

FRACTURES OF THE HUMERUS

Among the patients treated in the Surgical wards of the 12th General Hospital there were 342 cases of fracture of the humerus. Of these cases there were 129 treated in Africa, 147 were treated in Rome, Italy and 66 were treated in Leghorn, Italy.

Table I; Distribution of Cases:

:Africa	129:
:Rome	147:
:Leghorn	66:
: Total	342:

Types of Casualty:

Of the total 342 cases, 257 or 75.14% resulted from battle casualties; 83 or 24.29% resulted from accidental injury and 2 cases or 0.57% the way in which the casualty occurred is not recorded.

Table II; Type of Casualty:

:	Battle Casualties:	Injuries :	Unrecorded :	Total :
:Africa:	90	: 39	: 0	: 129 :
:Rome :	117	: 30	: 0	: 147 :
:Leghorn:	50	: 14	: 2	: 66 :
: Total:	257	: 83	: 2	: 342 :
:	(75.4%)	: (24.29%)	: (0.57%)	:

Nature of the Fractures:

68 or 19.88% of the total number of fractures were simple and 274 or 80.12% were compound, distributed as according to Table III.

Table III; Nature of the Fractures:

:	Simple :	Compound :	Total :
:Africa :	29	: 100	: 129 :
:Rome :	27	: 120	: 147 :
:Leghorn:	12	: 54	: 66 :
: Total :	68	: 274	: 342 :
:	(19.88%)	: (80.12%)	:

The majority of the cases of simple fracture of the humerus resulted from accidental injury as 58 cases of the total of 68 simple fractures resulted from this cause. Only 8 cases out of the total 68 simple fractures were the result of battle casualties while in 2 cases of the total 68 simple fractures the cause was not recorded.

On the other hand the majority of the cases of compound fracture of the humerus resulted from battle casualties or 249 cases of the total of 274 cases of compound fractures of the humerus resulted from battle casualties. The remaining 25 cases of compound fracture of the total of 274 cases were the result of severe accidental injury.

Table IV; Cause of Fractures:

	: Simple :	Total :	Compound :	Total :	Exten :	Total :
: Of 39 injuries in Africa	: 25 :		: 14 :		: 39 :	
: Of 30 injuries in Rome	: 24 :		: 6 :		: 30 :	
: Of 14 injuries in Leghorn	: 9 :		: 5 :		: 14 :	
		: 58 :		: 25 :		: 83 :
: Of 90 battle casualties in Africa	: 4 :		: 86 :		: 90 :	
: Of 117 battle casualties in Rome	: 3 :		: 114 :		: 117 :	
: Of 50 battle casualties in Leghorn	: 1 :		: 49 :		: 50 :	
		: 8 :		: 249 :		: 257 :
: Of 2 unrecorded cases in Leghorn	: 2 :					
		: 2 :				: 2 :
: Totals		: 68 :		: 274 :		: 342 :

Pathology Associated with Fractures of the Humerus:

Skin and Soft Tissues:

Contusion and ecchymosis of the skin and soft tissues about the site of the simple fractures of the humerus were not unusually marked.

In cases of compound fracture ~~of~~ the injury to the skin and soft tissues was always moderately severe to severe. The wounds were penetrating in 132 cases, perforating in 118 cases and lacerated in 34 cases. The penetrating and perforating wounds resulted from entrance of metallic missiles during combat while the lacerated wounds resulted for the most part from severe accidental injury.

Joints:

Severe injury to the joints adjacent to the fractured humerus resulted in 48 cases. The elbow was involved in 33 cases and the shoulder was involved in 15 cases. In 42 cases the fracture line extended into the joint. In 6 cases the joint was dislocated, the elbow once and the shoulder 5 times. All 5 cases of dislocation of the shoulder joint resulted from accidental injury received when the patient was catapulted through the air from a vehicle to the hard surface of the road during a vehicular accident.

