.	3 yrs. 7 mos.	?	Good
201	68 ♂	Good	Working as joiner a little over 8 wks. after the accident.	3 yrs. 10 mos.	Poor	Good
202	68 ♂	?	Fit at end of 2 mos.	2 yrs.	Poor	Good
203	68 ♀	Bad	?	3 yrs. 2 mos.	Good	Good
204	69 ♀	Good	?	1½ yrs.	Fair	Good
205	70 ♀	Good	Fit at end of a little over 2 mos.	2 yrs. 7 mos.	Good	Good

TABLE 48 (cont.)

Case No.	Age and sex	Pre-treatment position	Primary result	Follow-up	End result	
					Anat.	Funct.
206	70 ♀	Good	?	2 yrs. 5 mos.	Good	Good
207	70 ♀	Good	Managed at end of 3 mos.	2 yrs. 9 mos.	Good	Fair
208	70 ♀	Bad	?	4 yrs. 10 mos.	Poor	Poor
209	70 ♀	Good	Fit at end of 3 wks.	4 yrs. 2 mos.	?	Good
210	70 ♂	Good	?	1 yr. 10 mos.	Good	Fair
211	72 ♀	Bad	Managed at end of 2 mos.	2 yrs. 7 mos.	Poor	Good
212	72 ♀	Good	?	5½ yrs.	Good	Good
213	72 ♀	Good	?	1 yr. 7 mos.	Good	Good
214	72 ♀	Good	Managed at end of 3 wks.	2 yrs. 8 mos.	Good	Good
215	73 ♀	Bad	?	5 yrs. 10 mos.	?	Good
216	73 ♀	Bad	Managed at end of 6 wks.	3 yrs. 7 mos.	Poor	Good
217	74 ♀	Fair	Managed at end of 2 wks.	1 yr. 2 mos.	Fair	Poor
218	74 ♀	Good	Domestic work at end of 3 mos.	3 yrs. 1 mo.	Good	Good
219	74 ♀	Bad	Managed at end of 6 wks.	3 yrs. 9 mos.	Poor	Fair
220	74 ♀	Bad	Managed at end of 1 mo.	3½ yrs.	Poor	Good
221	76 ♀	?	Managed at end of 6 mos.	2½ yrs.	Poor	Good
222	78 ♀	Bad	Quite fit at end of 3 mos.	2 yrs.	Poor	Good
223	81 ♀	Fair	Managed at end of 2 wks.	3 yrs. 9 mos.	?	Good
224	82 ♂	Good	Poor	6 yrs. 4 mos.	Good	Poor
225	82 ♂	Bad	Managed at end of 3 wks.	2½ yrs.	Poor	Poor

The average age was 70 years.

Twenty-six patients were admitted to hospital for an average period of 13 days. Another 3 patients had been admitted, two of them with fracture of the pelvis and one with various contusions.

Thirteen were treated as out-patients.

Twelve patients reported that they had returned to work or recovered within an average of 14 weeks after the trauma. Thirty could not give satisfactory data in this respect.

End result:

Anatomical:	Functional:
Good: 17	Good: 33
Fair: 3	Fair: 5
Poor: 14	Poor: 4
Not stated: 8	

Four patients had poor function in the shoulder.

Case 208 was a 70-year-old woman who arrived 2 hours after the trauma with a severely displaced fracture of the surgical neck and greater tuberosity (she was, in addition, suffering from fracture of the pelvis, phlebitis, heart disease, and severe obesity). At the end of 12 days abduction splint-traction treatment was abandoned, and the patient was given physiotherapy. The shoulder was not X-rayed until at follow-up, and this showed that the fracture had united in a bad position. The function was also poor.

Case 217 was a 74-year-old woman whose fracture was in a fair position, when first seen. At follow-up the patient was 76. She was working hard as a charwoman, moving furniture etc. without subjective complaints, but abduction is only 90°, and she cannot carry her hand behind her back.

The remaining two patients with poor function were 82 years of age at the time of the trauma. One of them (Case 224) was 88 at follow-up. He cannot undress without a special contraption he has made for this purpose, but the fracture had united in a good position. The other one (Case 225) had very marked displacement of the fracture which also united in a bad position. He only received 3 weeks' treatment, but thereafter he could manage for himself and also clean his own room. He had no subjective complaints, but movements were restricted.

During treatment the position of the fracture changed from bad to good in two and from bad to fair in one. On the other hand, it changed from good to bad in one and from good to fair in another one.

A number of these case histories are extremely interesting, although they have not all been printed *in extenso*. There are, for instance, 9 patients whose fractures healed in bad position, but whose function is excellent or good.

Case 215 had marked displacement of the fracture. No X-rays were taken at follow-up, but the function was good.

Table 49 gives abstracts of the case records for those patients with fracture of the surgical neck and greater tuberosity, aged 60 or over, who were treated by immobilization in abduction for 3 weeks or longer.

TABLE 49

Fracture of the surgical neck and greater tuberosity. 10 patients aged 60 years or over. Immobilization in abduction. Results.

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
226	63 ♀	Fair	Abd. splint 4 wks.	Working as matron at end of 6 mos.	4 yrs. 4 mos.	Fair	Good
227	63 ♀	Good	Abd. splint 1 mo.	Managed at end of 2½ mos.	7½ yrs.	?	Fair
228	63 ♀	?	Abd. splint & tract. 5-6 (?) wks.	Managed at end of 7 wks.	5½ yrs.	?	Good
229	63 ♂	Bad	Abd. splint 3 wks.	Managed at end of 15 mos. (?)	2 yrs. 3 mos.	Poor	Fair
230	65 ♂	Bad	Abd. splint 2 mos.	Recovered "very slowly"	6 yrs. 11 mos.	Poor	Good
231	66 ♀	Good	Abd. splint 4 wks.	Managed at end of 2½ mos.	2 yrs. 3 mos.	Good	Good
232	69 ♀	Good	Abd. splint 4 wks.	Managed at end of 5 wks.	3 yrs. 5 mos.	Good	Good
233	69 ♂	Bad	Traction 2 wks., abd. splint 23 days.	Fit at end of 6 mos.	3 yrs. 4 mos.	Bad	Good
234	78 ♀	?	Traction 3 wks., abd. splint 4 wks.	Managed at end of 8 wks.	6 yrs. 9 mos.	?	Good
235	81 ♂	Fair	Abd. splint 1 mo.	Managed at end of 2½ mos.	5 yrs.	?	Good

The average age was 68 years.

Seven patients were admitted to hospital for an average of 32 days.

Another two were admitted, one with various fractures and another one developed a pulmonary infarct while in hospital, so that the duration of their stay in hospital is of no interest in this connection.

One patient was treated on an out-patient basis.

One returned to work as matron 6 months after the trauma. Another patient had recovered within the same period. One patient recovered "very slowly". Seven patients reported that they had been able to manage an average of $16\frac{1}{2}$ weeks after the accident. This includes one patient who maintained that he had not been able to manage without help until 15 months after the trauma. This patient had received quite high damages because of the accident, but it is not known how long it took him to obtain these damages. If this patient is left out, the other 6 managed without help an average of less than 9 weeks after the trauma.

End result:

Anatomical:	Functional:
Good: 2	Good: 8
Fair: 1	Fair: 2
Poor: 3	
Not stated: 4	

Displacement occurred only in one case, when the arm was bandaged on an abduction splint (Case 227). This patient was a 63-year-old woman. The position of the surgical neck fracture was so anatomical, that there was some doubt as to whether there was a fracture at all. After an abduction splint was applied, the fracture became completely displaced (Fig. 66). The splint was not removed until at the end of one month, and $5\frac{1}{2}$ weeks after the accident the fracture was seen uniting in the bad position. This patient did not receive physiotherapy. She refused to be X-rayed at follow-up $7\frac{1}{2}$ years after the accident. She has severe subjective complaints, and the function is fair. The arm should never have been treated in abduction, but by physiotherapy from the outset.

Traction on an abduction splint had a good effect in Case 228 who also obtained good function. In another two (Cases 233 and 235) it did not harm the position, and both patients obtained good function.

It must still be emphasized, however, that an abduction splint may be a very dangerous thing. There is hardly any treatment which requires more care and vigilance on the part of the surgeon. The patients must be under close supervision, and if the fracture becomes displaced,

the position must be corrected, perhaps by removing the splint. Nor is it pleasant to wear; many patients go on complaining of it, even years after the treatment.

Table 50 gives abstracts of the case reports for the two patients of this group who received mixed treatment.

TABLE 50
Fracture of the surgical neck and greater tuberosity. 2 patients over 60 years of age. Mixed treatment. Results.

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
236	66 ♀	Bad	Abd. splint & tract. 17 days. Then immobilization <i>in adduct</i> . Exercises from the 23rd day.	Managed at end of 3 mos.	3 yrs. 11 mos.	Good	Good
237	67 ♀	Bad	Velpeau's bandage 24 days. Then, functional treatment.	Managed at end of 4 wks.	4 yrs. 9 mos.	Poor	Good

Case 236 was admitted for 31 days, while Case 237 was treated as an out-patient.

End result:

Anatomical:

Good: 1

Poor: 1

Functional:

Good: 2

Case 236 was admitted with a fracture in a very bad position (true, the only film was taken in abduction which gives the poorest possible impression of the position, when the fracture is loose). The position remained bad after treatment with abduction splint-traction for 17 days, so this was abandoned and the arm fixed to the side with an axillary pad. This somewhat improved the position, but one month after the accident the fracture was still so loose that the abduction angle was increased, when the arm was carried into abduction. A follow-up X-ray film taken almost 4 years after the trauma showed that later the fracture had corrected itself very well indeed, although it had united with a slight posterior angulation.

Table 51 compares the various therapeutic methods in fracture of the surgical neck and greater tuberosity.

TABLE 51
*Fracture of the surgical neck and greater tuberosity. 99 cases.
Treatment and functional result.*

Treatment	Number of cases	Functional end results		
		Good	Fair	Poor
Functional treatment	67	58: 86.6 %	5: 7.4 %	4: 6.0 %
Immobilization in abduction	20	16: 80.0 %	3: 15.0 %	1: 5.0 %
Mixed treatment	7	6: 85.7 %		1: 14.3 %
Closed reduction	5	4: 80.0 %		1: 20.0 %
Total	99	84: 84.9 %	8: 8.1 %	7: 7.0 %

This shows that functional treatment gives 86.6 % good end results as against 80.0 % after immobilization in abduction.

A poor result was found in 6.0 % after functional treatment and in 5.0 % after treatment in abduction.

“Good” and “fair” make up 94.0 % together after functional treatment as compared with 95.0 % of those treated by immobilization in abduction.

CHAPTER IX

COMMUNUTED FRACTURE OF THE UPPER
END OF THE HUMERUS

Nine patients had comminuted fracture of the upper end of the humerus. One of them (Case 301) had to be left out of the series because of a history of syphilis, and grotesque skeletal changes in both shoulders had to be ascribed to this disease.

This leaves 8 patients (Cases 238–245), 5 women and 3 men.

Owing to the small number in this group, the patients will be listed in one table (Table 52), but in the usual order as regards treatment.

Functional treatment:	5 patients.
Immobilization in abduction:	2 patients.
Mixed treatment:	1 patient.

Average age 62 years.

Four patients were admitted, for an average of 26 days, whereas 4 were treated as out-patients.

Three patients returned to work one month after the accident. Five could manage without help an average of one month after the accident.

End result:

Anatomical:	Functional:
Good: 2	Good: 6
Fair: 0	Fair: 1
Poor: 5	Poor: 1
Not stated: 1	

One of the 5 patients treated by the functional method got a poor function (Case 240). The first X-ray showed a bad position, and the fracture united in the same position. The end result is ankylosis and marked subjective complaints.

We have no explanation of the poor result in this case.

Case 245 had mixed treatment. At the outset, the fracture was in a

TABLE 52
*Comminuted fracture of the upper end of the humerus. 8 patients.
 Treatment and results.*

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
238	51 ♀	Good	Functional	Working as factory hand at end of 3 mos.	3 yrs. 9 mos.	Good	Good
239	66 ♀	Bad	Functional	Managed at end of 5 wks.	2 yrs. 1 mo.	Poor	Good
240	68 ♀	Bad	Functional	Managed at end of 2 wks.	4 yrs. 1 mo.	Poor	Poor
241	75 ♀	Good	Functional	Domestic work at end of 3 mos.	1 yr. 10 mos.	Good	Good
242	86 ♂	Good	Functional	Managed at end of 2 wks.	1 yr. 9 mos.	?	Good
243	48 ♂	In adduct.: Good In abduct.: Bad	Abd. splint 4 wks. with tract. 3 wks.	Managed at end of 2 wks.	5 yrs. 9 mos.	Poor	Good
244	50 ♀	Bad	Abd. splint 33 days with tract. 26 days.	Working as ward maid at end of 3 mos.	4½ yrs.	Poor	Fair
245	51 ♂	Good	Sling and axillary pad. From 17th day functional treatm.	Managed at end of 5 wks.	3 yrs.	Poor	Good

good position; after treatment with sling and axillary pad, however, it united with a marked varus deformity and posterior angulation, but function is good.

An axillary pad must be very large and very firm to be able to produce a varus deformity. It is more likely that the sling elevated the arm too much and that the fracture united rapidly, although the patient was 51 years of age.

Table 53 is an abstract of Tables 41, 51, and 52, showing the functional end results from the various methods of treatment in 242 patients with the three types of fracture discussed above.

TABLE 53

Fracture of the surgical neck, fracture of the surgical neck and greater tuberosity, and comminuted fracture of the upper end of the humerus. 242 cases. Treatment and end results.

Treatment	Number of cases	Functional end results		
		Good	Fair	Poor
Functional treatment	159	131: 82.4 %	18: 11.3 %	10: 6.3 %
Immobilization in abduction	43	36: 83.7 %	5: 11.6 %	2: 4.7 %
Mixed treatment	24	20: 83.3 %		4: 16.7 %
Closed reduction	16	14: 87.5 %		2: 12.5 %
Total	242	201: 83.0 %	23: 9.5 %	18: 7.5 %

In these three types of fracture the functional result is:

Good: 83.0 %

Fair: 9.5 %

Poor: 7.5 %

Most of the patients with a poor function are in the group receiving mixed treatment and, next, in closed reduction. The latter group, however, also contains the highest percentage with good function.

Incidentally, the percentages for good function are so close to each other that on this basis alone it is impossible to single out one method as being the best.

As regards out-patient versus in-patient treatment and the period elapsing until the patients return to work after being treated by the different methods:

Functional treatment:

57 % out-patients.

43 % in-patients for an average of 17 days.

49.7 % had recovered or returned to work an average of 10 weeks after the trauma.

Position of fracture before treatment: Bad: 41

Fair and good: 114

Immobilization in abduction:

8 % out-patients.

92 % in-patients for an average of 32 days.

53.5 % had recovered or returned to work an average of 13 weeks after the trauma.

Position of fracture before treatment: Bad:	17
Fair and good:	22

Mixed treatment:

48 % out-patients.

52 % in-patients for an average of 24 days.

37.5 % had recovered or returned to work an average of 7 weeks after the trauma.

Position of fracture before treatment: Bad:	12
Fair and good:	9

Closed reduction:

7 % out-patients.

93 % in-patients for an average of 24 days.

50 % had recovered or returned to work an average of 15 weeks after the trauma.

Position of fracture before treatment: Bad:	11
Fair and good:	4

Judging from this tabulation each therapeutic method has its advantages as well as disadvantages.

Functional treatment and mixed treatment show the highest percentage of out-patients, a short period in hospital for the others, and the patients soon return to work.

The group of functional treatment, however, includes the least serious fractures, judging by the position before the treatment.

The groups immobilization in abduction and closed reduction include few out-patients, and the period in hospital is rather long as far as the former group is concerned. In addition, a long time is required before the patients return to work. However, in the group immobilization in abduction almost half the fractures were in a bad position prior to treatment and the group of closed reduction included the highest percentage of serious fractures.

The figures are not significant, but they seem to indicate that any of these methods is justified in selected cases.

CHAPTER X

FRACTURE OF THE GREATER TUBEROSITY

A total of 25 patients had fracture of the greater tuberosity (Cases 246-270), viz. 15 women and 10 men.

None of these patients was under 30 years of age, 17 being between 30 and 59 and 8 over 60. The average age was 52 years.

Twenty patients had functional treatment, 1 was treated by abduction splint for 5 weeks, and 4 had mixed treatment.

All the cases are listed in Table 54.

TABLE 54
*Fracture of the greater tuberosity. 25 patients.
Treatment and results.*

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
246	30 ♂	Good	Functional	Bricklayer, "very soon fit".	2 yrs. 9 mos.	Good	Good
247	35 ♂	Good	Functional	Managed all the time	2 yrs.	Good	Good
248	35 ♀	Good	Functional	Fit at end of 2 mos.	2 yrs. 5 mos.	Good	Good
249	36 ♀	Good	Functional	Domestic work all the time.	2 yrs.	Good	Good
250	38 ♀	Good	Functional	Working as ladies' hair-dresser at end of 3 mos.	1 yr. 9 mos.	Good	Good
251	38 ♂	Good	Functional	Back as porcelain worker at end of 6 wks.	1 yr. 8 mos.	Good	Poor
252	39 ♂	Good	Functional	Fit at end of 2 mos.	1 yr. 5 mos.	Good	Good
253	43 ♀	Good	Functional	Managed at end of 1 wk.	3 yrs. 4 mos.	Good	Good
254	45 ♀	Good	Functional	Managed at end of 2 wks.	2 yrs. 7 mos.	Good	Good

TABLE 54 (cont.)

Case No.	Age and sex	Pre-treatment position	Treatment	Primary result	Follow-up	End result	
						Anat.	Funct.
255	45 ♂	Fair	Functional	Working as postman at end of 5 mos.	4 yrs. 10 mos.	Good	Good
256	47 ♀	Good	Functional	Managed at end of 1 mo.	1½ yr.	Good	Good
257	52 ♂	Good	Functional	Managed at end of 2 wks.	1 yr. 4 mos.	Good	Good
258	54 ♂	Good	Functional	Working as representative at end of 3 mos.	4 yrs. 7 mos.	Good	Fair
259	55 ♂	Good	Functional	Fit at end of about 1 mo.	3 yrs. 2 mos.	Good	Good
260	60 ♀	Good	Functional	Managed at end of 2 wks.	3 yrs.	Good	Good
261	66 ♂	Fair	Functional	?	1 yr.	Good	Poor
262	68 ♀	Good	Functional	Managed at end of 1 mo.	1 yr. 2 mos.	Good	Good
263	72 ♀	Good	Functional	Managed all the time.	2 yrs. 5 mos.	Good	Good
264	75 ♀	?	Functional	Managed at end of 2 wks.	3 yrs. 8 mos.	Good	Good
265	78 ♀	Good	Functional	Managed at end of 1 mo.	1 yr. 5 mos.	Good	Good
266	45 ♀	Good	Abd. splint 5 wks.	?	3 yrs. 2 mos.	Good	Good
267	59 ♀	Good	Sling	Working as dressmaker at end of 3 mos.	3 yrs.	Good	Good
268	59 ♀	Good	Swathe	Working as housewife at end of 3 mos.	3 yrs. 7 mos.	?	Good
269	60 ♂	Good	Sling & axillary pad.	Back to business in 6 days.	2 yrs. 11 mos.	?	Good
270	76 ♀	Good	Sling	Managed at end of 24 days.	5 yrs. 3 mos.	Good	Good

Seven patients were admitted for an average of 15 days. So were another 2, but one of them had concussion and the other one contusion of the chest and metatarsal fracture. Sixteen were treated as out-patients.

