Management of Proximal Humeral Fractures in the Nineteenth Century

An Historical Review of Preradiographic Sources

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Abstract

Background The diagnosis and treatment of fractures of the proximal humerus have troubled patients and medical practitioners since antiquity. Preradiographic diagnosis relied on surface anatomy, pain localization, crepitus, and impaired function. During the nineteenth century, a more thorough understanding of the pathoanatomy and pathophysiology of proximal humeral fractures was obtained, and new methods of reduction and bandaging were developed.

Questions/purposes I reviewed nineteenth-century principles of (1) diagnosis, (2) classification, (3) reduction, (4) bandaging, and (5) concepts of displacement in fractures of the proximal humerus.

Methods A narrative review of nineteenth-century surgical texts is presented. Sources were identified by searching bibliographic databases, orthopaedic sourcebooks, textbooks in medical history, and a subsequent hand search.

Results Substantial progress in understanding fractures of the proximal humerus is found in nineteenth-century textbooks. A rational approach to understanding fractures of the proximal humerus was made possible by an appreciation of the underlying functional anatomy and subsequent pathoanatomy. Thus, new principles of diagnosis,

pathoanatomic classifications, modified methods of reduction, functional bandaging, and advanced concepts of displacement were proposed, challenging the classic management adhered to for more than 2000 years.

Conclusions The principles for modern pathoanatomic and pathophysiologic understanding of proximal humeral fractures and the principles for classification, nonsurgical treatment, and bandaging were established in the preradiographic era.

Introduction

The management of fractures of the proximal humerus has challenged medical practitioners since the earliest recorded medical texts [5]. The recommendations established by the ancient Greek and Roman medical authorities remained remarkably unchanged throughout medieval and early modern medicine [6]. Not until the late eighteenth century was the Hippocratic mode of reduction by forceful extension and manipulation (Fig. 1) followed by bandaging and delayed splinting challenged [14]. During the nineteenth century, a more thorough understanding of the pathoanatomy and pathophysiology of proximal humeral fractures was obtained, and new methods of reduction and bandaging were developed. This period is interesting because bone pathology was learned from topographic features of the injuries combined with an occasional post-mortem examination of the fracture or malunion site. It is somewhat amazing how accurately medical writers understood the situation with complex fractures of the proximal humerus almost a century before radiographs were discovered [34].

With the introduction of ether anesthetics in 1846 [25] and antiseptic surgical methods in 1867 [21], invasive

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Fig. 1 The Hippocratic mode of reduction for fractures of the humerus is illustrated. (Reprinted from Richter AL. *Theoretisch-praktisches Handbuch der Lehre von den Brüchen und Verrenkungen der Knochen*. Berlin, Germany: Verlag von TCF Enslin; 1828).

procedures of reduction or resection of the humeral head became less hazardous. However, internal fixation for fractures of the proximal humerus was not considered until the early twentieth century [19] after Röntgen's discovery in 1895 [34] profoundly changed operative orthopaedics and enabled preoperative planning.

Controversies regarding the optimal treatment of complex fractures of the proximal humerus remain in modern orthopaedics, even after the introduction of advanced diagnostic and operative technologies.

This study reviews nineteenth-century principles of (1) diagnosis, (2) classification, (3) reduction, (4) bandaging, and (5) concepts of displacement in fractures of the proximal humerus.

Search Strategy and Criteria

A PubMed search was conducted ("History, 19th Century"[Mesh] AND "Fractures, Bone"[Mesh]). Nineteenth-century textbooks on fractures were identified from orthopaedic sourcebooks [30, 38] and general sourcebooks to medical history [8, 32]. References from relevant textbooks were hand searched and potentially relevant books and journal articles were ordered through The Danish Royal Library (Copenhagen, Denmark), British Library (London, UK), Wellcome Library (London, UK), or Bibliothèque Nationale de France (Paris, France). Biographic information was obtained from searches of author names on PubMed, Google Scholar, Online Encyclopedia, and in biographic encyclopedias [1, 29].