Table V; Joint Injury:

	: Elbow :	Shoulder :	Total :
: Dislocation	: 1 :	: 5 :	: 6 :
: Fracture into joint:	: 32 :	: 10 :	: 42 :
: Totals	: 33 :	: 15 :	: 48 :

Blood Vessels:

Severe injury to the larger blood vessels requiring ligation of these vessels occurred one time in case of the axillary artery and vein and six times in case of the brachial artery and vein.

Nerves:

There were 94 cases in which the fractures of the humerus were complicated by permanent nerve damage. These were:

- 4 injuries of the brachial plexus,
- 16 injuries of the median nerve,
- 27 injuries of the ulnar nerve, and,
- 46 injuries of the radial nerve.

In cases where possible the ends of the lacerated nerves were repaired.

Bone Defect:

Extreme loss of bone substance of the humerus occurred in 18 cases.

Site of Fracture:

The fractures were almost equally divided between the two humeri as the left humerus was fractured in 169 cases and the right humerus in 178 cases. The total number of fractures, 347, is slightly more than the total number of cases, 342, as the humerus was fractured in two places in each of 5 cases. The upper extremity of the bone was fractured in 43 cases; the shaft was involved in 253 cases and the lower extremity in 51 cases. More details as to site of fracture can be obtained from the following chart.

Table VI; Site of Fractures of Humerus;

	:Head:	Neck	:Gr.Tub:	U/3:	M/3:	L/3:	Med Cond:	Lat Cond:	Total:		
Left humerus :	:Surg:	Ana-:	Undesig:	:	:	:	:	:	:		
:	:	tom:	nated:	:	:	:	:	:	:		
:	: 9 :	2 :	2 :	5 :	8 :	59:	18:	42:	14 :	10 :	169 :
Right humerus:	4 :	6 :	1 :	2 :	4 :	51:	26:	57:	22 :	5 :	178 :
	UPPER EXTREMITY				SHAFT			LOWER EXTREMITY			
	43				253			51			347

Type of Fracture:

308 of the 342 cases of fractures of the humerus were complete and comminuted. This is to be expected because the majority of the injuries were the result of severe battle wounds or serious accidents. Of the remaining 34 cases, 8 were clear cut, transverse, oblique, or chip fractures, while 26 were incomplete and comminuted.

TREATMENT

Primary Treatment :

Primary treatment, here described, is not the first aid treatment administered in the field. It is the first definitive treatment given to favor the restoration of position and function of the fractured bone. It includes reduction and fixation of the reduced fragments in the case of simple fractures. It includes adequate debridement of open wounds, removal of foreign bodies, metallic and bony fragments and fixation in the case of compound fractures.

Such treatment was rendered promptly in these 342 cases of fractures of the humerus, as 213 cases were treated within 24 hours, after injury. 99 cases were treated within 24 - 72 hours after injury; 2 were treated over 72 hours after injury.

2 cases were untreated. One of the untreated cases was injured on D-day in North Africa and the patient did not seek treatment until 6 months later when a chronic arthritis of the elbow joint complicating a fracture of the lower 1/3 of the humerus became disabling. The other case was detected when x-ray, taken 5 months after injury, revealed a malunited fracture that limited extension of the forearm.

Primary treatment of simple fractures:

57 of these fractures were reduced and fixed in plaster of paris spicas. 15 of these cases were later treated by operative methods to correct deformity and will be described later.

One case was not treated as it was an old case detected 6 months after injury.

Primary treatment of compound fractures of the humerus:

The 274 cases of compound fractures were treated primarily as follows:

- 208 were debrided and plaster of paris spica applied,
- 9 were debrided and plaster of paris long arm cast applied,
- 30 were debrided and plaster of paris hanging cast applied,
- 4 were debrided and plaster of paris abduction cast applied.
- 15 demanded surgical amputation on account of traumatic amputation or extensive soft tissue injury.
- 1 defective amputation stump was repaired.
- 3 were debrided and the fragments fixed by plating.
- 5 were debrided and the fragments wired.
- 7 were debrided and traction applied to the lower fragment by insertion of Kirschner wire in olecranon.
- 1 was debrided with removal of humeral head.
- 1 was debrided with removal of the distal end of the humerus.