Eleven patients reported that they had returned to work or recovered from 0 to 150 days after the accident, averaging 9 weeks. The 0 day refers to a 36-year-old woman who did domestic work right from the day of the accident. One patient "recovered very quickly", another two managed without help all the time. Nine had got on without help an average of 20 days after the trauma. Two patients, including the only one who was treated by abduction splint, were unable to state anything about the primary result.

End result:

Anatomical:	Functional:
Good: 23	Good: 22
Fair: 0	Fair: 1
Poor: 0	Poor: 2
Not stated: 2	

Two patients had poor function in the shoulder and will be briefly discussed.

One (Case 251) was a 38-year-old man admitted to hospital 5 days after a fall in which he sustained contusion of the chest, metatarsal fracture, and hurt his shoulder. There was a fissure through the greater tuberosity. He received physical therapy for 5 months. The patient returned to work 6 weeks after the trauma, but he considered the compensation he obtained insufficient. This patient made an impression of malingering, but as he could not be induced to better movement, the result must be judged as "poor".

The other patient (Case 261), a 66-year-old man, had a history of syphilis in addition to a fracture of the greater tuberosity with pronounced displacement. The follow-up X-ray does not give any explanation of the poor function. The patient received massage and exercises for 6 weeks after the trauma, but he is not working.

Patients who have no physical work must display extra energy in exercises, if they are to recover from a fracture of the upper end of the humerus.

One patient (Case 269) complained of pain in the shoulder for a fairly long time after the trauma, although there was no displacement worth mentioning. After a few X-ray treatments he recovered.

Many authors claim that fracture of the greater tuberosity is a serious injury with a poor prognosis, if the fragment does not unite in an almost anatomical position. They maintain that reduction must be performed in the presence of displacement and advocate after-treat-

ment in abduction. Even in the absence of displacement *Matti* and *Sever* recommend treatment in abduction.

In the literature I have not been able to find analyses of large series of fractures of this type. In his series from 1912 *Collin* had only 4 cases, including one with pronounced displacement of the fragment toward the acromion. All were treated by massage and mobilization with a good functional result.

In the present series all 23 cases X-rayed at follow-up had united in a good position. The position is classified as good, even in the presence of some elevation or prominence of the greater tuberosity. When first X-rayed, 22 were in a good position, 2 fair, and one unknown.

In Case 255 the tuberosity fragment was "greatly rotated" on the first X-ray, but at follow-up only rather prominent. In Case 263 it was slightly elevated. In one case the tuberosity was a little upward and laterally displaced, but at follow-up it was found to have united without elevation.

Thus, in some cases the greater tuberosity showed a tendency to improve its position, and the position did not in any case deteriorate during functional treatment.

If the two functionally poor results are explained as malingering in one and inactivity of old age in the other, fracture of the greater tuberosity does not seem to be a serious accident, judging by the present series. *As a rule, the fragment is in a good position, and it has a tendency to improve its position during treatment with mobilization which also affords good functional results.*

Table 55 gives a survey of the treatment and functional end results in the 25 cases.

TABLE 55
Fracture of the greater tuberosity. 25 patients.
Treatment and results.

Treatment	Number of cases	Functional end results		
		Good	Fair	Poor
Functional treatment	20	17	1	2
Immobilization in abduction	1	1		
Mixed treatment	4	4		
Total	25	22	1	2

CHAPTER XI

FRACTURE-DISLOCATION

As already mentioned on p. 45 this does not include the state which some authors have called "rotary dislocation", "Umkehrungsluxation", in which the head is completely rotated, but must be assumed to be inside the joint capsule. This I interpret as displacement of the fracture.

Only cases in which the head of the humerus must be assumed to be outside the joint capsule – below, in front of, or behind the glenoid cavity – will be called fracture-dislocation.

According to this nomenclature there are 30 patients with fracture dislocation (Cases 271–300).

13 with fracture of the head and neck or comminuted fracture
17 with fracture of the greater tuberosity.

Nineteen were women and eleven men.

Table 56 gives abstracts of the case records for the first group of 13.

The average age was 58 years.

Twelve patients were admitted to hospital for from 6 to 106 days, average 41 days. One patient (Case 279) was treated on an out-patient basis.

Nine patients arrived for treatment immediately after the accident, one came 2 days after, one 24 hours after, and one 16 hours after. Lastly, one patient came from another hospital; it is not known how long after the accident, but presumably it was immediately after, as he had only had X-ray films taken and no treatment had been instituted.

Open reduction was performed in 2 cases after vain attempts at closed reduction. After-treatment with abduction splint-traction. One obtained a fair and the other a poor end result.

Removal of the head was performed in one case after two unsuccessful attempts at reduction. Functional end result poor.

Closed reduction was successful in 5 cases. As after-treatment 3 had functional treatment from the 4th, 2nd, and 13th day respectively. All obtained good functional end results. The 4th patient had mixed treat-

TABLE 56
Fracture-dislocation. 13 patients with fracture of the head and neck or comminuted fracture.
Treatment and results.

Case No.	Age and sex	Diagnosis	Treatment	Post-reduct. position	Primary result	Follow-up	End results	
							Anat.	Funct.
271	35 ♂	Fract. of anat. neck & gr. tub.-dislocation	I. Attempt at reduct. under ether anaesth. II. Open red. 9 days after the trauma. Abd. splint 56 days, with tract. for 35 days.	Bad	Managed at end of 2½ mos.	4 yrs. 10 mos.	?	Fair
272	51 ♀	Comminuted fracture-dislocation.	I. Attempt at reduct. under ether anaesth. II. Open red. 3 days after the trauma. Abd. splint 30 days, with tract. for 20 days.	Bad	Working as housewife at end of 40 days.	3½ yrs.	Poor	Poor
273	69 ♀	Comminuted fracture-dislocation.	I. Attempt at reduct. under ethyl chloride. II. Attempt at reduct. under ethyl chloride. III. Resection		?	6 yrs. 9 mos.	Poor	Poor

274	45 ♀	Fract. surg. neck & gr. tub.-dislocation.	splint 32 days, with tract. 18 days. Closed reduct. under ethyl. chloride. Funct. treatm. from 4th day. Closed reduct. under ether anaesth. Funct. treatm. from 2nd day. I. Attempt at reduct. under ethyl chloride. II. Closed reduct. under ether anaesth. Abd. splint & tract. 11 days. Funct. treatm. from 16th day. Closed reduct. under ether anaesth. Funct. treatm. from 13th day. Closed reduct. Abd. splint 7 weeks, with tract. 5 wks.	Fair	Working as housewife at end of 3 mos.	3 yrs. 11 mos.	Fair	Good
275	55 ♂	Impacted surg. neck fract.-dislocation.		Good	Managed at end of 3 mos.	3 yrs. 9 mos.	Fair	Good
276	61 ♀	Comminuted fracture-dislocation.	I. Attempt at reduct. under ethyl chloride. II. Closed reduct. under ether anaesth. Abd. splint & tract. 11 days. Funct. treatm. from 16th day. Closed reduct. under ether anaesth. Funct. treatm. from 13th day. Closed reduct. Abd. splint 7 weeks, with tract. 5 wks.	Poor. After removal of splint and tract.: Fair.	Managed at end of 2 mos.	6 yrs. 9 mos.	Poor	Poor
277	63 ♂	Fract. surg. neck & gr. tub.-dislocation.		Good	Fit at end of 2¼ mos.	1 yr. 10 mos.	Fair	Good
278	63 ♂	Comminuted fracture-dislocation.	I: Good II: 9 days later: Bad.	I: Good II: 9 days later: Bad.	Working as foreman in factory at end of 4½ mos.	3 yrs. 9 mos.	Poor	Poor

TABLE 56 (cont.)

Case No.	Age and sex	Diagnosis	Treatment	Post-reduct. position	Primary result	Follow-up	End results	
							Anat.	Funct.
279	63 ♀	Comminuted fracture-dislocation*.	"Closed reduct." Funct. treatm. from 10th day.	Bad	Managed at end of 6 mos.	5 yrs.	Poor	Poor
280	54 ♀	Comminuted fracture-dislocation.	"Closed reduct."***. Ether anaesth. Abd. splint 9½ wks., with tract. 6 wks.	Bad	Managed at end of 3½ mos.	2 yrs. 11 mos.	Poor	Fair
281	74 ♀	Comminuted fracture-dislocation.	Funct. treatm. from 4th day.		Poor	1 yr. 3 mos.	Poor	Poor
282	76 ♀	Comminuted fracture-dislocation.	Funct. treatm. from 3rd day.		Poor	3 yrs. 4 mos.	Poor	Poor
283	43 ♂	Fract. anat. neck & surg. neck-dislocation. (cerebro-spinal syphilis)***	Bed rest 11 days. Funct. treatm. from 19th day.		Working as representative at end of 2 mos.	6½ yrs.	Poor	Poor

* The fracture of the anatomical neck was not detected until at follow-up, 5 years after the trauma, so there was no question of "reduction".

** The head fragment was not reduced.

*** The dislocation was not detected until at follow-up, 6½ years after the accident.

ment after the reduction. The functional end result was poor. The 5th patient was after-treated by traction for 5 weeks; the abduction splint was kept on for 7 weeks in all. Functional end result poor.

In one instance (Case 279) closed reduction was believed to have been effected, but dislocation of the head fragment was overlooked until follow-up, 5 years later, which showed that it was situated in the axilla. The patient received functional treatment from the 10th day after the manœuvre. Functional end result poor. (Thus, the patient was actually treated by the method of Riberi).

In one case (No. 280) the head fragment after "closed reduction" was dislocated far down the outer side of the humeral shaft. The patient was then treated by traction for 6 weeks; the abduction splint was kept on for 9½ weeks in all. Functional result fair.

Another 2 patients (Cases 281 and 282) had functional treatment (Riberi) from the 4th and 3rd day respectively after the accident without any attempt at reduction. Functional end result in both poor.

One patient (Case 283) was treated by bed rest for 11 days and functional treatment from the 19th day after the accident. (In addition, he received antisiphilitic treatment for cerebrospinal syphilis). In this case the dislocation was not detected until follow-up, 6½ years after the accident. Functional end result poor.

To make the results more perspicuous, the cases are listed in Table 57.

TABLE 57
Fracture-dislocation. 13 patients with fracture of the head and neck or comminuted fracture. Treatment and results.

Treatment	Number of cases	Functional end results		
		Good	Fair	Poor
Closed reduction	5	3		2
Open reduction	2		1	1
Functional treatment (Riberi)	3			3
Removal of head	1			1
Traction-abduction	1		1	
Mixed treatment	1			1
Total	13	3	2	8

The relation between functional and anatomical result may be seen from the following tabulation (source Table 56):

Functional result. Good: 3. Anatomical: Fair, Fair, Fair.
 Fair: 2. Anatomical: ? , Poor.
 Poor: 8. Anatomical: Poor in all cases.

This series of fracture-dislocation is too small to permit any conclusion regarding the treatment of choice. However, it does seem to support the general view that closed reduction is the best treatment. If it fails, most authors think that open reduction should be tried, but removal of the head is not believed to be indicated unless the other two methods fail or if it is estimated at operation that the head fragment will not be able to unite with the other fragments.

In addition to the three therapeutic methods, there is yet another way of treating fracture-dislocation, viz.

The Riberi method.

Riberi (quoted by *McBurnay & Dowd*, 1894) reported a case from 1843 in which he tried to form a new joint by exercises, without making any attempt at reducing the dislocation.

Gerard-Marchant (1928) also mentions this method.

Böhler (1941) has often seen quite good function result, although the dislocation is allowed to persist, while function is trained.

Mason (1908) treated one case by the *Riberi* method, with a poor functional result. In my series 3 cases had been treated by this method, all with a poor functional result.

TABLE 58
Fracture-dislocation. Fracture of the head and neck or comminuted.
Treatment and results.
 a. *Closed reduction.*

Author	No. of cases	Very good	Good	Fair	Im- pro- ved	Poor	Died	Not stated
Mason 1908	6*		1	1	2	1		1
Ritter 1927	2		2					
Wentworth 1940	3		3					
Gerhardt & Grolitsch 1941	8	6				1	1	
Madsen 1949	2		1			1		
Dehne 1945	2	2						
Present series	5		3			2		
Total	28	8	10	1	2	5	1	1

* Condensed summary of recent and old cases.

b. Open reduction.

Author	No. of cases	Very good	Good	Fair	Im- pro- ved	Poor	Died	Not stated
Mason 1908	23*		14	3	1	2	2	1
Roemer 1917	23	13	3	2		2		3
Silfverskiöld 1928	12**	5	3	3		1		
Wentworth 1940	1					1		
Gerhardt & Grolitsch 1941	1							1
Madsen 1949	4		2	1		1		
Dehne 1945	5		3			2		
Present series	2			1		1		
Total	71	18	25	10	1	10	2	5

* Condensed summary of recent and old cases.

** In three of these secondary resection was done.

c. Removal of head.

Author	No. of cases	Very good	Good	Fair	Im- pro- ved	Poor	Died	Not stated
Mason 1908	21*			9	10		2	
Roemer 1917	25		7	9		8	1	
Ritter 1927	2					1		1
Silfverskiöld 1928	2**			1		1		
Wentworth 1940	1			1				
Gerhardt & Grolitsch 1941	5					5		
Madsen 1949	2		1	1				
Michaelis 1944	2		2					
Dehne 1945	8		2			6		
Present series	1					1		
Total	69		12	21	10	22	3	1

* Condensed summary of recent and old cases.

** Primary resection.

*d. Functional treatment only**.*

Author	No. of cases	Very good	Good	Fair	Im- pro- ved	Poor	Died	Not stated
Mason 1908	5*			1	2	2		
Present series	3					3		
Total	8			1	2	5		

* Condensed summary of recent and old cases.

** Mason's "rest and massage".

e. *Abduction splint only.*

Author	No. of cases	Very good	Good	Fair	Im- pro- ved	Poor	Died	Not stated
Gerhardt & Grolistch 1941	2					1		1
Present series	1			1				
Total	3			1		1		1

It has been mentioned already how difficult it is to compare results, when the criteria of judging them have differed. The present series, for instance, includes 3 cases (Nos. 271, 273, and 276) which had previously been reported by *Madsen* (1949) as having good, good, and fair function, whereas according to my criteria the same three patients belong to the categories fair, poor, and poor.

Table 58 (a-e) gives the results reported by some authors in the treatment of fracture-dislocation. It must be mentioned that special columns have not been reserved by all the authors for e.g. "very good", or "improved", but all have columns for "good", "fair", and "poor".

Seventeen patients, listed in Table 59, had fracture of the greater tuberosity and dislocation.

Closed reduction was performed in all cases, in 16 without difficulty. In one case the first attempt was unsuccessful, but after 6 kg. traction in abduction overnight, reduction could be effected.

In 7 cases the reduction was carried out under ethyl chloride anaesthesia, in 5 under ether anaesthesia, in one case with N₂O analgesia, and in one without anaesthesia. In the remaining cases no mention is made of anaesthesia.

After the reduction, 14 patients had functional treatment, 2 had exercises, started 3 weeks after the accident, and one had no after-treatment.

The average age of these patients was 56 years 3 months.

Fourteen were admitted to hospital for from 1 to 74 days, average 17 days.

One of the patients (Case 292) came to hospital immediately after the trauma with an inferior dislocation, a greatly displaced fragment, and flaccid paresis of the limb. After closed reduction under ethyl chloride, the fracture was in good position. The patient remained in

hospital for 74 days, and the paresis gradually cleared. A neurologist interpreted it as a functional paresis.

Another patient (Case 297) did not arrive for treatment until 3 weeks after the trauma and remained in hospital for 52 days. At follow-up he stated that he had "recovered quickly".

One patient came for treatment 7 days, one 3 days, one 18 hours, and one on the day after the trauma. Twelve came immediately after the trauma (including Case 292).

Three patients had returned to work an average of 8 weeks after the trauma. The others could not remember.

In three cases the functional end result was poor.

One of them (Case 291) arrived after having fallen in the street. After reduction, which was effected without difficulty, the greater tuberosity was *in situ*. The patient had exercises and could manage two weeks after the accident. She has no subjective complaints, but a poor function. Her economic status is such that she need not work, so the shoulder has had ample occasion to become stiff. Although the greater tuberosity is $1\frac{1}{2}$ cm elevated, there is no explanation of the poor function other than the patient's inactivity.

In Case 294, the subjective, functional and anatomical end result is poor. At follow-up there was a big fissure in the articular surface of the scapula. On the first film it had looked like a small marginal fracture in a good position. This dislocated fracture in the joint surface is sufficient explanation of the poor result.

The last poor result was in a patient (Case 300) who was 82 years of age at follow-up. The first attempt at reduction failed, but after 6 kg traction overnight it was easy. After reduction, the fracture showed considerable displacement. Physiotherapy was started 3 weeks after the trauma. At follow-up the tuberosity had united with marked displacement, and calcific deposits were seen between the tuberosity and acromion. No wonder, therefore, that function is poor.

Most authors stress the necessity of reducing the dislocation as soon as possible. In this series there was a patient whose dislocation was not reduced until 3 weeks after the accident. He "recovered quickly" and obtained good function. Another patient was treated 7 days after the trauma. Function fair. A third patient arrived for treatment 3 days after the accident. Reduction without anaesthesia did not give rise to any difficulties. This patient has never recovered completely. She has marked complaints and the function is fair. However, she is an invalid for other reasons and is not working.

TABLE 59
Fracture-dislocation. 17 patients with fracture of the greater tuberosity.
Treatment and results.

Case No.	Age and sex	Position before reduct. of dislocation	Treatment	Position after reduct. of dislocation	Primary result	Follow-up	End results	
							Anat.	Funct.
284	24 ♂	?	Closed reduct. under ethyl chloride. Funct. treatm.	Good	Working as mechanic at end of 5 wks.	4 yrs. 2 mos.	?	Good
285	37 ♂	?	Closed reduct. under ethyl chloride. Funct. treatm.	Good	Managed at end of 6 mos.	3 yrs.	Fair	Fair
286	37 ♂	?	Closed reduct. under ether anaesth.	Good	Managed at end of 2 wks.	3 ½ yrs.	?	Good
287	43 ♂	Good	Closed reduct. under ether anaesth.	Good	Clerical work at end of 3 wks.	2 yrs. 9 mos.	Good	Good
288	43 ♀	Fair	Closed reduct. under ethyl chloride. Funct. treatm.	Good	Managed at end of 6 mos.	3 yrs. 5 mos.	Good	Good
289	51 ♀	Good	Closed reduct. under ethyl chloride. Funct. treatm.	Good	Working as telephone operator at end of 4 mos.	1 yr. 3 mos.	Good	Good
290	53 ♂	Good	Closed reduct. under ether anaesth.	?	Managed all the time	6 yrs. 2 mos.	Good	Good
291	59 ♀	?	Closed reduct. under ethyl chloride. Funct. treatm.	Good	Managed at end of 2 wks.	1 yr. 11 mos.	Good	Poor

292	61 ♀	Bad	Closed reduct. under ethyl chloride.	Good	Managed at end of 2 mos.	6 yrs. 3 mos.	Fair	Good
293	63 ♀	?	Funct. treatm. Closed reduct. under ether anaesth.	?	Managed at end of 4 mos.	5 yrs. 2 mos.	Good	Good
294	68 ♀	?	Funct. treatm. Closed reduct. under ether anaesth.	Bad + fract. of the scapula.	Managed at end of 1 yr.	3 yrs. 10 mos.	Poor	Poor
295	72 ♀	?	Funct. treatm. Closed reduct. under ethyl chloride.	Good	Managed all the time	5 yrs.	Good	Good
296	73 ♀	?	Funct. treatm. Closed reduct. Funct. treatm.	?	Managed at end of 6 mos.	1 yr. 11 mos.	Good	Good
297	74 ♀	?	Closed reduct. with N ₂ O analgesia.	Fair	"Recovered quickly"	6 ½ yrs.	Good	Good
298	67 ♀	Fair	Funct. treatm. Closed reduct. under ethyl chloride.	?	Managed at end of 5 mos.	3 yrs. 1 mo.	Good	Good
299	56 ♀	?	No after-treatment Closed reduct. Sling. Exercises at end of 3 wks.	Good	Managed at end of 2 mos.	2 yrs. 3 mos.	?	Fair
300	76 ♂	Bad	Unsuccessful attempt at reduct. under ether anaesth. 6 kg tract. overnight Then, closed reduct. Funct. treatm. at end of 3 wks.	Fair	Managed at end of 3 mos.	5 yrs. 11 mos.	Poor	Poor

The anatomical and functional end results in the 17 cases are as follows:

End result:

Anatomical:	Functional:
Good: 10	Good: 12
Fair: 2	Fair: 2
Poor: 2	Poor: 3
Not stated: 3	

Or set out differently:

Functional end result: Good 12. Anatomical: Good: 9, fair: 1, not stated: 2.