Diagnosis

Nineteenth-century clinicians were laboring without the benefit of radiographs. The clinical diagnosis of shoulder injuries was based on assessment of the surface characteristics, crepitus, ROM, and pain localization. The difficulties of distinguishing displaced or impacted fractures of the proximal humerus from glenohumeral dislocations and fracture-dislocations have been discussed in the surgical literature since the third century BC [5].

In the first American systematic textbook in surgery published in 1813 [15] (Appendix 1), John Syng Dorsey (1773–1818) explained how fractures of the proximal humerus could be distinguished clinically from glenohumeral dislocations: "When the bone is fractured at its upper end, or neck, there is some difficulty in distinguishing the accident from a dislocation of the head of the bone into the axilla. It can always, however, be known, by a depression at the upper and external side of the arm, very different from that depression which occurs in dislocations, and which is situated immediately under the acromion. In the present instance, the shoulder retains its natural rotundity, and no depression exists directly under the acromion. The axilla being examined with the fingers the fractured unequal surface is readily felt; whereas, in dislocations, the round head of the bone is felt high upon the arm-pit. By moving the arm the grating of the fractured surfaces can be distinctly perceived" [15].

In 1823, the British surgeon and pathologist Sir Astley Cooper (1768–1841) described a simple test to distinguish fractures of the proximal humerus from glenohumeral dislocations: "...embrace the head of the os humeri with the fingers and fix it, then rotate the arm at the elbow, and it will be found that the head of the bone does not obey the rotary motion, as it is separated from the body of the humerus by the fracture, which is in this case external to the capsular ligament..." [10].

With this test, however, it may have been difficult to distinguish firmly impacted fractures clinically from glenohumeral dislocations, and to distinguish different anatomic patterns of proximal humeral fractures. Only occasionally postmortem examination of bone pathology was performed and compared with the clinical findings.

In 1888, Albert Hoffa (1859–1907) distinguished fractures of the surgical neck, the greater tuberosity, and the lesser tuberosity according to the surface characteristics [18]. In fractures of the surgical neck, he describes ecchymosis and a typical deformity. The arm is substantially shortened and the deltoid flattened. The acromion is prominent but not sharp as in dislocations. The upper part of the lower fragment can be felt in the axilla. In fractures of the greater tuberosity, the shoulder is broadened and the acromion is prominent. Abduction is impaired and the arm

is hanging loosely by the trunk and cannot be abducted more than 90°. The greater tuberosity is found below and behind the acromion. The fractured tuberosity can be moved against the rotated arm, but outer rotation is impossible and the arm is not shortened. In fractures of the lesser tuberosity, a small swelling can be found around the lesser tuberosity. The arm is rotated outward and the humeral head can be felt in the axilla [18].

Classification

From the early nineteenth century, postmortem studies of bone and soft tissue disorders were conducted and new pathoanatomic and pathophysiologic classification systems emerged.

Two case reports illustrating Astley Cooper's careful studies of shoulder disorders in the early nineteenth century are presented (Appendix 2, Cases 1 and 2). In 1851, Astley Cooper distinguished three patterns of proximal humeral fractures according to the anatomic segments involved [11]: (1) extraarticular fractures (surgical neck fractures); (2) fractures through the anatomic neck and tuberosities with or without dislocation; and (3) fracture-dislocations. He further analyzed the mechanisms of injury and distinguished abduction-fractures from adduction-fractures.

The Irish physician and pathologist Robert William Smith (1807–1873) undertook numerous autopsies and collected pathologic preparations of healed fractures. In his illustrated textbook *A Treatise on Fractures in the Vicinity of Joints and on Certain Forms of Accidental and Congenital Dislocations*, from 1847 [36], he gave a thorough description of the pathoanatomic pattern of an impacted four-part fracture-dislocation of the proximal humerus (Appendix 2, Case 3).

In his illustrated *Traité des fractures et des luxations* published in 1847 [23], the French surgeon Joseph-François Malgaigne (1806–1865) gave several descriptions of complex fractures of the proximal humerus. In Figure 2, an intracapsular fracture involves the anatomic neck and both tuberosities. The tuberosities are separated from the humeral head and shaft. The diaphysis, which is in contact with the inferior part of the glenoid, is displaced superiorly and medially. The tuberosities are still connected to the periosteum but are considerably displaced outward [23].