Subsequent Treatment of Fractures:

1. Subsequent treatment of simple fractures:

Fifteen cases of the 58 cases of simple fracture of the humerus had to undergo operative procedures subsequent to primary reduction and fixation with plaster cast. Two of these 15 cases had Kirschner wires led through the olecranon process of the ulna in order that traction might be exerted on the displaced lower fragment of the humerus. In the remaining 13 cases, operative procedures were performed at the site of the fractured bone. In all cases except one the operation followed the primary treatment within 2 to 23 days; while in this one, fixation of an ununited fracture was done 5 years after the original injury. One case was plated 6 days after injury and had to be re-plated 23 days after the injury. In 2 cases bony fragments, which would have prevented perfect healing, were removed. Further details of subsequent treatment of cases of simple fracture in this series can be obtained from Table VII.

Table VII; Subsequent treatment of Simple Fractures of Humerus:

:Fixation of fragments with nail or screws	2:
:Fixation of fragments with bone plates	5:
:Fixation of fragments with wire	4:
:Removal of bony fragments	2:
:Kirschner wire traction of olecranon	2:
: Total	15:

2. Subsequent treatment of compound fractures of the humerus:

Thirty-three cases of compound fractures of the humerus were operated at the time of primary treatment. The remaining 241 cases of the total 274 cases of compound fractures were reduced by non-operative treatment, other than manipulation, and supported with plaster of paris casts. Subsequently, 16 of these 241 cases demanded operative treatment as the following table shows.

Table VIII; Subsequent treatment of Compound Fractures of Humerus:

:Amputation following gas gangrene infection ..	4:
:Amputation following dry gangrene	1:
:Amputation on account of soft tissue damage ..	1:
:Bone plating of fragments	2:
:Wiring of fragments	4:
:Fixation of fragments with screws	2:
:Kirschner Wire traction to olecranon	2:
: Total	16:

The paucity of delayed operations in these cases of compound fractures is an indication of the careful consideration of the proper treatment at time of primary treatment.

Complications:

Serious complications were rare:

Hemorrhage:

Two cases of alarming hemorrhage occurred. One of these was controlled by pressure bandages. The other occurring two days after primary treatment necessitated the ligation of the brachial artery.

Infection:

There were four cases complicated by gas gangrene which necessitated amputation of the humerus, two of these cases occurring in German prisoners of war.

There were six other cases that developed infection in the wound that gradually cleared up.

One case resulted in chronic osteomyelitis.

Vascular:

There were two cases of vascular complications. One was only temporary while the other, apparently due to prolonged pressure on the brachial artery by plaster of paris cast, led to dry gangrene and ultimate amputation of the humerus.

Amputations:

The primary injury and subsequent complications resulted in 21 amputations. Nine traumatic amputations were followed by surgical amputations.

There was one case of dry gangrene, referred to above, that demanded amputation of the humerus.

There were four amputations done following gas gangrene.

There were seven amputations performed on account of extensive soft tissue damage which had destroyed all hope of the viability of the arm.

Table IX; Amputations complicating Fractures of the Humerus:

: Surgical amputation following traumatic amputation	9:
: Surgical amputation following severe soft tissue injury	7:
: Surgical amputation following gas gangrene	4:
: Surgical amputation following dry gangrene	1:
:	Total
	21:

Final Disposition:

From the 12th General Hospital 307 cases were transferred to the Zone of Interior as they could not be restored to duty status in this theatre.

Eleven (11) cases were sent to "B" duty. Of these, six (6) were simple fractures; (2) two received as result of battle casualties and (4) four the result of accidental injury. Five (5) were compound fractures resulting from battle casualties. These were for the most part condylar fractures and incomplete fractures of the humeral shaft with solid healing of the fracture and some limitation of the elbow joint.