Fair 2. Anatomical: Fair: 1, not stated: 1.

Poor 3. Anatomical: Good: 1, poor: 2.

Table 60 gives a survey of the treatment, after reduction of the dislocation, and of the functional results in these 17 cases.

TABLE 60
Fracture of the greater tuberosity-dislocation. 17 patients.
Treatment after reduction. Results.

Treatment	Number of cases	Functional end results		
		Good	Fair	Poor
Functional treatment	14	11	1	2
No after-treatment	1	1		
Mixed treatment	2		1	1
Total	17	12	2	3

CHAPTER XII

END-RESULTS

The first question asked at the beginning of this follow-up study was:

How is the prognosis of fracture of the upper end of the humerus?

Table 61 was set up in the endeavour to answer this question.

TABLE 61
*Fracture of the upper end of the humerus. 300 patients.
Functional results.*

Type of fracture	Number of cases	Functional results		
		Good	Fair	Poor
1. Separation of the upper humeral epiphysis	1	1		
2. Fracture of the anatomical neck	2	1		1*
3. Fracture of the surgical neck ...	135	111	14	10
4. Fracture of the surgical neck and greater tuberosity	99	84	8	7
5. Comminuted fracture of the upper end of the humerus	8	6	1	1
6. Fracture of the greater tuberosity	25	22	1	2
7. Fracture-dislocation with fracture of the head and neck or comminuted	13	3	2	8
with fracture of the greater tuberosity	17	12	2	3
Total	300	240 (80.0 %)	28 (9.3 %)	32 (10.7 %)

* Co-existing fracture of the greater tub.

Thus, the functional result in all the cases was as follows:

Good: 80.0 %

Fair: 9.3 %

Poor: 10.7 %

Table 62 sets out the functional results in relation to age.

TABLE 62
300 patients. Functional results in relation to age.

Age	Number of cases	Functional results		
		Good	Fair	Poor
7-29 yrs.	28	28: 100.0 %		
30-59 yrs.	127	105: 82.6 %	11: 8.7 %	11: 8.7 %
60 years and over	145	107: 73.8 %	17: 11.7 %	21: 14.5 %
Total		240: 80.0 %	28: 9.3 %	32: 10.7 %

This shows that a good function in the shoulder was obtained in all cases under 30 years of age, in 82.6 % of the middle-aged, and in 73.8 % of the patients over 60.

A poor function resulted in 14.5 % of the oldest age group and in 8.7 % of the patients from 30 to 59 years of age.

The second question to be elucidated by the study was:

Is union in an anatomically good or correct position necessary to obtain good function in the shoulder?

To be able to answer this question a comparison is made between the anatomical and the functional end results in Table 63. Parts a-d set out the various methods of treatment, whereas in part e the results of all methods are summarized.

This comparison includes cases with fracture of the surgical neck,

fracture of the surgical neck and greater tuberosity, comminuted fracture of the upper end of the humerus.

A total of 242 patients had fractures of these types, but only 202 were X-rayed at follow-up, so the comparison will be based only on these 202.

Patients with other types of fracture are not suitable for this purpose for the following reasons:

Separation of the upper humeral epiphysis and fracture of the anatomical neck occurred in so few cases that they do not afford a sufficient basis for comparison.

Out of the 25 fractures of the greater tuberosity all 23 that were

X-rayed had united in a good position and will therefore not be included in the comparison.

Fracture-dislocation presents special problems which do not relate merely to the bony union. This type will, therefore, also be ruled out in this connection.

TABLE 63

Fracture of the surgical neck, fracture of the surgical neck and greater tuberosity, comminuted fracture of the upper end of the humerus. 202 patients. Comparison between anatomical and functional end results.

a. Closed reduction. 15 patients.

Anatomical end results	Functional end results
Good: 6	Good: 6
	Fair: 0
	Poor: 0
Fair: 3	Good: 3
	Fair: 0
	Poor: 0
Poor: 6	Good: 5
	Fair: 0
	Poor: 1

b. Functional treatment. 130 patients.

Anatomical end results	Functional end results
Good: 72	Good: 66
	Fair: 5
	Poor: 1
Fair: 19	Good: 15
	Fair: 2
	Poor: 2
Poor: 39	Good: 23
	Fair: 9
	Poor: 7

c. Immobilization in abduction. 36 patients.

Anatomical end results	Functional end results
Good: 14	Good: 14
	Fair: 0
	Poor: 0
Fair: 6	Good: 6
	Fair: 0
	Poor: 0
Poor: 16	Good: 10
	Fair: 4
	Poor: 2

TABLE 63 (cont.)

d. *Mixed treatment. 21 patients.*

Anatomical end results	Functional end results
Good: 12	Good: 11
	Fair: 0
	Poor: 1
Fair: 1	Good: 1
	Fair: 0
	Poor: 0
Poor: 8	Good: 6
	Fair: 0
	Poor: 2

e. *Condensed summary of a-d. 202 patients.*

Anatomical end results	Functional end results		
	Good	Fair	Poor
Good: 104	97: 93.3 %	5: 4.8 %	2: 1.9 %
Fair: 29	25: 86.2 %	2: 6.9 %	2: 6.9 %
Poor: 69	44: 63.8 %	13: 18.8 %	12: 17.4 %
Total	166	20	16

This shows that union in a good position also gives the best chance of good function in the shoulder, i.e. good function in 93.3 % against 63.8 % in case of union in a bad position.

The fact that 63.8 % did obtain good function despite union in a bad position shows, however, that *a good position is not an essential condition for good function in the shoulder.*

TABLE 64

Fracture of the surgical neck, fracture of the surgical neck and greater tuberosity, comminuted fracture of the upper end of the humerus. 199 patients. Comparison of position before treatment and at follow-up.

a. *Closed reduction. 15 patients.*

Position before treatment	Position at follow-up		
	Good	Fair	Bad
Good: 3	2		1
Fair: 2	1	1	
Bad: 10	3	2	5
Total	6	3	6

b. Functional treatment. 128 patients.

Position before treatment	Position at follow-up		
	Good	Fair	Bad
Good: 70	55	7	8
Fair: 20	11	5	4
Bad: 38	6	7	25
Total	72	19	37

c. Immobilization in abduction. 36 patients.

Position before treatment	Position at follow-up		
	Good	Fair	Bad
Good: 10	8	1	1
Fair: 7	2	3	2
Bad: 19	4	2	13
Total	14	6	16

d. Mixed treatment. 20 patients.

Position before treatment	Position at follow-up		
	Good	Fair	Bad
Good: 7	6		1
Fair: 1	1		
Bad: 12	5	1	6
Total	12	1	7

e. Condensed summary of a-d.

Position before treatment	Position at follow-up		
	Good	Fair	Bad
Good: 90	71	8	11
Fair: 30	15	9	6
Bad: 79	18	12	49
Total	104	29	66

Considering, however, that a good anatomical position gives the best chances of good function, it is important to investigate which therapeutic method gives the best anatomical result.

Table 64 a-e compares the position of fractures, treated by the different methods, before treatment and at follow-up.

The patients are the same as shown in Table 63 less the three who were not X-rayed before treatment was instituted.

In cases with bad position before the treatment, the position improved as follows:

Closed reduction improved the position in	50 %
Mixed treatment improved the position in	50 %
Functional treatment improved the position in	34 %
Immobilization in abduction improved the position in	32 %

On the other hand, there are also some patients whose good position before the treatment got worse in the course of treatment. This applies to all the therapeutic groups.

CHAPTER XIII

DISCUSSION

The analysis of the present series has shown that *no one method of treatment is so superior to the others that it can be recommended in every case*. It seems that the treatment must be adapted to the condition in each individual case.

Let us recapitulate the conflicting views regarding the therapeutic principles:

- (1) Union in anatomically correct position above all.
- (2) Union in anatomically correct position is, particularly in the case of juxta-articular fractures, subordinate to the earliest possible training of function.

As far as fractures of the upper end of the humerus are concerned, the adherents of the former view advocate immobilization of the arm on an abduction splint with or without traction or abduction in bed, possibly with traction, or else immobilization in an arm-chest plaster cast, perhaps preceded by reduction.

Adherents of the second principle stress early mobilization of the shoulder. Most of these authors also recommend massage and heat in some form or other, e.g. diathermy or short wave treatment. Other physiotherapeutic methods worth mentioning are pulley and wand exercises, iontophoresis, etc. For the sake of convenience these methods have been called "functional treatment" in this paper.

These two therapeutic principles will be briefly discussed below.

FUNCTIONAL TREATMENT

This method has the advantage of permitting ambulation in most cases, all the time or after a few days in hospital. This is possible, because the patient only carries a light, supporting bandage, viz. collar-and-cuff sling or sling.

The risk of using a sling has been emphasized above. It may be too tight, elevating the distal fragment too much, so that it counteracts the natural traction exerted by the weight of the arm. As a result, it

may increase a possible angulation in the fracture or even lift the shaft fragment to the level of the head fragment.

A collar-and-cuff sling is, therefore, preferable to a sling. It supports the wrist and the forearm, while almost the entire weight of the arm exerts traction on the site of the fracture. As the arm is so free, the patients can better make, first small and gradually increasing, movements in the shoulder.

It is important, therefore, that the patients should be out of bed as far as possible. During bed rest, there is no traction by the weight of the arm, and in the presence of a tendency to displacement, this may be counteracted by other measures, e.g. skin traction.

During the first few days the patients usually have severe pain. If it is very severe, the arm may be bandaged to the side, e.g. in Velpeau's bandage, for a few days. Owing to the pain the patient will invariably keep his muscles tense to guard against any movement that might increase the pain. Analgesics should, therefore, be administered to relax the muscles.

At the end of a few days, the pain subsides, especially if the patient is ambulatory, with the arm hanging down along the side in the physiological resting position. The muscles relax, and there is a chance of reducing the fracture by the traction of the arm. According to *Lowett* (1922) the arm of an adult weighs 10–15 pounds. This is no slight traction, when it is allowed to act in the right direction. Even an impacted fracture may be loosened and may reduce itself by this traction, especially when the patient also does active exercises. When I recommend exercises, I always mean active movements.

Active movements cannot displace the fracture, as they never exceed the pain limit. Therefore, the patient can make active movements to his heart's content, the more the better.

A serious warning must be sounded against passive movements. They are hardly ever of any use, and often they may displace the fracture. Therefore: *Always active, never passive movements until firm union has taken place.*

There is one form of passive movements, done by the patient himself, that will not displace the fracture, viz. those described by *All-dredge & Knight* as well as by *Brostrom* as "relaxed motions". With the trunk bent forward and the arm hanging relaxed, he moves his trunk so as to set up flexion, extension, abduction, adduction, and circumduction in the shoulder. This method is without doubt excellent in many cases, particularly during the first few days while pain is present.

Massage and heat are well-suited to relax the muscles and increase the circulation in the injured region. Massage must be light and gentle, not painful, but pleasant to the patient. Massage and heat can be instituted during the very first days. Active movements should be started as early as possible, usually 3–4 days after the accident.

At a later stage other physiotherapeutic methods may be started: pulley exercises and wand exercises, when the fracture has united and the training of function can be done with more energy. X-ray therapy has a good effect on the pain.

Nothing is as essential in regaining function as the patient's own energy. "The patient must cure himself" (*Collin*). Where energy is deficient, an experienced physiotherapist can do much to stimulate the patient. The after-treatment should, therefore, be under the supervision of an experienced physiotherapist.

On the whole, functional treatment has a stimulating effect on the patient. He is told that the result depends on himself, that he has permission and a duty to do something, and he can note progress day by day.

When treated by the functional method the patient can soon return to work. The arm is only supported by a light bandage. The patient knows that he is allowed all the movements he can make. As a result, he will return to his work earlier than if he had immobilizing treatment, and work is the best kinesitherapy.

IMMOBILIZATION IN ABDUCTION

Often, when the arm is X-rayed in the adducted position, there is a good or excellent position, but as soon as the arm is abducted, the fracture becomes displaced.

This is obvious. In the case of a loose fracture through the upper end of the humerus, often even with valgus deformity, this angle must become increased in abduction. Owing to the weight of the arm, moreover, the distal fragment will sink down into the axilla. The result is medial displacement of the shaft fragment. Furthermore, this involves the risk of shortening. When the weight of the arm is no longer acting into the correct direction, the longitudinal muscles, which are tense owing to the pain, can more easily pull the distal fragment upward. The result is Malgaigne's displacement with the shaft fragment pulled inward and up into the axilla.

An abduction splint may be fitted so well into the axilla that this

displacement does not occur or is reduced immediately. It is, however, an experience which most surgeons have made that after a few days the position of the splint is not as good as it was when it was applied. The straps which hold it are not so tight any more, the abduction splint has slid down along the chest, pulling the arm, i.e. the distal fragment, down with it and forming the displacement described above.

The abduction splint may, therefore, be an extremely dangerous thing. If used at all, it requires close supervision with frequent X-ray control of the position which must be corrected immediately, if it deteriorates. The abduction splint demands much work and care on the part of the therapeutic team.

Impacted fractures are less apt to become displaced, when the arm is bandaged on an abduction splint. In such instances, however, the splint is superfluous, because the patients can immediately start active movements.

Traction on abduction splint involves less danger of displacement, particularly of shortening, and in some cases a good position may be obtained and maintained by this method. However, it also presupposes accurate supervision, so that the splint does not slide down along the side, pulling the arm with it.

Therefore: *Never bandage a loose fracture of the upper end of the humerus on an abduction splint without simultaneous traction.*

What has been said above applies to loose fractures and to fractures with valgus deformity. A varus deformity may benefit from the abduction splint in some cases. It must be borne in mind, however, that union with even marked angulation, need not prevent satisfactory function in the shoulder.

In the present series 23 fractures had become displaced by the abduction splint with or without traction.

In 7 cases the abduction splint improved the position. Out of these cases simultaneous traction was exerted on the arm in 6.

As already pointed out, displacing a fracture, with the attendant rupture of vessels and injury to soft tissues, is by no means a harmless doing, even though the position can be improved again.

Nor is it comfortable to wear the abduction splint. At follow-up, years after the accident, many patients stated spontaneously or when questioned that it had been unpleasant. One of them said that "wearing the abduction splint was hell".

SUGGESTION FOR THERAPEUTIC SCHEDULE

At the beginning of this analysis three questions were asked:

- (1) How is the prognosis of fracture of the upper end of the humerus?
- (2) Is union in an anatomically good or correct position necessary to obtain good function in the shoulder?
- (3) Which method is preferable as the routine treatment in these fractures?

In Chapter XII an attempt was made to answer the first two questions. The correctness of my answer to the third question cannot be proved numerically, but after my studies of the literature and the analysis of these 300 cases I suggest the following main lines:

1. *Separation of the Upper Humeral Epiphysis.*

- (a) With no or negligible displacement: Functional treatment.
- (b) With marked displacement: Closed reduction with traction and cautious manipulations. After-treatment functional in the absence of a tendency to re-displacement. Otherwise, the reduction must be repeated and the arm immobilized in the position which can best counteract the tendency to displacement.

2. *Fracture of the Anatomical Neck.*

- (a) If the fracture is in good position: Collar-and-cuff sling and active exercises as early as possible, perhaps supported by massage and heat.
- (b) If the head fragment is in a bad position, e.g. rotated inside the joint capsule, reduction should be attempted by traction and cautious manipulations, followed by functional treatment.
- (c) If closed reduction fails, the head fragment must be removed, and thereafter the treatment should be as under (a).

3. *Fracture of the Surgical Neck.*

4. *Fracture of the Surgical Neck and Greater Tuberosity.*

5. *Comminuted Fracture of the Upper End of the Humerus.*

- (a) With no, negligible or considerable, displacement: Collar-and-cuff sling and functional treatment as early as possible, i.e. in most cases from 3–4 days after the accident, if the patient is out of bed.

If the patient is confined to bed it may be necessary to apply traction

on the arm in a slightly abducted position to substitute the extending action of the arm in an ambulatory patient.—But in this case too: Active exercises as early as possible.

(b) With marked displacement: In the presence of “rotary dislocation” or other forms of marked displacement, it should be attempted to reduce the fracture by traction and cautious manipulations under anaesthesia.

After reduction there is little tendency to re-displacement, if the patient is ambulatory with the arm in a supporting bandage. In bedridden patients the after-treatment must be adapted according to the tendency to displacement. Traction may be applied as described above.

Active movements and other physiotherapeutic measures as early as possible.

If contact cannot be established between the fragments, e.g. in “rotary dislocation” with a very short head fragment, open reduction should be performed. It must still be borne in mind, however, that even if it does prove impossible to obtain a good position in the fracture, the function in the shoulder may become excellent, if the patient as well as the surgeon display sufficient energy. The patients should be submitted to frequent examinations, including X-rays, particularly during the early period. It is recommended to treat and supervise the patient so long as any progress in function is perceptible. Often, this means a year or longer.

6. *Fracture of the Greater Tuberosity.*

(a) With no, negligible, or considerable displacement: Functional treatment.

(b) With marked displacement, e.g. if the fragment has been pulled up to between the head and the acromion: Open reduction and osteosynthesis followed by active exercises.

7. *Fracture-dislocation.*

I. With fracture of the head and neck or comminuted.

(a) Closed reduction under anaesthesia with traction and gentle manipulations, perhaps supplemented by McElvenny’s manœuvre. If this fails:

(b) Open reduction with or without osteosynthesis according to the condition. If this fails, or if the appearances of the fracture suggest that it cannot unite, then

(c) Removal of the head.

After-treatment after (a), (b), and (c) should be individualized. Cautious mobilizing treatment as soon as possible, perhaps after resting for a short time in a supporting bandage: collar-and-cuff sling, sling, swathe, or Velpeau's bandage in ambulatory patients in the absence of a tendency to re-dislocation or re-displacement.