The German physician and pioneer in brain chemistry, Johann Ludwig Wilhelm Thudichum (1829–1901), submitted a doctoral dissertation in 1851 entitled [*On the Fractures Appearing at the Upper End of the Humerus*] [37]. He proposed a comprehensive classification based on the anatomic level of the fracture lines (Table 1) half a century before the radiographic era. From a modern perspective, Thudichum's classification is anatomically

Fig. 2 A posterior view of a left shoulder with a displaced four-part fracture is shown. (Reprinted from Malgaigne JF. *Traité des fractures et des luxations*. Paris, France: JB Baillière; 1847).

Table 1. A classification of fractures of the proximal humerus

Classification
I. Anatomic neck fractures
A. Intracapsular fracture without impaction
1. Intracapsular fracture
2. Intracapsular fracture-dislocation
B. Intracapsular fracture with impaction
1. Intracapsular fracture with impaction
2. Intracapsular fracture with impaction and complicating tuberosity fracture
II. Fractures of greater tuberosity
III. Fractures of lesser tuberosity
IV. Epiphysiolysis
A. Epiphysiolysis
B. Fracture involving the epiphyseal line
V. Surgical neck fractures
A. Extracapsular fractures without impaction
1. Extracapsular fracture
2. Extracapsular fracture-dislocation
B. Extracapsular fracture with impaction

(Modified and translated from Thudichum L. *Über die am oberen Ende des Humerus vorkommende Knochenbrüche* [dissertation]. Giessen, Germany: J Ricker'sche Buchhandlung; 1851).

comprehensive but, like other nineteenth-century classifications, lacks a notion of displacement.

Reduction

In *A Dictionary of Practical Surgery* from 1818, the British surgeon Samuel Cooper (1781–1848) [12] criticized the

widely used technique of reduction recommended by the French surgeon Petit (1674–1750) [31] who placed the arm at a right angle to the body and applied extension above the elbow by an assistant. A second assistant applied counter-extension by grasping the fleshy part of the shoulder. Samuel Cooper raised three concerns with this technique: “It fatigues and even pains the patient; it lessens the extending powers by bringing them near the moveable point, it irritates such muscles as proceed from above to the lower end of the fracture, and thus increases their disposition to contract” [12].

Instead, Samuel Cooper recommended a technique proposed by Desault (1744–1796) [14] who gently extended the humerus slightly separated from the trunk with the forearm in semiflexion.

Astley Cooper revisited the ancient discussion of reduction of fracture-dislocations of the proximal humerus, which he considered incurable: “...let the surgeon do what he will, the head of the bone will probably remain in the axilla, and the upper motions of the arm will be in a considerable degree lost” [11].

Astley Cooper’s skepticism was opposed by the American surgeon Samuel Davis Gross (1805–1884). In his textbook published in 1862 [16], Gross even recommended open reduction: “...cut down upon the dislocated bone, and push it back into its natural position. The broken pieces being placed in contact, and the wound carefully closed, I should not apprehend any bad results from inflammation and its consequences” [16].

Anesthesia was induced by chloroform. The operation, however, was conducted without any antiseptic procedures, gloves, or antibiotics. Absence of infection seems unlikely, although this was not mentioned by Gross.

Bandaging

A more thorough understanding of the pathophysiology facilitated the development of functional treatments for fractures of the proximal humerus. Liston’s bandage allowed for a permanent valgus pressure (Fig. 3). The bandage was extended to the forearm and hand to prevent swelling. “Middledorpf’s triangle” (Fig. 4) fixed the upper arm in abduction, Hamilton’s adhesive plaster bandage applied permanent traction (Fig. 5) and Bardenheuer’s extension apparatus (Fig. 6) allowed for differentiated traction during the immobilization period.