Twenty-four cases were returned to "A" duty by way of the convalescent

hospital or the conditioning and rehabilitation ward. Of these, 15 were simple fracture, 11 resulting from accidental injury, 4 from battle casualties. 9 were compound fractures, 6 resulting from battle casualties and 3 from accidental injury. These were cases of impacted fractures of the surgical or anatomical neck of the humerus, incomplete fractures of the humeral shaft or condylar fractures, which had healed completely without limitation of function.

Associated Injuries:

The associated injuries were varied and wide-spread as regards other parts of the body. The more serious ones were:

15 cases of fracture, both bones of forearm, of same extremity in which the fractured humerus occurred.

9 cases of fractured radius of same extremity.

7 cases of fractured ulna of same extremity.

15 cases of fracture of scapula of same side on which the fractured humerus occurred.

3 cases of fracture of clavicle of same side.

20 cases of fracture of other upper extremity.

34 cases of fractures of lower extremities.

11 cases of fractured skull and cerebral concussion and other brain injuries.

18 injuries of the chest, 5 causing sucking wounds. The remaining 13 accompanied by hemothorax and 2 complicated by empyema.

4 serious intraabdominal injuries.

5 cases of fractured vertebrae.

5 cases of fractured bones of face.

4 cases of serious injury to the eye.

Summary:

342 patients suffering from fractures of the humerus were treated at the 12th General Hospital.

75.14% were due to battle casualties.

24.19% were due to accidental injury.

0.57% the cause was not recorded.

Nature of fractures:

68 or 19.88% of the fractures of the humerus were simple.

274 or 80.12% of the fractures of the humerus were compound.

Simple cases resulted mostly from accidental injury.

Compound cases resulted from battle casualties.

Associated Pathology:

Wounds of skin and soft tissues were;

Penetrating in 132 cases;

Perforating in 118 cases;

Lacerated in 34 cases.

Joints:

The elbow (33 cases) was involved in the injury over twice as often as the shoulder joint (15 cases). The fracture line extended into the joint in 42 cases.

Dislocation of the elbow occurred in 1 case; dislocation of the shoulder in 5 cases, all the result of accidental injury.

Blood Vessels:

The axillary artery and vein were ligated in one case; the brachial artery and vein in five cases.

Nerves:

There were 94 cases of nerve injury, the majority of which were injuries to the radial nerve (46). Then in order of frequency the ulnar nerve, (27), the median nerve, (16), and the brachial plexus, (4).

Bone:

Extensive loss of bone occurred in 18 cases.

Site of fracture:

In each of five cases the humerus was fractured twice, totalling 347 fractures in 342 patients.

The upper extremity of the humerus was involved in 43 cases; the shaft in 253 cases, and the lower extremity in 51 cases.

Type of Fracture:

334 out of the 347 fractures were complete and comminuted. This is to be expected for most of the injuries resulted from extensive battle injuries and severe accidental injury.

Treatment:

Primary treatment was given early, secondary operative treatment following a conservative primary treatment was necessary only in 31 cases.

Complications:

Serious complications were rare.

Hemorrhage occurred in two cases.

Infection occurred in eleven cases only four of which were due to gas producing organisms.

Vascular complication resulted only once due, evidently, to pressure of plaster cast on the brachial artery. Dry gangrene resulted and amputation of the humerus became necessary.

Amputations:

21 surgical amputations were performed;

9 following traumatic amputation.

1 following development of dry gangrene at upper extremity.

4 following gas gangrene.

7 on account of extensive destruction of soft tissues of the arm which rendered the arm non-viable.

Disposition:

307 of the total 342 cases were discharged to the Zone of the Interior as they could not be restored to "A" (combat) duty within 120 days. 11 cases were sent to "B" duty and 24 cases were returned to "A" duty.

END RESULTS:

The final outcome of these cases cannot be given or predicted. The majority of them were sent into the Zone of Interior with fractures in good alignment with plaster of paris support as quickly as possible after the date of injury (less than three months). To insure the patient's ability to return to "A" (combat) duty a period of longer than 120 days would be necessary.