Possibly traction in bed or on an abduction splint in the position which most efficiently counteracts the tendency to dislocation or displacement in each individual case.

The Riberi method cannot be recommended for any patient except one who is so old and debilitated that he cannot tolerate any other form of treatment.

II. With fracture of the greater tuberosity.

Closed reduction. The same after-treatment as in fracture of the greater tuberosity without dislocation.

The method of substituting the head fragment by a prosthesis has not been discussed in this paper, as the series is derived from a period before these methods came into general use.

SUMMARY

Chapter I

The literature on the treatment of fractures is reviewed, fractures in general and fractures of the upper end of the humerus in particular. The relative frequency of the latter fractures, their classification, treatment, and therapeutic results are reported.

Chapter II

Reviewing the literature on fracture-discoloration, the author discusses the nomenclature, history, therapeutic methods, and results.

Chapter III

The present series comprises 481 consecutive cases of fracture of the upper end of the humerus treated in some Copenhagen hospitals during the period 1938–1942. Some cases were left out, i.e. patients who have died, patients who had complications beyond the area of the fracture which might be assumed to influence the treatment or its results, and a few others. This leaves 329 patients who, at best, could have been followed up personally. Of them 302 or 91.8 % were re-examined.

This follow-up was designed to seek the answer to the following questions:

1. What is the prognosis of fracture of the upper end of the humerus?
2. Is union in an anatomically good or correct position necessary to obtain good function in the shoulder?
3. Which method is preferable as the routine treatment of these fractures?

A special section deals with rotation displacement. Unlike previous workers, the present author found internal rotation of the proximal fragment to be most common, viz. 31 cases against 8 of external rotation. This phenomenon is discussed.

Chapter IV

The follow-up period ranged from one to eight years, averaging 3 years 8 months. In two cases the follow-up period was only one year, in 12 it was less than 18 months, whereas in 289 cases (95.6 %) it was more than 18 months.

It was attempted to measure the angulation between the fragments in degrees, but it is pointed out that this measurement cannot be accurate.

Criteria are set up to evaluate function which is grouped into "good", "fair", and "poor". These criteria differ quite perceptibly from those established by *Schoch* in 1901 (cf. Chapter VII.) and which have been used ever since. In the present series stricter demands are made if the function is to be assessed as "good" or "fair".

At the time of the accident the age distribution of the patients was as follows: 28 were from 7–29 years (9 %), 130 were 30–59 years (43 %), and 144 were 60 years of age or over (48 %). Only 9 % of the patients were under 30 years of age, whereas e.g. in *Andler's* series 57 % were under 30.

A total of 189 were females (63 %) and 113 males (37 %).

According to the therapeutic methods used, the patients are grouped into four categories:

Functional treatment, i.e. when systematic exercises, perhaps with auxiliary massage, heat therapy, and other physiotherapeutic measures, are started within two weeks of the accident.

Immobilizing treatment, when the arm is immobilized in abduction for at least three weeks, be it on an abduction splint, during bed rest, or with an arm-chest plaster spica.

Mixed treatment, i.e. any treatment which cannot be classified under one of the two above methods or the fourth category:

Reduction, comprising practically only closed reduction, carried out as a primary procedure and under anaesthesia (Open reduction was only performed in three cases of fracture-dislocation).

Chapter V

The only case of separation of the upper humeral epiphysis occurred in a 15-year-old girl. After 35 days' traction on an abduction splint, there was 30° posterior angulation. Six years later, function was good (no X-ray film obtained).

Chapter VI

Fracture of the anatomical neck occurred in two cases, co-existing in one with fracture of the greater tuberosity. The uncomplicated case obtained good function by functional treatment, whereas at follow-up, 3 years 8 months after the accident, the other patient had shoulder complaints. The treatment had been sling for 16 days, followed by functional measures.

Chapter VII

Fracture of the surgical neck occurred in 136 cases. One was left out because of complications beyond the area of the fracture. The remaining 135 are distributed by age as follows: 25 were 7–29 years (18 %), 51 were 30–59 years (38 %), and 59 were 60 or over (44 %). 78 were women (58 %) and 57 men (42 %).

An abstract is given of each case record. After each therapeutic group the most interesting cases are discussed.

One patient (Case 138) exhibited non-union at follow-up.

The functional result of the surgical neck fractures was “good” in 82.2 %, “fair” in 10.4 %, and “poor” in 7.4 %.

Chapter VIII

In 99 cases there was fracture of the surgical neck co-existing with fracture of the greater tuberosity. One patient was under 30 years of age (1 %), 42 were 30–59 years (42 %), and 56 were 60 or over (57 %). 70 were women (71 %) and 29 men (29 %).

The cases are discussed as in the preceding chapter.

The functional end result was “good” in 84.9 %, “fair” in 8.1 %, and “poor” in 7.0 %.

Chapter IX

Comminuted fracture of the upper end of the humerus occurred in 9 cases, but one patient (Case 301) was left out because of enormous bony changes in both shoulders due to an irrelevant disease (syphilis). Four were in the 30–59 age group and four were older. Five were females and three males.

“Good” function was obtained in 6, “fair” in 1, and “poor” in 1.

The cases from Chapters VII, VIII, and IX are tabulated in order to compare the results of the various therapeutic methods. The figures

representing "good" function in the different groups are so close together that these values alone cannot show which method is the best one.

Ambulant treatment was used from the very outset in 57 % of the cases that received functional treatment, in 8 % of those who received immobilizing treatment, in 48 % of those receiving mixed treatment, and in 7 % of those who had reduction.

The pre-treatment position of the fracture was worst in the patients treated by reduction and best in those who had functional treatment.

Chapter X

Twenty-five patients had isolated fracture of the greater tuberosity. Of them 17 were 30–59 years of age (68 %) and 8 were older (32 %). Fifteen of these patients were women (60 %) and ten men (40 %). Sixteen had ambulant treatment. The functional end result was "good" in 22 patients (88 %), "fair" in 1, and "poor" in 2. One of the latter gave the impression of malingering, and the other one is not working. The only explanation of the poor result is inactivity.

Chapter XI

Fracture-dislocation, according to the definition given, is taken to mean only those cases in which the articular head is outside the joint capsule, not – as used by some authors – cases with rotation of the head within the joint.

Thirty patients come within this category: 1 under 30 years of age (3 %), 14 between 30 and 59 (47 %), and 15 older (50 %). Nineteen were women (63 %) and eleven men (37 %).

Thirteen had fracture of the head and surgical neck or comminuted fracture and 17 had fracture of the greater tuberosity. In the former group the functional end result was "good" in 3, "fair" in 2, and "poor" in 8. The 3 "good" cases are among the 5 in which reduction (closed) was successful; the remaining 2 showed a "poor" result.

Table 58 gives a comparison with therapeutic methods and results in the literature.

All 17 patients with fracture of the greater tuberosity and dislocation of the shoulder joint had closed reduction. After-treatment was functional in 14 cases. Two had exercises at the end of three weeks and one no after-treatment. The functional end result was "good" in 12, "fair" in 2, and "poor" in 3.

Chapter XII

In the endeavour to answer the first main question (Chapter III): the prognosis of fracture of the upper end of the humerus, the functional end result in 300 cases is analysed. The results are as follows:

"Good"	80.0 %
"Fair"	9.3 %
"Poor"	10.7 %

All patients under 30 years of age obtained "good" function. Within the age group 30–59 a total of 82.6 % had a "good" result, and in the over-60 group 73.8 % obtained a "good" result.

A "poor" result was observed in 14.5 % of the patients in the oldest age group against 8.7 % of those between 30 and 59.

The anatomical and functional results is compared within a group of 202 patients who had been X-rayed before the treatment and at follow-up. The categories of fractures were as follows: surgical neck, surgical neck plus greater tuberosity, and comminuted.

Out of the cases in which union took place in a good position, good function resulted in 93.3 %. With union in a bad position, function was good in 63.8 %. In other words, a good position is not necessary to obtain good function in the shoulder. This affords the answer to the second main question.

Chapter XIII

The two therapeutic methods, functional and immobilizing, are discussed. In the majority of cases functional treatment can be ambulant, either from the very outset or after a few days in hospital. A collar-and-cuff sling is preferable to a sling. In some instances, a bandage affording more support, e.g. Velpeau's, may be indicated by severe pain. It is recommended to start active exercises as early as possible, with auxiliary massage, heat, and perhaps other physiotherapy. It is pointed out that even greatly displaced fractures can reduce themselves by this treatment due to the weight of the arm, when it is allowed to act in the correct direction, down along the side, only the wrist being supported by a collar-and-cuff sling around the neck.

Passive movements are not advisable, until definite union has taken place. The "relaxed motions" described by *Allredge & Knight* and by *Brostrom*, which are performed by the patient himself, may, however, be useful during the first few days.

The psychologically beneficial influence of functional treatment is mentioned. The patient feels that the result depends upon himself and that he is able to cure himself.

It is recommended that the functional therapy be supervised by a physiotherapist.

Discussing treatment by immobilization in abduction, the author points out that a fracture in a good position with the arm adducted will often become displaced in abduction. It is emphasized that the abduction splint may be very dangerous. In the present series, it displaced the fracture in 23 cases, whereas it was beneficial in 7. In 6 out of these 7 cases traction on the arm was applied at the same time. The author warns against using an abduction splint, without simultaneous traction, in a loose fracture of the upper end of the humerus. If the abduction splint is to be used at all, it presupposes close supervision and control at short intervals.

In reply to the third main question (Chapter III) a *treatment schedule* is set up. It is pointed out that the correctness of this schedule cannot be proved numerically. It represents the author's personal opinion based on studies of the literature and on the present series.

CASE REPORTS*

ABBREVIATIONS

K.H.-I: Kommunehospitalet (Copenhagen City Hospital), Surgical Department I.

K.H.-V: Kommunehospitalet, Surgical Department V.

K.H.-Out-pt.: Kommunehospitalet, Surgical Out-patient Department.

O.H.: Orthopaedic Hospital, Copenhagen.

R.H.-C: Rigshospitalet (University Hospital), Surgical Department C.

R.H.-D: Rigshospitalet, Surgical Department D.

Case 5. (O.H., Case rec. 5038/1942) 11-year-old errand boy.

Fracture of the surgical neck.

Admitted for 36 days from 24.6.42, immediately after having fallen off a lorry, striking his left shoulder and upper arm. Tenderness and pain upon attempts at movements.

Objectively, the axis of the humerus points more to the medial aspect than normal.

X-rays: A serrated fracture low in the surgical neck. Proximal fragment rotated. Otherwise, little displacement.

Treatment: Attempt at reduction, abduction splint. X-rays showed a fairly good position in the anteroposterior view, whereas in the lateral view there was displacement (amounting to the width of the bone) and elevation of the distal fragment. Ether anaesthesia, ulnar bone traction 4.5 kg. X-rays: Unchanged. Traction increased to 6 kg. Four days later X-rays showed that the elevation had been almost abolished, but the lateral displacement was unchanged. Traction, 5.5 kg, was continued. X-rays showed the same position, but increasing callus. The abduction splint was removed at the end of 4 weeks, and then active movements and pulley exercises were instituted. Six months after the accident there was normal mobility in the shoulder.

Follow-up 2 years after the accident: The patient went back to work as errand boy 2 months after the injury. Shortly after, the complaints had ceased, not to return.

Obj. findings: 2 cm. shortening, measured from the tip of the acromion to the lateral epicondyle. No other abnormality.

X-rays: Normal shoulder apart from slight angulation at the site of the fracture.

Result: Subj.: Good.

Obj.: Good.

X-ray: Good. *Functional result:* Good.

Author's comment: It is doubtful whether the good result can be attributed to the treatment. Despite marked displacement during the treatment, the humerus was of practically normal appearance 2 years later. This only shows how the bone can correct itself during the healing of fractures in children.

* Only a selection of the case reports will be given.

Case 6. (R.H.-D, Case rec.: 726/1941). 13 year-old schoolboy.

Fracture of the surgical neck.

Admitted for 22 days from 2.5.1941, immediately after having fallen, striking his left shoulder. Obj. examination revealed suggillation and prominence anteriorly on the left shoulder, and just beneath the skin the tip of the distal fragment was palpable.

X-rays: (anteroposterior view): Fracture of the surgical neck in an ideal position (Fig. 14).



Fig. 14.



Fig. 15.

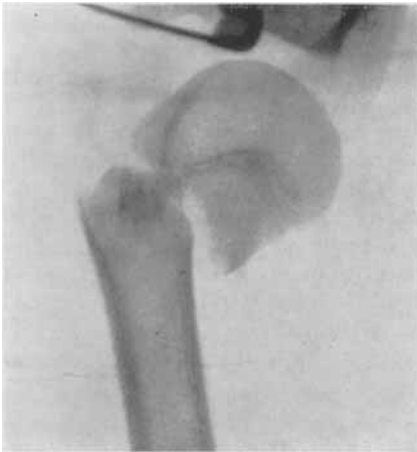


Fig. 16.

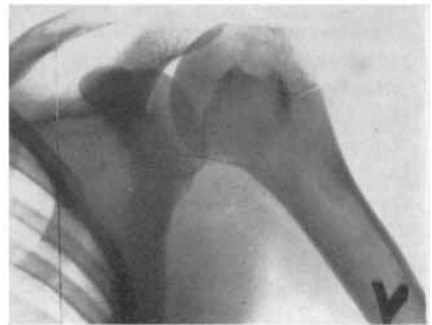


Fig. 17.

Treatment: "Reduction" under ether anaesthesia. Skin traction, 3 kg, on abduction splint. Now, X-rays showed the position to be much worse, i.e. about 50° varus deformity, and in the lateral view the shaft was seen to have become elevated to the level of the head (Fig. 15). May, 6th: Position unchanged. Traction increased to 8 kg. May 7th: Patient complained of pain. X-rays showed that in the lateral view there was 60° angulation. May 8th: Patient complained of paraesthesiae and limitation of movements in the fingers. Traction decreased to 3½ kg. Three days later the traction was discontinued (9 days' traction). Large bullae on the skin. May 14: X-rays showed that the position had again got worse (same position as in Fig. 15). May 16: Local analgesia. Ulnar bone traction, 8 kg, on abduction splint. May 19: X-rays: Improved in anteroposterior view. In the lateral view the position was bad (Fig. 16). May 23: Attempt at reduction under ethyl chloride anaesthesia. X-rays showed the position to be unchanged. May 30: Abduction splint and traction removed at the end of 28 days, and on the next day the patient was discharged with his arm in a sling. 57 days after the accident, the patient was moving his arm almost freely, and 71 days after the accident the mobility in the shoulder had become normal.

Follow-up 4½ years after the accident: Reported that he had recovered 2 months after the accident. No complaints.

Obj. findings: A perfectly normal shoulder.

X-rays: Slight deformity at the site of the fracture, but no angulation (Fig. 17).

Result: Subj.: Good.

Obj.: Good.

X-ray: Good. **Functional result:** Good.

Author's comment: The ultimate result was good, but there is little doubt that the same result would have been obtained by functional treatment, less unpleasant to the patient. This is one of the cases that should be left alone except for collar-and-cuff sling and exercises.

Case 12. (O.H., Case rec. 8101/1936 (1941)), 70-year-old female. Housewife.

Fracture of the surgical neck.

Admitted for 35 days, from 19.9.1941, after having fallen off her bicycle, striking her left shoulder.

X-rays: Anteroposterior view showed transverse fracture through the surgical neck.

There seemed to be considerable rotation of the proximal fragment. Medial displacement of the distal fragment (Fig. 18).

Treatment: Reduction under local analgesia. X-rays now showed unchanged position. Sling, axillary pad, and the arm was fixed with a swathe. Twelve days after the accident X-rays showed the distal fragment to be displaced to up in front of the head and posterior angulation of about 20°. Internal rotation of proximal fragment. Passive and active exercises were instituted.

Follow-up 3 years 5 months after the accident: Reported that she had recovered about one month after the accident.

Obj. findings: No abnormality.

X-rays: Union in 20° varus deformity and with some posterior angulation (Fig. 19).



Fig. 18.



Fig. 19.

Result: Subj.: Good.

Obj.: Good.

X-ray: Poor. *Functional result:* Good.

Case 13. (K.H. - I, Case rec. 2259/1942). 73-year-old woman, retired.

Fracture of the surgical neck.

Admitted for 23 days, from 14.10.1942, immediately after having fallen down a flight of stairs, striking her right shoulder.

X-rays with the arm in abduction: Transverse fracture of the surgical neck.

Proximal fragment rotated, the articular surface turning away from the glenoid cavity. Distal fragment far from the head, down in the axilla, below the neck of the scapula. In addition, an oblique fracture without displacement at the upper end of the humeral shaft (Fig. 20).

Treatment: Reduction under local analgesia. Skin traction in abduction in bed.

X-rays showed that the head was still rotated as previously, but the distal fragment was now approaching the proximal one (Fig. 21). Twelve days later X-rays showed that the position was good. Good contact between the fragments, and the head facing the right way. Slight varus and posterior angulation, but both negligible (Fig. 22). 16 days after the accident, an abduction splint was applied and the traction maintained. X-rays showed that the position was still good. The patient was discharged, but re-admitted 10 days later, after a doctor she had called had removed the abduction splint and she still had pain, especially at night. Objective examination revealed firm union. Two days after admission paresis of the radial nerve was noted. X-rays on 20.11 showed that the varus

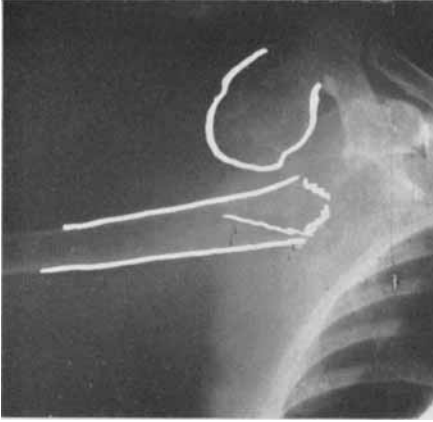


Fig. 20.

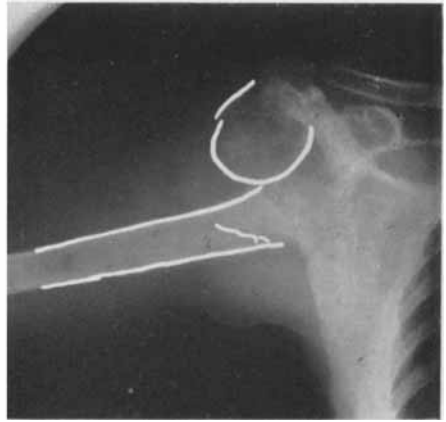


Fig. 21.



Fig. 22.

angulation had increased to 15° . On 26.11 the patient was transferred to a convalescent home.

Follow-up 18 months after the accident: Had massage 25 times. Constant pain and unable to dress. Is living together with her husband who has to do most of the domestic work.

Obj. findings: Flexion (35° , i.e. almost ankylosis) 110° , abduction (60°) 110° , rotation $120^\circ/120^\circ$. Strength very slight. "Pins and needles" in the two ulnar fingers. (The patient was unable to appear for X-ray examination, as she is very delicate, staying in bed most of the time).

Result: Subj.: Poor.

Obj.: Poor. *Functional result: Poor.*

Case 24. (K.H. - Out-pt., Case rec.: E.E.H./1939). 23-year-old seamstress.

Fracture of the surgical neck.

Came into the Out-patient Department on 18.8. after having fallen off her bicycle the day before. Hurt her right shoulder.

X-rays: Oblique fracture through the surgical neck with a small triangular intermediate fragment. No displacement as far as this one view can show (Fig. 23).



Fig. 23.

Treatment: Sling and, at the end of one week, massage and exercises. 4½ weeks after the accident anteroposterior X-ray film showed marked rotation of the proximal fragment, but no angulation. No definite callus. "The fracture appears to be consolidated. Active mobility fairly good. *Marked resistance upon passive, forced abduction*". X-rays (after this "forced abduction") in two projections and in abduction showed marked displacement. The distal fragment had become elevated and laterally displaced, the proximal fragment turning the articular surface inward and downward, making a varus angulation of about 25°. In the lateral view posterior angulation, but the film was of very poor quality. No definite callus. Six weeks after the accident the patient was capable of active abduction to 70°.

Follow-up 4 years 9 months after the accident. Went back to work as seamstress 2 months after the accident. Shortly after, the complaints ceased.

Obj. findings: Flexion, abduction 150°. No other abnormalities. (The patient was not X-rayed).

Result: Subj.: Good.

Obj.: Good. *Functional result:* Good.

Author's comment: At the end of 4½ weeks the fracture had not united so firmly that it could not be broken up by "forced abduction". Regrettably, I have no X-ray

of this fracture after it became displaced. This case shows how much care must be exercised in making passive movements until firm union has taken place.

Case 40. (O.H., Case rec. 5986/1942). 40-year-old male tramway employee.

Fracture of the surgical neck.

Admitted for 33 days from 25.7.1942. Six days previously the patient had fallen from a roof, striking his right shoulder. He had been lying in bed at home. Abolished movements in the right shoulder.



Fig. 24.

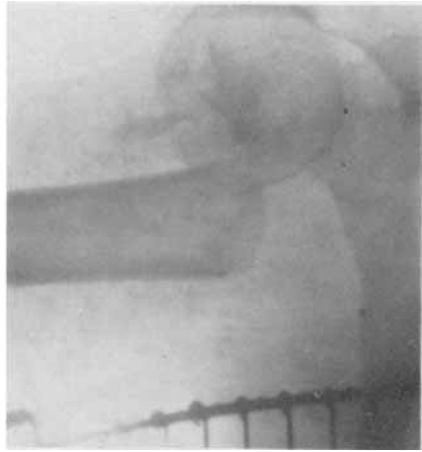


Fig. 25.

X-rays: Transverse fracture of the surgical neck with a few small fragments laterally. Marked rotation of proximal fragment, 1 cm medial displacement of distal fragment, but axis good. (Fig. 24).

Treatment: Abduction splint. Now, X-rays showed a much worse position. The shaft of the humerus had sunk down into the axilla and had lost all contact with the head (Fig. 25). Abduction splint removed at the end of 4 days. Sling, exercises. X-rays then showed a good position, as before the abduction splint was applied. Three weeks after the accident pulley exercises were instituted and the sling abandoned. Two months after the accident flexion was almost free and abduction 100°. Histamine iontophoresis was instituted with great success. Two and a half months after the accident, flexion and abduction were only 30° short of normal and external rotation $\frac{1}{4}$.

Follow-up 1 year 7 months after the accident: The patient went back to work 3 months after the accident. His complaints are negligible: He cannot reach as high up with his right arm as with the left. Flexion (75°) 145°, abduction (90°) 150°, extension normal, rotation normal. Strength excellent.

X-rays: Union in a slight varus deformity. External rotation of proximal fragment. Position excellent.

Result: Subj.: Good.

Obj.: Good.

X-ray: Good. *Functional result:* Good.

Case 80. (R.H. - C, Case rec.: 82/Febr. 1939). 58-year-old matron.

Fracture of the surgical neck (concussion, fracture of the radius, metacarpal bones, sacral bone, and hip).

Admitted on 3.12.1938 after having been run over by a car. Tenderness, abnormal mobility, and strepitus in the right shoulder in addition to the other injuries.

X-rays: 15° varus fracture of the surgical neck, but otherwise the position is good.

Treatment: The patient was extremely debilitated for a long time. At first she lay in bed with the arm in abduction, but when 11 days after the accident X-rays



Fig. 26.

showed the position to be much worse, the varus deformity being increased to 75° and the proximal fragment greatly rotated with the joint surface facing backward and downward, and the distal fragment having little contact with the fractured end of the proximal fragment, traction in abduction was applied over the edge of the bed. Thereupon, X-rays (18 days after the accident) showed that the position had improved. The varus deformity was now 35°, and there was good contact between the fragments. Seven weeks after the accident abduction was 90°, whereas other movements were normal.

Follow-up 6 years 8 months after the accident: Went back to work as matron 4½ months after the accident. Felt quite well 6 months after the accident. No complaints.

Obj. findings: No abnormality.

X-rays: Union in marked varus deformity (Fig. 26).

Result: Subj.: Good.

Obj.: Good.

X-ray: Poor. *Functional result:* Good.

Case 86. (O.H., Case rec.: 267/1942). 59-year-old male, professor.

Fracture of the surgical neck.

Admitted for 27 days, from 9.1.1942, the day after having fallen off his bicycle, striking his right shoulder directly against the kerb.



Fig. 27.



Fig. 28.



Fig. 29.

Obj. findings: Strepitus and abolished movements.

X-rays in two projections in abduction: Valgus fracture of the surgical neck with 35° angulation. Distal fragment medially displaced by $\frac{1}{2}$ width of the bone and

pulled up in this abducted position (Fig. 27). Proximal fragment rotated, the joint surface facing backward.

Treatment: Skin traction in abduction in Thoma's splint. X-rays showed unchanged position. The arm was now carried somewhat mediad, and the abduction thus decreased. Now, X-rays showed that the valgus deformity had decreased to 20°. The position was believed to be good enough to give a satisfactory result, when also considering the patient's great energy. Exercises all the time. Traction discontinued at the end of 17 days. Flexion and abduction were then 90° and 80° respectively.

Follow-up 3 years 2 months after the accident: Got on without help from 17 days after the accident. Has all the time displayed great energy and goes in for sport: Swimming, rowing, skiing, etc. No complaints.

Obj. findings: Greater tuberosity somewhat prominent, and increase in the width of the head anteroposteriorly. Otherwise normal conditions. All movements normal and as in a young man.

X-rays: Union in 20° valgus position with small posterior angulation. Marked prominence of the greater tuberosity. Osteoarthritis. (Figs. 28, 29).

Result: Subj.: Good.

Obj.: Good.

X-ray: Poor. *Functional result:* Good.

Author's comment: This case very clearly shows the significance of exercises and the patient's energy which are far more important than union in an anatomically correct position.

Case 91. (R.H. - C, Case rec.: 50/Nov. 1940). 61-year-old housewife.

Fracture of the surgical neck.

Admitted for 10 days, from 4.11.1940, after having fallen down a flight of stairs. Pain in the right shoulder and abolished movements.

X-rays: Fracture of the surgical neck with considerable valgus deformity. Pronounced rotation of the head, which way cannot be seen from this one projection. Distal fragment 1 cm medially displaced.

Treatment: Arm abducted with axillary pad. X-rays now showed a somewhat worse position with shortening of the fragments. The patient was now allowed out of bed (4 days after the accident) with her arm in a collar-and-cuff sling and an axillary pad. Nine days after the accident active exercises were instituted.

Follow-up 4 years 7 months after the accident: Massage, pulley exercises and other exercises continued for about 6 months. Recovered very slowly. After the end of one year she could do her domestic duties without complaints.

Obj. findings: Very slight atrophy of the deltoid. Rotation 40°/175° (left 40°/190°). Other movements equal on both sides.

X-rays: Union with normal skeletal pattern. A 25° valgus deformity and 1 cm medial displacement of the distal fragment. (Fig. 30).

Result: Subj.: Good.

Obj.: Good.

X-ray: Poor. *Functional result:* Good.



Fig. 30.



Fig. 31.



Fig. 32.

Case 103. (K.H. - Out-pt., Case rec.: 5/1942. 66-year-old male representative.

Fracture of the surgical neck.

Came into the Out-patient Department on 2.1.1942, one day after having fallen in the courtyard, striking his right arm.

X-rays: Oblique valgus fracture of the surgical neck with only a slight valgus de-

formity, but about 40° posterior angulation. Pronounced rotation of the proximal fragment, the joint surface facing backward (Fig. 31).

Treatment: Sling, massage, exercises.

Follow-up 2½ years after the accident: Recovered completely within 6 months.

Working as representative; no complaints.

Obj. findings: Normal shoulder.

X-rays: Union in 5° varus deformity. The posterior angulation has been abolished (Fig. 32).

Result: Subj.: Good.

Obj.: Good.

X-ray: Good. *Functional result:* Good.

Case 104. (K.H. - V, Case rec.: 1586/1942). 67-year-old female, retired.

Fracture of the surgical neck.

Admitted for 14 days, from 6.8.1942, immediately after having fallen down from her kitchen table when arranging the blackout curtain. Unable to move the right arm.

X-rays: Valgus fracture of the right surgical neck. In the anteroposterior view the shaft is 17 mm medially displaced; in the lateral view the distal fragment is completely anteriorly displaced and elevated to beside the head. Proximal fragment rotated and no contact between the bone ends. (Figs. 33, 34).

Treatment: Bed rest for one week, the arm resting on a soft pillow in abduction. Then sling, massage, and exercises.

Follow-up 1 year 4 months after the accident: Massage and exercises continued for about 2½ months. Looked after her flat without help from 3 months after the accident. No complaints.

Obj. findings: On the anterior aspect of the shoulder a considerable prominence of the bone is visible and palpable. The axis of the humerus points forward. Flexion, abduction 110° (left 160°), rotation 60°/165° (left 35°/190°). Strength considerably reduced, compared with the left.

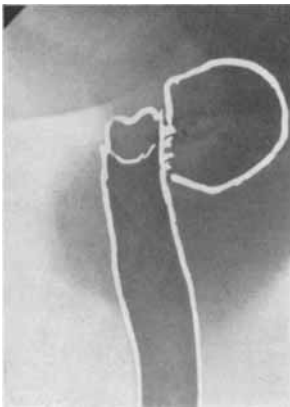


Fig. 33.

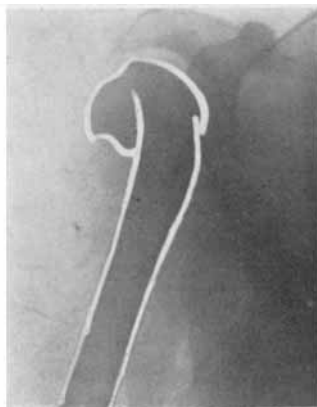


Fig. 34.



Fig. 35.



Fig. 36.

X-rays: Union with very marked deformity at the site of the fracture, but the angulation is perceptibly smaller than previously (Figs. 35, 36).

Result: Subj.: Good.

Obj.: Fair.

X-ray: Poor. *Functional result:* Fair.

Author's comment: This was a very severe fracture of the type which some authors call "fracture with rotary dislocation". In the case of this 68-year-old lady I doubt that so good a result could have been obtained by any method other than the functional. And she could look after her flat without help 3 months after the accident.

Case 108. (R. H. - D, Case rec.: 236/1942). 69-year-old housewife.

Fracture of the surgical neck.

Admitted for 17 days, from the 2.2.1942, after having fallen on the slippery street. Swelling, tenderness, and pain in the right shoulder.

X-rays (in two projections, taken in abduction): Valgus fracture of the surgical neck with about 30° angle and pronounced posterior angulation. Medial displacement and elevation of distal fragment (Fig. 37).

Treatment: Sling and axillary pad; at the end of 5 days massage and exercises. *X-rays*, taken 10 days after the accident in rather less abduction, showed considerably improved position, abolished shortening, less medial displacement, and less pronounced valgus deformity.

Follow-up 3 years 4 months after the accident: The patient is living by herself and has managed her domestic duties from the time of discharge (17 days after the accident). No complaints.

Obj. findings: All movements normal and good for her age. Strength good.

X-rays (in two projections): Union in 25° valgus deformity and with 1 cm medial displacement of the distal fragment. Somewhat irregular skeletal pattern (Fig. 38). No angulation in the lateral view.

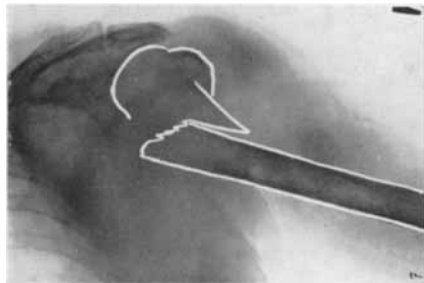


Fig. 37.



Fig. 38.

Result: Subj. Good.

Obj.: Good.

X-ray: Poor. *Functional result:* Good.

Author's comment: This is a fine example of how good mobility may be obtained despite union in a bad position. It also shows how quickly and how easily the patient can recover during functional treatment.

Case 117. (K.H. - V, Case rec.: 1883/1941). 74-year-old male, cobbler.

Fracture of the surgical neck.

Admitted for 34 days, from the 4.10. 1941 after having been knocked over by a car. Since then, severe pain and abolished movements in the right shoulder.

X-rays: High valgus fracture of the surgical neck. Pronounced elevation of the distal fragment, which is in front of and medial to the backward rotated head (Fig. 39).

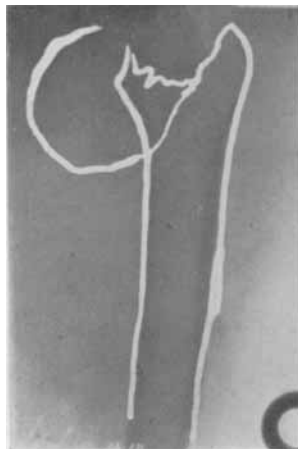


Fig. 39.



Fig. 40.



Fig. 41.

Treatment: Bed rest for 4 days, the arm resting on a soft pillow. Then, sling, massage, and exercises. On the 7.11. X-rays showed improvement of the position, although there was still considerable shortening, the distal fragment being beside the head. (Fig. 40).

Follow-up 2 years 2 months after the accident: Went back to work 3 months after the accident. No complaints.

Obj. findings: Considerable muscular atrophy. Flexion, abduction (60°) 125° , rotation $50^\circ/140^\circ$ (left $45^\circ/170^\circ$).

X-rays: Union with small valgus deformity, but the posterior angulation has been abolished. Skeletal pattern uneven and sclerotic, and the joint surface of the head is irregular (Fig. 41).

Result: Subj.: Good.

Obj.: Fair.

X-ray: Fair. *Functional result:* Fair.

Author's comment: The fracture had corrected itself considerably from the position seen one month after the accident. This shows the long time which may elapse until firm union, especially when the position is not good, but it also shows how the position can correct itself when the patient is allowed to use his arm.

Case 128. (R.H. - C, Case rec.: 14/Nov. 1938). 63-year-old housewife.

Fracture of the surgical neck (and concussion).

Admitted on the 28.9.1938 after having fallen down a flight of stairs, striking her right arm and shoulder.

X-rays: "Fracture of the surgical neck. The position of the head in the articular



Fig. 42.

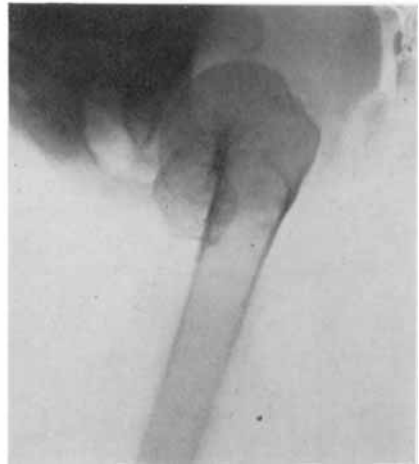


Fig. 43.

cavity is good, but it seems to be slightly backward and upward rotated. There seems to be impaction, but this cannot be said with certainty".

Treatment: Abduction splint for 28 days after 3 days' bed rest. On 29. 10. X-rays showed 75° valgus deformity. The head was greatly rotated, with the joint surface facing backward. Distal fragment elevated up in front of the head (Fig. 42 in antero-posterior view. Lateral of poor quality). On discharge abduction was 130°.

Follow-up 6 years 9 months after the accident: Got on without help 2 months after the accident: Went on doing pulley exercises for 3 months. Had completely recovered at the end of 6 months. No complaints.

Obj. findings: Rotation 40°/175° (left 40°/195°), 10° short of full elevation. Strength good.

X-Rays: Union with 60°–70° valgus deformity with a marked posterior angulation (Fig. 43).

Result: Subj.: Good.

Obj.: Good.

X-ray: Poor. *Functional result: Good.*

Case 136. (K.H. - I, Case rec.: 421/1939). 62-year-old male, retired.

Fracture of the surgical neck.

Admitted for 23 days, from 6.2. 1939, two days after having fallen, striking his right shoulder. Severe pain, swelling, tenderness, strepitus, and abnormal mobility in the right shoulder.

X-rays (in one view): Varus fracture of the surgical neck with numerous small fragments and about 60° angulation. Poor contact between the bone ends, the distal fragment contacting the joint surface of the head which is inward and downward rotated (Fig. 44).

Treatment: Bed rest for 4 days with the arm abducted. Then, out of bed with the



Fig. 44.



Fig. 45.

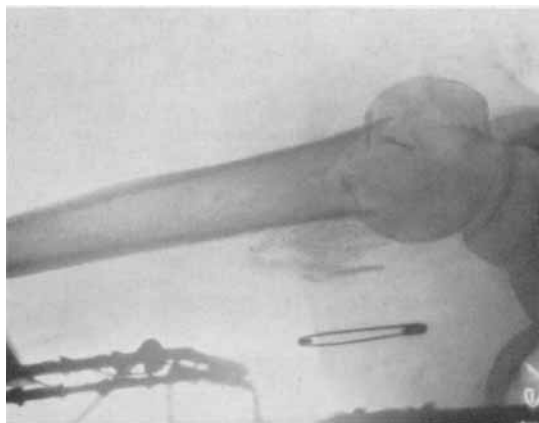


Fig. 46.



Fig. 47.



Fig. 48.

arm in a sling. X-rays on 13.2. showed the position to be worse, the proximal fragment being even more rotated, the joint surface facing downward (Fig. 45). On 18.2. skin traction on abduction splint. X-rays now showed a fairly good position, as far as can be seen in one view. Varus angulation only about 20° (Fig. 46). Traction and abduction splint removed at the end of 19 days. After removal, X-rays showed that the varus deformity had increased. There was great medial displacement of the distal fragment (Fig. 47). One month after the accident there was "almost ankylosis in the right shoulder joint in 20° abduction". Massage and exercises were then started.

Follow-up 4 years 10 months after the accident: Massage and systematic exercises continued for 6 weeks. Got on without help 2 months after the accident. Living by herself in a 2-room flat. No complaints apart from the "right arm being shorter" when reaching up.

Obj. findings: Right upper arm $3\frac{1}{2}$ cm shorter than the left. Thickening of the head is palpable, especially anteriorly. Moderate atrophy of all shoulder muscles. Flexion (70°) 140° , abduction (80°) 135° . (Elevation 160° on the left). Extension normal. Rotation $60^\circ/165^\circ$). Strength of lifting quite good.

X-rays: (in anteroposterior view, as the lateral failed despite repeated attempts): Union with 30° – 40° varus deformity. Enormous hyperproduction of callus (Fig. 48).

Result: Subj.: Good.

Obj.: Good.

X-ray: Poor. *Functional result:* Good.

Case 138. (K.H. - Out-pt., Case rec.: K.S.S.L./1940). 74-year-old female, retired.

Fracture of the surgical neck.

Came into the Out-patient Department on 18.4.1940, two days after having fallen off a chair in an attempt to arrange the blackout curtain. Struck her left shoulder. Pain, tenderness, abnormal mobility, and strepitus.

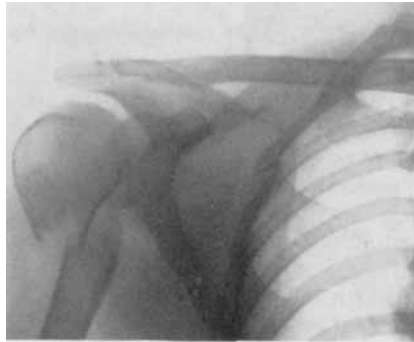


Fig. 49.



Fig. 50.



Fig. 51.



Fig. 52.

X-rays: Valgus fracture of the surgical neck with 35° angulation. Proximal fragment greatly rotated, distal fragment medially displaced, there being contact between the bone ends only in an area of 9 mm (Fig. 49).

Treatment: Sling and axillary pad; at the end of 6 weeks massage and exercises. On the 27.6. the case record states that *passive* mobility is fairly good.

Follow-up 3 years 11 months after the accident: Disabled because of the shoulder, can neither dress nor undress without help. Pain in the shoulder day and night. *Obj. findings:* Left shoulder swollen and tender and feels warmer than the right. Atrophy of the muscles, 6 cm shortening of the upper arm. Flexion (30°) 50°, abduction (50°) 70°, extension 45°, no active rotation. The patient is unable to carry her hand to the other shoulder, to the nape of her neck, or behind her back. Strength very slight.

X-rays: Non-union (Figs. 50, 51, 52).

Result: Subj.: Poor.

Obj.: Poor.

X-rays: Poor. *Functional result:* Poor.

Case 159. (O.H., Case rec.: 6593/1940). 54-year-old female, brewery hand.

Fracture of the surgical neck and greater tuberosity.

Admitted for 33 days, from 8.11.1940, immediately after having fallen in the brewery. Put out her right hand, but hit some machinery, striking the under aspect of the right upper arm. Pain and restricted movements.

X-rays: Fracture of the surgical neck, with practically no displacement. Fracture of the greater tuberosity which is 1 cm elevated (Fig. 53).

Treatment: Abduction splint, but only for 8 days, as X-rays showed the position to be worse: The distal fragment had become 1 cm medially displaced (having sunk down into the axilla) and there was a fairly large valgus deformity. In addition increased displacement of the greater tuberosity (Fig. 54). After removal of the abduction splint, the position of the surgical neck improved at once (Fig. 55), and repeated X-rays showed that even the greater tuberosity gradually improved in position during treatment with sling, heat, exercise, electrotherapy, and massage. Nevertheless, the position never became as good as before the abduction splint was applied.

Follow-up 3½ years after the accident: Physiotherapy on and off for 6 months. Went back to work at the brewery 6 months after the accident. No complaints.

Obj. findings: Apart from rotation 40°/180° no abnormality. Strength satisfactory. Squeeze dynamometer 23 (left 19).

X-rays: Union with 150 valgus deformity and marked prominence of the greater tuberosity.

Result: Subj.: Good.

Obj.: Good.

X-ray: Fair. *Functional result:* Good.

Author's comment: Note how much worse the position was rendered by the abduction splint. Happily it was soon removed, and the position then improved quite considerably.



Fig. 53.



Fig. 55.



Fig. 54.

Case 172. (R.H. - D, Case rec.: 1415/1941). 47-year-old male, telephone fitter.

Fracture of the surgical neck and greater tuberosity.

Admitted for 30 days, from 17.9.1941, immediately after having fallen, striking his left shoulder. Pain, tenderness, abolished mobility, and strepitus.

X-rays: An irregular, somewhat splintered oblique fracture of the surgical neck with 10° valgus angulation and fracture of the greater tuberosity. The fragments are well assembled and the position is good (Fig. 56).

Treatment: Abduction splint for 29 days. X-rays now showed the position to be worse (Fig. 57). Skin traction was applied. X-rays showed improved position in the antero-posterior view, almost as good as before the abduction splint was applied, but in the lateral view there is now a posterior angulation of 30° and a medial displacement by $\frac{1}{2}$ width of the bone. Formerly, the position had been good in the lateral view. The skin traction slid repeatedly, and the skin was greatly affected. The traction was maintained for a total of 24 days. After removal of the splint collar-and-cuff sling, massage, and exercises.



Fig. 56.

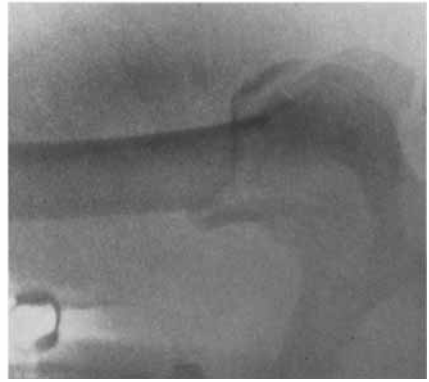


Fig. 57.



Fig. 58.

Follow-up 2 years 2 months after the accident: The patient went back to work 4 months after the accident. No complaints. (The patient stated spontaneously that the abduction splint had been extremely uncomfortable).

Obj. findings: No abnormality.

X-rays: Union with 10° valgus deformity and somewhat more marked posterior angulation. A projection anteriorly at the site of the fracture (Fig. 58).

Result: Subj.: Good.

Obj.: Good.

X-ray: Fair. *Functional result:* Good.

Author's comment: The abduction splint made the position worse and it was unpleasant to wear. Traction had to be re-applied several times, and the skin was

greatly affected by it. There was no indication for abduction splint or traction in this case.

Case 173. (K.H. - V, Case rec.: 1129/1938). 49-year-old male, tobacconist.

Fracture of the surgical neck and greater tuberosity.

Admitted for 35 days, from 21.5.1938, immediately after having fallen off his bicycle, striking his left elbow. Pain in the left shoulder, abolished movements, and tenderness.

X-rays: Valgus fracture of the surgical neck with large angulation and fracture of the greater tuberosity which is *in situ*.

Treatment: Ulnar bone traction in abduction in bed for 25 days. X-rays then showed a much worse position. It was tried to adduct the arm, and the weight was increased to 6 kg, but the position remained unchanged, until the patient was taken out of bed with his arm in a collar-and-cuff sling at the end of 25 days. Thereafter, X-rays immediately showed a better position.

Follow-up 5 years 5 months after the accident: Massage continued for 3 months. Went back to work 6 weeks after the accident. Restricted mobility in the shoulder, but no complaints in his type of work.

Obj. findings: All movements equal on both sides except rotation $50^{\circ}/145^{\circ}$ (right $40^{\circ}/170^{\circ}$).

X-rays: Union with serrated and uneven bone, but the position is fairly good.

Result: Subj.: Good.

Obj.: Good.

X-ray: Fair. *Functional result: Good.*

Case 175. (O.H., Case rec.: 760/1939). 54-year-old female, clerk.

Fracture of the surgical neck and greater tuberosity.

Admitted for 61 days, from 2.2.1939, three days after having fallen on the street, striking her left shoulder.



Fig. 59.

X-rays (immediately after the accident): Valgus fracture 30° transversely through the surgical neck. Distal fragment 2 mm medially displaced. In addition, a large portion broken off the greater tuberosity, upward and laterally displaced.

Treatment: Abduction splint, which was removed the day prior to admission, as the patient could not bear carrying it any longer. On the day after admission, another abduction splint was applied and maintained for 10 weeks. X-rays showed increased displacement of the greater tuberosity, but otherwise unchanged position. The patient lay in bed for 13 days. Exercises were instituted one month and massage 1½ months after the accident. X-rays 10 weeks after the accident showed a bad position, the distal fragment being displaced up in front of the proximal one. Ample callus.

Follow-up 5½ years after the accident: Went back to secretarial work 4 months after the accident. The patient complains of severe pain when exerting the arm and when the weather is changing.

Obj. findings: Greater tuberosity prominent. 1½ cm shortening. Rotation 40°/170° (right 40°/200°); no other abnormalities.

X-rays: Union in 30° valgus deformity and considerable posterior angulation. Marked prominence of the greater tuberosity (Fig. 59).

Result: Subj.: Fair.

Obj.: Good.

X-ray: Poor. *Functional result:* Fair.

(The author feels that this patient was exaggerating the subjective complaints, but even so they must bring the functional result somewhat down).

Case 179. (K.H. - I, Case rec.: 2145/1940). 47-year-old labourer.

Fracture of the surgical neck and greater tuberosity.

Admitted for 4 days from 19.12.1940, 11 weeks after having broken his left upper arm.

X-rays (11 weeks before admission) in anteroposterior view: Varus fracture high in the surgical neck with marked rotation of the proximal fragment, the joint surface facing backward. In addition, a chip broken off the greater tuberosity and elevated.

Treatment: Sling for 6 weeks, then massage and exercises. Immediately before admission the patient fell and struck his left shoulder again. X-rays showed re-fracture of the surgical neck with increased varus angulation, now amounting to 20°. 30° posterior angulation, and proximal fragment turning joint surface backward. Physiotherapy continued.

Follow-up 3 years 4 months after the accident: Went back to work 5 months after the accident. Rheumatic pain on and off, but nothing worth mentioning.

Obj. findings: No difference between the two shoulders.

X-rays: Union in a bad position, there being a large varus deformity, marked prominence of the area of the greater tuberosity, and subchondral cysts indicating osteoarthritic changes (Fig. 60).

Result: Subj.: Good.

Obj.: Good.

X-ray: Poor. *Functional result:* Good.



Fig. 60.



Fig. 61.

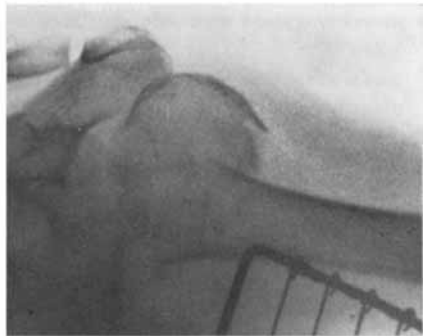


Fig. 62.

Case 180. (R.H.-C., Case rec.: 11/Oct. 1940). 49-year-old female, tobacco worker.

Fracture of the surgical neck and greater tuberosity.

Admitted for 39 days, from 27.8.1940, immediately after having fallen off her bicycle, striking her right shoulder.

X-rays: Valgus fracture of the surgical neck with a slight angulation and fracture of the greater tuberosity without displacement (Fig. 61).

Treatment: Abduction splint, which greatly aggravated the position, the distal fragment becoming pulled up in front of the proximal one and at the same time sinking down into the axilla (Fig. 62). The head was rotated, the joint surface facing backward. The abduction splint was, therefore, removed at the end of 13 days and replaced by a sling, and the position became good again. Massage and exercises instituted 4 weeks after the accident.

Follow-up 4 years 9 months after the accident: Took a long time recovering and did not feel fit until one year after the accident. Is working.

Obj. findings: No abnormality.

X-rays: Union. In the anteroposterior view the position is almost anatomical, whereas in the lateral view there is a slight posterior angulation.

Result: Subj.: Good.

Obj.: Good.

X-ray: Good. *Functional result: Good.*

Case 191. (K.H. - V, Case rec.: 33/1939). 62-year-old male, retired.

Fracture of the surgical neck and greater tuberosity.

Admitted for 20 days, from 18.12.1938, immediately after having fallen on a slippery floor, striking his left shoulder against a sharp edge. Since then, severe pain and abolished movements.

X-rays (anteroposterior view with the arm in abduction): Oblique fracture of the surgical neck with a valgus angulation of about 40°. Proximal fragment greatly rotated, distal fragment 12 mm medially displaced and pulled somewhat into the axilla. In addition, fracture of the greater tuberosity, but without displacement.

Treatment: Skin traction in abduction in bed. One week after the accident X-rays showed the position to be worse, the valgus angulation now being about 60°, distal fragment medially displaced by a whole width of the bone and pulled even more into the axilla. It was attempted to increase the traction, but the position remained unchanged. Skin traction was removed at the end of 13 days and replaced by a sling, massage, and exercises.

Follow-up 5 years 5 months after the accident: Massage and exercises for 3 weeks. Could dress and undress 4 weeks after the accident. Has retired and does not work except in his garden, where he is very industrious. No complaints.

Obj. findings: No abnormality at all. Elevation 160° on both sides. Strength good. Squeeze dynamometer 25 (right 28). The patient refused to be X-rayed.

Result: Subj.: Good.

Obj.: Good. *Functional result: Good.*

Case 197. (K.H. - V, Case rec.: 993/1942). 64-year-old male, painter.

Fracture of the surgical neck and greater tuberosity (and fracture of the pelvis).

Admitted on 20. 4. 1942, immediately after having fallen down a ladder. Pain, swelling, tenderness, strepitus, and abolished movements in the right shoulder.

X-rays (anteroposterior view): Varus fracture of the surgical neck with numerous small fragments and considerable angulation. The position must, however, be

called good. Fracture of the greater tuberosity, which was only a little displaced. When the arm was abducted, the lateral view showed that the head was rotated, the joint surface turning backward; 55° posterior angulation. Marked shortening. *Treatment:* Bed rest for one month because of the pelvic fracture. Massage and exercises of the shoulder from the 7th day.

Follow-up 1 year 7 months after the accident: Returned to work 8 months after the accident, but his working capacity is reduced. He must have somebody else to paint ceilings etc. Has been adjudged 5 % disablement. Occasionally pain when the weather is changing and when he is working.

Obj. findings: 2 cm shortening of the right upper arm. Slight atrophy of the deltoid muscle. Flexion 110°, abduction 120°, extension normal, rotation 30°/175°. Strength and sensibility normal.

X-rays: Union in 25° varus deformity. Shortening much less than before.

Result: Subj.: Fair.

Obj.: Fair.

X-ray: Poor. *Functional result:* Fair.

Case 199. (K.H. - V, Case rec.: 29/1941). 66-year-old female, retired.

Fracture of the surgical neck and greater tuberosity.

Admitted for 13 days, from 26.12.1940, after having fallen on the street, striking her left shoulder. Pain, tenderness, and abolished movements.

X-rays: Valgus fracture of the surgical neck with very marked angulation. Distal fragment 7 mm medially displaced. Fracture of the greater tuberosity which is markedly displaced upward and laterally (Fig. 63).

Treatment: Bed rest for 7 days, then massage and exercises.

Follow-up 2 years 11 months after the accident: Massage and exercises continued for 2½ months. Could dress and undress without help one month after the accident. Working as char-woman. On and off a little rheumatic pain, but no other complaints.

Obj. findings: 1 cm shortening. Negligible atrophy of the deltoid muscle. Flexion



Fig. 63.

(70°) 100°, abduction (70°) 120°, extension 20°, rotation 50°/135°. Can carry her hand to the other shoulder, but with difficulty to the nape of her neck and behind her back. Strength good. Squeeze dynamometer 17 on both sides.

X-rays: Union in unchanged position apart from the greater tuberosity which is practically *in situ*.

Result: Subj.: Good.

Obj.: Fair.

X-ray: Poor. *Functional result:* Fair.



Fig. 64.



Fig. 65.

Case 211. (K.H. - V, Case rec.: 949/1941). 72-year-old housewife.

Fracture of the surgical neck and greater tuberosity.

Admitted for 12 days, from 23.5.1941, immediately after having fallen on the floor. She put out her left hand and got severe pain in the shoulder.

X-rays: Valgus fracture of the surgical neck with a rather marked angulation. Proximal fragment rotated, the joint surface turning backward. Distal fragment 11 mm medially displaced and elevated. Fracture of the greater tuberosity which is displaced upward (Fig. 64).

Treatment: Bed rest for two days with the arm abducted. Then, sling and, from the 4th day, massage and exercises.

Follow-up 2 years 7 months after the accident: Massage continued for 2 months. After that, she got on without help. Is living in a 3-room flat with 2 lodgers and looks after everything without complaints.

Obj. findings: 1 cm shortening. Considerable atrophy of the shoulder muscles. Flexion, abduction 20° short of that on the right. Rotation 50°/170°.

X-rays: Union in the same bad position (Fig. 65).

Result: Subj.: Good.

Obj.: Good.

X-ray: Poor. *Functional result:* Good.

Case 224. (R.H. - D, Case rec.: 383/1939). 82-year-old male, sometime bricklayer.

Fracture of the surgical neck and greater tuberosity.

Admitted for 15 days, from 26.2.1939, immediately after having been knocked over by a motorcycle. Put out his left hand and was afterwards unable to move the shoulder.

X-rays (anteroposterior view): Valgus fracture of the surgical neck with a slight angulation. Distal fragment 1 cm medially displaced. The head appears to be rotated. Shell-shaped chip broken off the greater tuberosity, but in a good position.

Treatment: Bed rest for 8 days. Massage and exercises from the 4th day. Sling.

Follow-up 6 years 4 months after the accident: Massage continued for 3 months.

No systematic exercises. The patient is not working, but he complains of restricted movements; is unable to dress or undress without help. He has found a method by which he can take off his coat and waistcoat: He fixes a paper clip in the waistcoat in front, hangs it on a hook on the door-frame, and walks a few steps away so that the waistcoat slips off. Never pain.

Obj. findings: Marked atrophy of the muscles of the left shoulder. Flexion, abduction 105° (right 155°), extension normal, rotation 50°/160° (right 50°/190°). Can carry his hand to the nape of his neck, but behind his back only to the sacral bone. No sensory disturbances. Strength slight.

X-rays: Union with a slight valgus angulation and negligible medial displacement of the distal fragment.

Result: Subj.: Fair.

Obj.: Poor.

X-ray: Good. *Functional result: Poor.*

Author's comment: This patient ought to have had systematic exercises, preferably under the supervision of an experienced physiotherapist.

Case 227. (R.H. - C, Case rec.: 2/Apr. 1938). 63-year-old female, retired.

Fracture of the surgical neck and greater tuberosity.

Admitted for 70 days, from 19.1.1938, after having stumbled over a kerbstone, striking her left arm. Pain, tenderness, and abnormal mobility.

X-rays: "Fracture line through the greater tuberosity and apparently through the surgical neck". (The film has regrettably been lost).

Treatment: Abduction splint for one month. After its application X-rays showed that the fracture was completely displaced. The head was rotated, the joint surface turning downward and backward. The distal fragment was medially displaced by the whole width of the bone and pulled up medially and anteriorly to beside the head. The fractured greater tuberosity was *in situ*. (Fig. 66).

One week after removal of the splint and 5½ weeks after the accident it is stated in the case record that little progress was noted in movements. X-rays showed a very bad position: Head rotated in 90° valgus, medial displacement and shortening unchanged. A little callus between the broken end of the head and the lateral aspect of the humeral shaft (Fig. 67). The patient was seen as an out-patient for 5 months during which progress was slow.

Follow-up 7½ years after the accident: Got on without help 2½ months after the

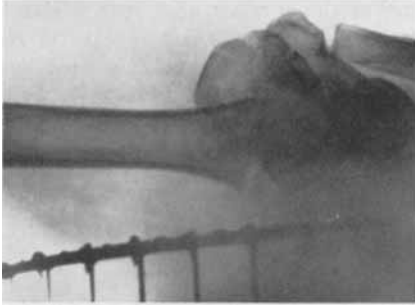


Fig. 66.



Fig. 67.

accident. Complains of pain in the shoulder when the weather is changing and of restricted movements.

Obj. findings: Marked prominence of the greater tuberosity and pronounced atrophy of all shoulder muscles as well as tenderness on palpation. $1\frac{1}{2}$ cm shortening of the left upper arm. Flexion (70°) 140° (right 155°), abduction (80°) 140° (right 155°), extension normal, rotation $50^\circ/175^\circ$ (right $50^\circ/180^\circ$). The patient can carry her hand to the nape of her neck and to the other shoulder, but not behind her back. Strength reduced.

X-rays: The patient flatly refused to be X-rayed.

Result: Subj.: Poor.

Obj.: Fair. *Functional result:* Fair.

Author's comment: A surgical neck fracture, which was originally a barely visible line, was completely displaced by abduction—which was absolutely not indicated in this case. Another error was the omission of physiotherapy which would no doubt have improved matters. In the third place, the patient is not working, and work is the best kinesitherapy.

Case 243. (R.H. - C, Case rec.: 48/March 1940). 48-year-old male, baker.

Comminuted fracture of the upper end of the humerus.

Admitted for 42 days, from 29.1.1940, after having fallen off his bicycle, striking his left shoulder. Swelling, tenderness, abolished movements, and streptitus.

X-rays (in 2 views): Splintered fracture of the upper end of the humerus. Fracture through the anatomical neck, a serrated fracture through the surgical neck, and fracture of the greater tuberosity. The position was good with the arm hanging down along the side (Fig. 68), but when it was abducted, shortening appeared.

Treatment: Abduction splint. After it was applied, the position was much worse, there being both medial displacement of the distal fragment and valgus deformity (Fig. 69). Skin traction 2 kg. X-rays showed unchanged position. Axillary pad



Fig. 68.

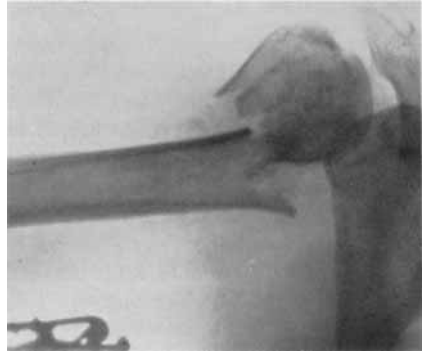


Fig. 69.

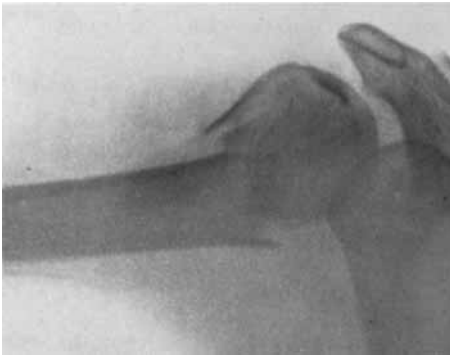


Fig. 70.



Fig. 71.

and increased traction. Position somewhat better, but not as good as on the first film with hanging arm (Fig. 70). Traction removed at the end of 3 weeks and the abduction splint at the end of 4 weeks. Then, exercises.

Follow-up 5 years 9 months after the accident: Working. Got on without help 2 months after the accident. "The abduction splint was very uncomfortable". No complaints now.

Obj. findings: No abnormality.

X-rays: Union with some valgus deformity, and the diaphysis medially and backward displaced. A bony projection medially on the surgical neck (Fig. 71).

Result: Subj.: Good.

Obj.: Good.

X-ray: Poor. *Functional result:* Good.

Case 244. (R.H. - D, Case rec.: 179/1941). 50-year-old housewife.

Comminuted fracture of the upper end of the humerus.

Admitted for 38 days, from 2.1.1941, two days after having fallen on the floor on her outstretched right hand. Immediately pain in the shoulder.

X-rays (in 2 projections): Splintered fracture of the upper end of the humerus. The greater tuberosity is splintered into several fragments which are markedly upward displaced. In addition, fracture of the anatomical neck with marked displacement, there being a valgus angulation of 85° and a very pronounced posterior angulation.

Treatment: Skin traction 5 kg. Abduction splint. The position remained bad. Frequent X-ray control during the subsequent period showed unchanged position. Skin traction removed at the end of 26 days and abduction splint at the end of 33 days. Then, massage and exercises.

Follow-up 4½ years after the accident: Massage for about 2½ months. Went back to work as a ward maid in a hospital 3 months after the accident. Considerable complaints in the form of pain in the shoulder every day.

Obj. findings: Palpable prominence of the greater tuberosity and pronounced atrophy of the shoulder muscles. Flexion, abduction 120° , extension 15° , rotation $85^\circ/160^\circ$ (left $45^\circ/155^\circ$).

X-rays: Union in unchanged position.

Result: Subj.: Poor.

Obj.: Fair.

X-ray: Poor. *Functional result: Fair.*

Case 251. (K.H. - V, Case rec.: 773/1942). 38-year-old male, factory hand.

Fracture of the greater tuberosity (fracture of the metatarsal bones and contusion of the chest).

Admitted on 8.4.1942, five days after having fallen, striking int. al. his left shoulder. Pain on attempts to move, and tenderness.

X-rays: Fissure through the greater tuberosity.

Treatment: Bed rest for 6 days. Massage and exercises from the 14th day.

Follow-up 1 year 8 months after the accident: Massage continued for 5 months with some breaks. Went back to work in the porcelain factory 6 weeks after the accident, but there are still certain jobs which he cannot perform. Reports pain in the shoulder on and off. The patient was awarded disablement pension for 20 % disability, but he is dissatisfied and wants more. This apparently affects him, and he gives an impression of malingering.

Obj. findings: No abnormality on inspection or palpation. Flexion 110° , abduction 90° (passive 100° , but after that he resists "because of pain"), extension normal, rotation $60^\circ/170^\circ$. Carries the hand with difficulty to the nape of his neck. (Afterwards, he could swing his arm much better while dressing).

X-rays: Normal shoulder.

Result: Subj. Fair.

Obj.: Poor.

X-ray: Good. *Functional result: Poor.*

(This patient is evidently wrapped up in compensation. He has made up his mind to be an invalid and has therefore not done anything to improve the function).

Case 266. (O.H. - Case rec.: 2174/1941). 45-year-old housewife.

Fracture of the greater tuberosity.

Admitted for 33 days from 8.4.1941, 8 days after having fallen off a car, striking her left shoulder. A doctor who was called made three unsuccessful attempts at reducing a "dislocation". The patient was then brought to a hospital, where X-ray examination revealed "a fissure in the arm". When the patient came here she was wearing a home-made abduction splint.

X-rays (in two views on the splint): Fracture of the greater tuberosity without displacement worth mentioning.

Treatment: Abduction splint for 5 weeks. Exercises on the splint (when?).

Follow-up 3 years 2 months after the accident: Exercises, including pulley exercises, for about 6 months. Reports that she was not quite fit until 2 years after the accident. No complaints.

Obj. findings: External rotation 20° short of that on the right. No other abnormalities.

X-rays: Normal shoulder.

Result: Subj.: Good.

Obj.: Good.

X-ray: Good. *Functional result:* Good.

Author's comment: It is difficult to see any reason to use an abduction splint in this case, and the patient required a long time before she was fit.

Case 271. (R.H. - Case rec.: 1667/1940). 35-year-old male, lawyer.

Fracture-dislocation (fracture of the anatomical neck and greater tuberosity).

Admitted for 75 days, from 23.9.1940, two days after having fallen off his bicycle, striking his left shoulder. A doctor who was called diagnosed dislocation and made an attempt at reduction "which was successful, but immediately after the head slid anteriorly". A new attempt failed. The patient was X-rayed by a radiological practitioner. The film was said to have shown fracture of the anatomical neck and greater tuberosity as well as dislocation.

X-rays (in two views on admission): Fracture-dislocation of the upper end of the humerus. Fracture of the anatomical neck, and the greater tuberosity area is detached as one large fragment. The head fragment is dislocated down into the axilla. Proximal end of the humerus elevated into the glenoid cavity (Fig. 72). No signs of nerve injuries.

Treatment: Although the possibilities of closed reduction were considered slight, it was decided to give the patient a chance. Under ether anaesthesia a cautious attempt at reduction was made by exerting traction on the arm in the abducted position. This failed. Then, skin traction, 4 kg, on abduction splint. Nine days after the accident open reduction was performed under ether anaesthesia. Incision at the junction of the deltoid and pectoralis muscles. "It was evident that pathological fixation had already set in owing to the injury. The layers stuck together. The head was displaced far medially, below the coracoid process... Reduction was difficult, but was accomplished at last... A gaping hole between the greater tuberosity fragment and the diaphysis, and a chip in the area of the lesser tuberosity. All these parts were squeezed together and up toward the reduced head, the capsule being sutured to keep them together. Abduction splint



Fig. 72.

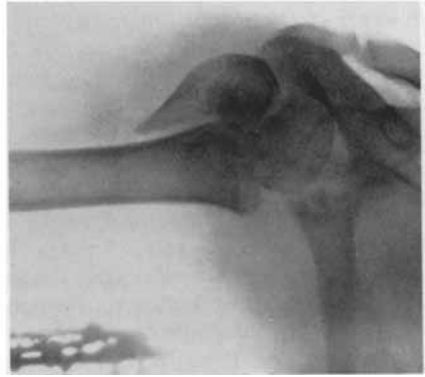


Fig. 73.

with minimal traction". *"In the course of the operation it was realized that these cases ought to be operated upon while quite fresh"*. X-rays 5 days later showed the fragments to be close together, but there was medial displacement of the diaphysis by $\frac{1}{2}$ width of the bone. Marked lateral displacement of the greater tuberosity fragment (Fig. 73). The wound healed by first intention.

One month after the operation the patient could raise his arm from the splint. Traction removed at the end of 35 days. Then, active exercises. Later wand exercises and massage. The abduction splint was kept on for 56 days. The patient came for occasional follow-up visits for more than a year. He was making good progress and had no complaints in his daily work as a lawyer. He also swam, but owing to deficient external rotation in the shoulder he had been obliged to give up playing the violin which had been his hobby. X-rays one year after the accident showed that the head had united in its medial half, while laterally a conical piece projected over the somewhat elevated greater tuberosity.

Follow-up 4 years 10 months after the accident: The patient says he got on without help $2\frac{1}{2}$ months after the accident. He was awarded 12%–15% disablement pension, but has no complaints in his daily work as lawyer. On the other hand, he is still unable to play the violin.

Obj. findings: Considerable atrophy of the shoulder muscles, but no shortening. When the scapula is in the normal position, the upper arm is 15° – 20° short of full adduction. Flexion 115° , abduction up to 120° , extension 40° , rotation $50^{\circ}/140^{\circ}$. Can carry his hand to the other shoulder and behind his back, but only with difficulty to the nape of his neck with his head upright. Strength fairly good.

The patient did not appear for X-ray examination.

Result: Subj.: Fair.

Obj.: Fair. *Functional result:* Fair.

Case 272. (R.H. - C, Case rec.: 107/1942). 51-year-old housewife.

Fracture-dislocation (comminuted fracture of the upper end of the humerus).

Admitted for 39 days, from 13.12.1941, immediately after having fallen down a



Fig. 74.



Fig. 75.

flight of stairs, striking her right shoulder. Immediately severe pain and abolished movements. Dislocation of the head distinctly palpable.

X-rays: Comminuted fracture of the upper end of the humerus. Fracture line passing through the anatomical neck, but otherwise the head was splintered and the greater tuberosity detached as a large fragment or several fragments. Dislocation of the head down below the neck of the scapula (Fig. 74). (The patient reported that she had dislocation of the same arm 10 years ago, reduced by her husband who is a tobacconist. Since then, no complaints).

Treatment: Attempt at reduction under ether anaesthesia. Failed, and afterwards the displacement of the greater tuberosity had increased. Three days after the accident open reduction. Abduction splint, skin traction. X-rays now showed that the head was *in situ* in the glenoid cavity, but there was marked displacement of the fragments: Very marked posterior angulation, 15° valgus deformity, and lateral displacement of the greater tuberosity. Shortening. Traction removed at the end of 20 days and the abduction splint at the end of one month. Then, physiotherapy. 102 days after the accident, improved movements and good strength.

Follow-up 3½ years after the accident: Massage and exercises for 3 months. Resumed her domestic duties 40 days after the accident. Recovered very slowly and still complains of restricted movements. No pain.

Obj. findings: Prominence anteriorly at the site of the surgical neck. 2 cm shortening. Marked atrophy. The arm is in 10° flexion and 45° abduction. Movement in the humeroscapular joint only a few degrees. With free scapula flexion, abduction up to 75°, extension ½, rotation 90°/135°. Cannot carry her hand to the nape of her neck. Squeeze dynamometer 20 (left 18).

X-rays: Deformed upper end with irregular structure. No joint space visible (Fig. 75).

Result: Subj.: Fair.

Obj.: Poor.

X-ray: Poor. *Functional result: Poor.*

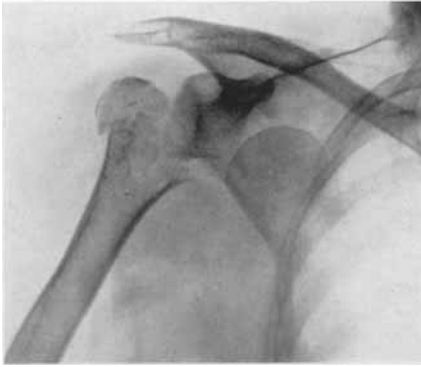


Fig. 76.

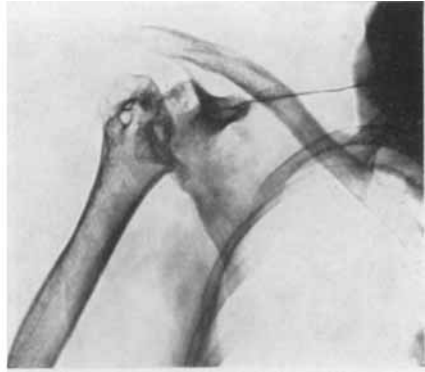


Fig. 77.

Case 273. (R.H. - D, Case rec.: 790/1939). 69-year-old female, lady's companion.

Fracture-dislocation (comminuted fracture of the upper end of the humerus).

Admitted for 82 days, from 8.3.1939, immediately after having fallen on the floor on her outstretched left arm. Immediately pain in the left shoulder. Obj. findings: Dislocation of the humerus. Glenoid cavity empty and the head seems to be palpable infero-anteriorly, below the coracoid process. Attempt at reduction under ethyl chloride anaesthesia. Strepitus was felt and the irregular end of the humerus was palpable on a level with the empty glenoid cavity without the head accompanying it.

X-rays: Comminuted fracture of the upper end of the humerus. The head was medially and anteriorly displaced, superimposed on the lower lateral end of the neck of the scapula. Comminuted fracture also of the greater tuberosity which is laterally and upward displaced, but connected with the remaining part of the humeral shaft which is lying against the lower part of the glenoid cavity (Fig. 76).

Treatment: After the first attempt, another attempt at reduction was performed on the next day under ethyl chloride anaesthesia. As it failed, operation and excision of the head which was loose and cut off from blood supply. Skin traction, abduction splint. Traction removed at the end of 18 days and the abduction splint at the end of 32 days, but the position was not satisfactory, the end of the humerus still being dislocated downward and anteriorly. Two weeks after the splint was removed, closed reduction was carried out, and an abduction splint was left on for 21 days. At the end of this period, the position was good. Then, sling and exercises (10 weeks after the accident). Re-examination 2 years after the accident: Doing domestic work. No complaints. Flexion 80°, abduction 90°, rotation 80°/135°. "Bridge-shaped exostoses (? ankylosis)".

Follow-up 6 years 9 months after the accident: Does exercises with great energy and occasionally has massage. Only slight complaints in the form of restricted movements and pain on and off. The patient is not working, only looking after her own flat.

Obj. findings: Muscular atrophy, 3 cm shortening. Flexion, abduction 90°, extension normal, rotation 70°/155° (right 40°/195°).

X-rays: See Fig. 77.

Result: Subj.: Good.

Obj.: Poor.

X-ray: Poor. *Functional result: Poor.*

Case 274. (R.H. - D, Case rec.: 772/1941). 45-year-old housewife.

Fracture-dislocation (fracture of the surgical neck and greater tuberosity).

Admitted for 16 days, from 24.5.1941, immediately after having fallen off her bicycle, striking her left shoulder. Head palpable in the axilla.

Treatment: Gentle reduction under ethyl chloride anaesthesia. Then, swathe and sling. Four days after the accident, massage and passive movements, replaced 7 days later by active exercises. X-rays after reduction showed a high-seated serrated transverse fracture of the surgical neck and fracture of the greater tuberosity with elevation. Distal fragment 1 cm medially displaced. Marked posterior angulation and rotation of the head, the articular surface turning backward (Fig. 78). One month after the accident, X-rays showed no more medial displacement of the distal fragment. (Fig. 79). Massage for 3 months at which time she was looking after her domestic duties.

Follow-up 3 years 11 months after the accident. No complaints.

Obj. findings: Pronounced atrophy of the shoulder muscles. Flexion, abduction 10° short of that on the right. Rotation equal on both sides. Strength satisfactory. No sensibility disturbances.

X-rays: Union with a slight posterior angulation, but marked prominence of the greater tuberosity (as Fig. 79).

Result: Subj.: Good.

Obj.: Good.

X-ray: Fair. *Functional result: Good.*



Fig. 78.



Fig. 79.

Case 275. (K.H. - V, Case rec.: 997/1940). 55-year-old male, editor.

Fracture-dislocation (fracture of the surgical neck).

Admitted for 26 days, from 16.5.1940, one day after having fallen when getting off a tram. Fell on his outstretched right hand and felt a snap in the shoulder.

X-rays: Inferior dislocation of the right shoulder.

Treatment: Reduction by light traction under ether anaesthesia. X-rays then showed a high fracture of the surgical neck, impacted without displacement. Sling, two days after the accident exercises, and 4 days after massage.

Follow-up 3 years 9 months after the accident: Massage continued for 2 months. Got on without help 3 months after the accident. No complaints.

Obj. findings: Rotation $45^{\circ}/160^{\circ}$, (left $40^{\circ}/185^{\circ}$). Other movements equal on both sides.

X-rays: Union. Here and there calcific shadows in the joint capsule and a particularly large one between the surgical neck and the glenoid cavity.

Result: Subj.: Good.

Obj.: Good.

X-ray: Fair. *Functional result:* Good.

Case 276. (R.H. - D, Case rec.: 1296/1938), 61-year-old housewife.

Fracture-dislocation (comminuted fracture of the upper end of the humerus).

Admitted for 35 days, from 13.8. 16 hours after having fallen, striking her right shoulder against a tramcar. Was brought to a casualty ward, where the condition was "interpreted as dislocation, reduced under ethyl chloride anaesthesia, and the curve of the shoulder was re-established. The patient was told to appear for X-ray examination the following day". On admission, swelling, tenderness, abolished movements, and the articular head was palpable in the axilla. No nerve injuries.

X-rays: "Fracture of the right surgical neck and fracture of the greater tuberosity. The detached head is downward dislocated".

Treatment: Closed reduction by traction and manipulations under ether anaesthesia. Then skin traction on abduction splint.

X-rays: The head is now *in situ* in the glenoid cavity. Poor contact between the fractured surfaces. Head greatly rotated, distal fragment medially displaced by $\frac{1}{2}$ width of the bone and a marked valgus angulation (Fig. 80). During the subsequent period it was attempted to correct the fracture by an axillary pad and by altering the direction of the traction, but the distal fragment remained medially displaced by about $\frac{1}{2}$ width of the bone and the valgus angulation was about 15° . Therefore, the splint and traction were removed at the end of 11 days and replaced by sling, axillary pad, and swathe. This gave an excellent position, no angulation, but 4-5 mm medial displacement of the distal fragment (Fig. 81). Passive movements from the 16th day after admission. Massage from 2 months after the accident. At that time, flexion was 120° and abduction 90° . Seen $2\frac{1}{2}$ years after the accident: Pain at night and when doing needlework. Flexion 120° , abduction 90° , rotation $45^{\circ}/135^{\circ}$.

Follow-up 6 years 9 months after the accident: Massage and systematic exercises from the 2nd to the 4th month after the accident. Got on without help 2 months after the accident, but recovered very slowly. Living by herself in a small flat

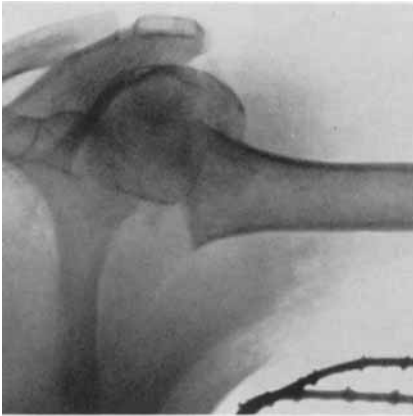


Fig. 80.



Fig. 81.



Fig. 82.

which she looks after without help. Complains of restricted movements and pain on and off.

Obj. findings: Pronounced atrophy of the muscles. Right scapula elevated from the chest wall, occupying its normal position when the arm is 30° abducted. Further abduction only 10° , flexion 145° (left 160°), extension 15° , rotation $50^\circ/120^\circ$ (left $45^\circ/190^\circ$). Strength greatly reduced.

X-rays: Quite considerable deformity of the upper end which is markedly flattened with irregular, serrated contours. In addition, cystic translucencies in the structure below the joint surface. Joint space not narrowed (Fig. 82).

Result: Subj.: Fair.

Obj.: Poor.

X-ray: Poor. **Functional result:** Poor.

Case 277. (K.H. - I, Case rec.: 2086/1942). 63-year-old male, paviour.

Fracture-dislocation (fracture of the surgical neck and greater tuberosity).

Admitted for 19 days, from 26.9.1942, after having fallen off his bicycle on his



Fig. 83.

outsretched right hand. The patient could not be examined until the following day, because he was too drunk. At that time, there was paresis of the radial nerve on the right.

X-rays: Transverse fracture of the surgical neck, inferior dislocation of the humerus and fracture of the greater tuberosity which was laterally displaced.

Treatment: Closed reduction under ether anaesthesia. Afterwards, X-rays showed both fractures in a good position and the head in the glenoid cavity. On 9.10. physiotherapy and electrotherapy. Three months after the accident the case record states that there was satisfactory progress as regards the radial paresis.

Follow-up 1 year 10 months after the accident. Massage continued for 2 months. Got on without help 3 weeks after the accident, and reported that he had been quite fit 2½ months after. Working. No complaints.

Obj. findings: 10° short of elevation as compared with the left shoulder. Rotation 50°/160°. No other abnormalities.

X-rays: Union of the surgical neck in the anatomical position with normal callus. At the site of the greater tuberosity there is a calcific shadow, 2 × ¾ cm, projecting a few mm up above the head and without bony union to the latter. This is a partially absorbed greater tuberosity with fibrous union (Fig. 83).

Result: Subj.: Good.

Obj.: Good.

X-ray: Fair. *Functional result: Good.*

Case 278. (O.H., Case rec.: 5852/1940). 63-year-old male, foreman in factory.

Fracture-dislocation (comminuted fracture of the upper end of the humerus).

Admitted for 106 days, from 7.10.1940, immediately after having stumbled over a kerbstone. Fell, striking his left arm. Immediately pain, and the patient could hardly move. The head was palpable on the anterior aspect of the joint.



Fig. 84.

X-rays: Inward and downward dislocation of the head. Splintered fracture of the entire area between the surgical neck and anatomical neck, but the greater tuberosity fragment could be distinguished, laterally displaced.

Treatment: Abduction splint. Ulnar bone traction. Closed reduction. With cautious traction, manipulations with the head made it slide down into the depth with audible strepitus. X-rays now showed that the head was *in situ* and the position was excellent, the distal fragment being in good contact with the fractured surface of the head. The greater tuberosity fragment was laterally displaced. Traction 4 kg, at the end of 3 days 2 kg. Nine days after reduction, X-rays showed the distal fragment to be medially displaced by almost the whole width of the bone (sunk down into the axilla). At the same time, the head was tilted into a varus position. The traction was increased and an axillary pad applied to lift the distal fragment. X-ray appearances unchanged. Now, paraesthesiae developed in the ring and little fingers, so the external rotation was reduced, and the paraesthesiae diminished. X-ray appearances unchanged. Traction removed at the end of 5 weeks. Then exercises. The abduction splint was removed at the end of 7 weeks, but was re-applied two weeks later and left on for a month, as the patient had severe pain in the shoulder and oedema of the arm. Fourteen weeks after the accident, X-rays showed unchanged position. Ample callus (Fig. 84). Fifteen weeks after the accident, active abduction was 60°.

Follow-up 3 years 9 months after the accident: The patient went back to work 4½ months after the accident. Now, he has retired, is living by himself and looking after his rooms. He complains of restricted movements in the left shoulder and pain on and off.

Obj. findings: Considerable muscular atrophy. Flexion (70°) 95°, abduction (85°) 95°, extension 30°, rotation 60°/135°. Cannot carry his hand to the nape of his

neck or behind his back. Strength satisfactory. Squeeze dynamometer 25 (right 27).

X-rays: Union in exactly the same position as Fig. 84.

Result: Subj.: Fair.

Obj.: Poor.

X-ray: Poor. *Functional result: Poor.*



Fig. 85.



Fig. 86.

Case 279. (K.H. - Out-pt., Case rec.: E.M.H./1939). 63-year-old widow.

Fracture-dislocation (comminuted fracture of the upper end of the humerus).

Came into the Out-patient Department on 13.3.1939 immediately after having been knocked over by a bicycle. The "clinical picture corresponds exactly to dislocation of the right humerus". "Reduction by the method of Kocher was successful".

X-rays (anteroposterior view): Comminuted fracture of the upper end with several fracture lines and fracture of the anatomical neck. The fragments are close together except the head which is not visible in this view, as it is taken too far laterally (Fig. 85). (The fracture of the anatomical neck and the dislocation of the head were not detected until the films were reviewed at follow-up - Author's comment).

Treatment after the above-mentioned "reduction": Sling. Massage and exercises from the 10th day. Two months after the accident the case record mentions axillary paresis and pronounced atrophy of the deltoid.

Follow-up 5 years after the accident: Massage and electrotherapy continued for about 1 year with an interval of 2 months. Did not get on without help until 6 months after the accident. The patient has many complaints: Pain every day, restricted movements, weakness, tires easily, stiffness of the fingers, and occasionally pins and needles in the thumb.

Obj. findings: Atrophy of the muscles, swelling and heat in the right shoulder. Reduced sensibility on the outside of the upper arm. Flexion 70°, abduction 90°, extension 50°, rotation 70°/110°. Has difficulty in carrying her hand to the nape of her neck and to the opposite shoulder; behind her back it goes only to the sacral bone.

X-rays: The head is medially and downward in the axilla. The upper end of the humerus is very irregular, showing areas of increased density (Fig. 86).

Result: Subj.: Poor.

Obj.: Poor.

X-ray: Poor. *Functional result: Poor.*



Fig. 87.



Fig. 88.

Case 280. (O.H. - Case rec.: 9050/1941). 54-year-old female, bookbinder.

Fracture-dislocation (comminuted fracture of the upper end of the humerus).

Admitted for 62 days, from 24.7.1941. The patient had been sitting on a horse-drawn carriage which collided with a car. In the collision, the patient was flung against a telegraph pole, striking her left shoulder. X-ray report from another hospital: "Comminuted fracture of the left surgical neck with severe distal, later-

al, and dorsal dislocation of the head. In addition, the head is rotated, the fractured surface pointing almost mediad. The shaft of the humerus is dislocated so as to point inward to the anterior aspect of the scapula. Greater and lesser tuberosities detached, but approximately *in situ*".

Treatment (O.H.): Ether anaesthesia, "reduction". Ulnar bone traction, 5 kg. Abduction splint.

X-rays now showed fairly good position of the splintered upper end which was outside the glenoid cavity, *except for the head which was down on the shaft*, the fractured surface turning against the bone and projecting laterally and anteriorly (Fig. 87). X-ray control during the subsequent period showed unchanged position. The traction was removed at the end of 6 weeks, the abduction splint at the end of 9½ weeks.

On several control visits the patient exhibited slow progress. 3½ months after the accident she got on without help. Fourteen months after the accident, the patient came for the last control visit. At that time she had pain upon forced movements. Restricted movements. Flexion 100°, abduction 80°, external rotation ½.

Follow-up 2 years 11 months after the accident: Every day the patient does energetic exercises. She is working and has no complaints.

Obj. findings: The acromion is projecting owing to the absence of the head. Almost one hand's breadth below the acromion some swelling on the outside of the arm. On palpation this swelling is found to be fixed to the bone. One cm shortening of the upper arm. Some atrophy of the muscles. Flexion (60°) 120°, abduction (70°) 110°, extension 25°, rotation 75°/140°. Can easily carry her hand to the nape of her neck. *Strength exceptionally good*. Sensibility normal.

X-rays: Upper end of the humerus uneven and sclerotic. The head of the humerus, which is partially absorbed, appears to be attached to the shaft of the humerus by bony union (Fig. 88).

Result: Subj.: Good.

Obj.: Fair.

X-ray: Poor. *Functional result: Fair.*

Case 281. (K.H. - V, Case rec.: 1623/1942). 74-year-old female, retired.

Fracture-dislocation (comminuted fracture of the upper end of the humerus).

Admitted for 6 days, from 21.8.1942.. Two hours previously the patient had fallen on the street, striking her right shoulder. Severe pain and unable to move. The curve of the shoulder was flattened. The axis of the humerus pointing past the glenoid cavity.

X-rays (anteroposterior view): Comminuted fracture of the upper end of the humerus with at least 3 fragments: The area of the greater tuberosity, the head, and an intermediary fragment. The greater tuberosity is only slightly laterally displaced, the head is medially displaced and downward dislocated. The diaphysis is pointing up toward the glenoid cavity.

Treatment: Collar-and-cuff sling. From the 4th day massage and exercises. (The patient was transferred to a medical department because of diabetes mellitus).

Follow-up 1 year 3 months after the accident: Massage and exercises continued for about one year. The patient is unable to dress or undress without help. Pain in the shoulder on movements.

Obj. findings: Distinct swelling of the joint, atrophy of the muscles. Ankylosis in the humero-scapular joint in 30° flexion, 60° abduction, and 90° rotation. With a free scapula flexion, abduction up to 90°, extension 0°. Strength very slight. Sensibility normal. Can carry her hand almost up to her mouth, but not to the opposite shoulder, to the nape of her neck or behind her back.

X-rays: Union in the same position. The head is lying separately, dislocated medially and inferiorly.

Result: Subj.: Poor.

Obj.: Poor.

X-ray: Poor. *Functional result:* Poor.

Case 282. (K.H. - I, Case rec.: 1692/1940). 76-year-old female, retired.

Fracture-dislocation (comminuted fracture of the upper end of the humerus).

Admitted for 7 days, from 28.9.1940, after having fallen down a flight of stairs. Pain, tenderness, and crepitation in the right shoulder.



Fig. 89.

X-rays in one projection: Comminuted fracture of the upper end of the humerus.

Distal fragment pointing up toward the glenoid cavity, whereas the upper end is completely splintered and displaced, mainly laterally. The head is not visible in this view (Fig. 89).

Treatment: Bed rest for 3 days. Then collar-and-cuff sling, massage, and exercises. *Follow-up* 3 years 4 months after the accident: Massage continued for about 6 weeks.

It is not until the past year that the patient has been able to dress and undress, but she is still unable to do her hair. Not working, but receiving old age pension. Pain in the shoulder day and night.

Obj. findings: Very pronounced atrophy of the muscles. Rotation 85°/95°, flexion, abduction (30°) 60°, extension 20°. All movements painful. Cannot carry her hand to the nape of her neck, to the opposite shoulder, or behind her back. Sensibility estimated as normal.



Fig. 90.

X-rays: The upper end of the humerus is atrophic, sclerotic, and irregular. The head can be seen down in the axilla, projected to the middle of the scapula (Fig. 90).

Result: Subj.: Poor.

Obj.: Poor.

X-ray: Poor. **Functional result:** Poor.

Case 283. (K.H. - I, Case rec.: 1139/1938). 43-year-old male, representative.

Fracture-dislocation (fracture of the anatomical neck and surgical neck - cerebrospinal syphilis).

Admitted for 22 days, from 5.6.1938. Shortly before, the patient had been seized with malaise and lost consciousness for some minutes. When he came to, he had pain and abolished function in the right shoulder.

X-rays (anteroposterior view): A fracture line through the anatomical neck and another one through the surgical neck. In addition, anterior dislocation of the head (Fig. 91). (The dislocation was not detected until at follow-up 6½ years later - Author's comment).

Treatment: Bed rest for 11 days with the arm abducted on a pillow. At the end of 19 days massage and exercises (at the same time antisypilitic treatment). X-rays, taken in 1939, showed enormous newformation of bone with a false joint in front of and below the glenoid cavity.

Six months after the accident flexion, abduction 120°.

Follow-up 6½ years after the accident: Went back to work about 2 months after the accident. On and off "rheumatic pain" in the shoulder, but no other complaints.

Obj. finding: The right shoulder is lower than the left. The inferior angle of the scapula is elevated from the chest wall and medially displaced, but is returned to its normal position when the arm is 35° abducted. Pronounced atrophy, particularly of the deltoid and supraspinatus muscles. Flexion, abduction 115°, exten-



Fig. 91.



Fig. 92.

sion 35° , rotation $65^\circ/85^\circ$. Cannot carry his hand to the nape of his neck and with difficulty behind his back and to the opposite shoulder.

X-rays: Union in pronounced varus deformity. The head is atrophic with irregular skeletal structure. Joint surface irregular. The head articulates with the false joint (Fig. 92).

Result: Subj.: Good.

Obj.: Poor.

X-ray: Poor. *Functional result: Poor.*

Case 285. (K.H. - Out-pt., Case rec.: 540/1941). 37-year-old male, shop assistant.

Fracture-dislocation (fracture of the greater tuberosity).

Came into the Out-patient Department on 28.1.1941. Seven days previously, the patient had fallen on the street, striking his left upper arm. Did not go to a doctor until yesterday. Referred to the Out-patient Department because of fracture of the humerus. Obj. findings: Swelling of the left shoulder, ecchymoses on the shoulder and upper arm. Resilient fixation in the shoulder joint. Head palpable infero-anteriorly.

X-rays (anteroposterior view): Inferior dislocation of the humerus and a large portion broken off the greater tuberosity.

Treatment: Closed reduction under ethyl chloride anaesthesia. X-rays now showed the head *in situ* and the greater tuberosity in a good position. Sling. Seven days after the patient was first seen (two weeks after the accident), massage and exercises.

Follow-up 3 years after the accident: Massage and electrotherapy for 3 months. Did not get on without help until 6 months after the accident. On and off pins and needles superiorly on the outside of the left upper arm. The patient is working in a factory, and has no complaints in his daily work, but tires readily in the arm.

Obj. findings: Very pronounced atrophy of the deltoid muscle, somewhat less pronounced of the other shoulder muscles. Flexion (45°) 125° , abduction (55°) 115° , extension 30° , rotation $65^{\circ}/150^{\circ}$. Reduced sense of touch in the area innervated by the axillary nerve. Strength of shoulder muscles reduced.

X-rays: Skeletal structure of the head somewhat uneven and sclerotic. Rather marked calcific deposits medially and inferiorly in the capsule. The joint space appears to be normal. Union of the greater tuberosity without displacement.

Result: Subj.: Good.

Obj.: Fair.

X-ray: Fair. *Functional result:* Fair.

After critical analysis, two patients were left out of the series, but their case histories will be reported below:

Case 301. (K.H. - I, Case rec.: 217/1938). 59-year-old male.

Comminuted fracture of the upper end of the humerus. (History of syphilis).

Admitted for 24 days, from 14.1.1938, after having fallen on the street, striking his right shoulder. Active abduction and flexion 45° . Looseness at the site of the fracture: The fragments can be shifted without giving rise to pain.

X-rays: Fracture of the anatomical neck as well as the surgical neck, the area of the tuberosities forming an intermediary fragment. Fig. 93 shows the position with the arm hanging down along the side, Fig. 94 with the patient lying in bed, his arm somewhat abducted on a pillow.

Treatment: Skin traction in bed for 3 days, then sling and axillary pad. At the end of two weeks exercises and massage.

Follow-up 6 years 4 months after the accident: The patient was out of work during the period after the accident. Now, he is doing clerical work without complaints. Three years ago he hurt his left shoulder which was not examined and received



Fig. 93.



Fig. 94.

no treatment. The patient finds that both shoulders are equally bad. No pain, but restricted movements.

Obj. findings: Pronounced atrophy of both shoulders.. Ankylosis in the humero-scapular joint on the right in 15° flexion and abduction, almost ankylosis in the left humero-scapular joint (20° movement). With a free scapula, flexion on both sides is 80°, abduction on the right 70° and on the left 60°, extension 20° on both sides. Rotation on the right 50°/90°, on the left 50°/170°.

X-rays: Right side: Humerus and scapula fused to one large bony mass. Left side: Articular head atrophic. It is surrounded by large newformation of bone. Broad bony bridges from the upper end of the humerus toward the scapula.

(It is impossible properly to assess this case or to include it in the analysis owing to the bilateral newformation of bone, presumably of syphilitic origin).

Case 302. (O.H., Case rec.: 5615/1942). 41-year-old male.

Fracture of the surgical neck.

Admitted for 27 days, from 15.7.1942, after having fallen off his bicycle, striking his left shoulder. Tenderness and pain on attempts to move.

X-rays: Oblique fracture of the surgical neck. In addition, halisteresis of the upper end of the humerus which is of a peculiar shape, with no articular surface, but a flat area on the head, articulating with the scapula.

Treatment: Abduction splint for 3 weeks. Then, massage and exercises. It was later learnt that in childhood the patient had been treated by a homeopath for "glands" in the left axilla. Had not had an operation.

Follow-up 1 year 7 months after the accident: Working as charterer. Went back to work 6 weeks after the accident and has no complaints.

Obj. findings: Flexion, abduction 110°, rotation 60°/125°.

X-rays: Union, but the findings were otherwise as before.

(The patient reports that the arm is no worse than before the accident, but owing to the pre-existing pathological conditions the result cannot be assessed).

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