In a textbook on bone and joint injuries published in 1828, the Prussian military surgeon Adolph Leopold Richter (1798–1876) [33] recommended reduction by the Hippocratic mode of extension (Fig. 1) followed by application of a spica humeri ascendens. After reduction, retention was obtained by ascending tours of a roller band

Fig. 3 In Robert Liston’s bandage, the entire arm is bandaged to prevent soft tissue swelling and a valgus pressure could be applied over the fracture. (Reprinted from Liston R. *Practical Surgery*. 2nd ed. London, England: John Churchill; 1838).

Fig. 4 Middledorpf’s triangle is illustrated. (Reprinted from Stimson LA. *A practical treatise on fractures and dislocations*. New York, NY: Lea Brothers & Co; 1899).

covering the entire shoulder. Two splints of pasteboard covered by linen then were applied: one on the inner side from the axilla to the elbow and a longer splint covering the outer side of the upper arm, the fracture, and the shoulder. The splints were secured by circular tours in both ends by a roller band. Another roller band was placed before circular tours around the chest and arm, and finally, the forearm was supported by a sling [33].

After the Dutch army surgeon Antonius Mathijssen (1805–1878) introduced the hard setting plaster of Paris bandage in 1852, plaster bandages for fractures of the

Fig. 5 Hamilton's bandage with permanent skin traction is shown. (Reprinted from Hoffa A, Grashey R. *Verbandlehre* (first published 1896). 5th ed. Munich, Germany: JF Lehmanns Verlag; 1914).

Fig. 6 Bardenheuer's apparatus for permanent traction treatment is shown. (Reprinted from Hoffa A. *Lehrbuch der Frakturen und Luxationen für Ärzte und Studierende* (first published 1888). Würzburg, Germany: Stahel; 1891).

proximal humerus were developed. Hennequin's plaster bandage (Fig. 7) used the principle of later hanging casts [9]. Other modified nineteenth-century bandages still in use

Fig. 7 Hennequin's plaster splint is shown. (Reprinted from Stimson LA. *A practical treatise on fractures and dislocations*. New York, NY: Lea Brothers & Co; 1899).

Fig. 8 Desault's bandage is shown. (Reprinted from Hoffa A, Grashey R. *Verbandlehre* (first published 1896). 5th ed. Munich, Germany: JF Lehmanns Verlag; 1914).

include the bandages proposed by Desault (Fig. 8) and Velpeau (1795–1867) (Fig. 9).

Mechanism of Displacement

Displacement was not an explicit criterion in nineteenth-century classification systems, but a differentiated treatment was offered according to the assumed degree of displacement.

Fig. 9 Velpeau's bandage is shown. (Reprinted from Hoffa A, Grashey R. *Verbandlehre* (first published 1896). 5th ed. Munich, Germany: JF Lehmanns Verlag; 1914).

In 1807, the French surgeon Alexis Boyer (1757–1833) described the muscular forces causing displacement in fractures of the proximal humerus: "...fractures of the neck of the humerus are always attended with derangement, which is produced by the action of the pectoralis major, latissimus dorsi, and teres major, which being attached to the lower portion near its superior extremity, draw it first inward and then upward, in which last direction it is powerfully aided by the biceps, coracobrachialis, and long portion of the triceps" [4].

Boyer further accounted for the rotational displacement of the humeral head, which is: "...directed a little outward by the action of the infraspinatus, supraspinatus, and teres minor, which make the head of the humerus perform a rotatory motion in the glenoidal cavity" [4].

However, from a modern perspective, Boyer did not mention the rotational displacement by the traction of the subscapularis in the lesser tuberosity.

In 1838, the British surgeon Edward Lonsdale (died 1857) gave an account of the mechanism of trauma in fractures of the anatomic neck in the elderly: "The anatomical neck is generally broken, in very old people, and a force acts more easily upon this part of the bone for two reasons; one is, that the bone itself is more brittle; a second is, that the soft parts around have wasted to a certain extent, and so do not deaden the blow so much when force is applied; a third is, that old people fall with more weight than young..." [22].

In a textbook from 1888, Albert Hoffa explained and illustrated the mechanism of displacement in fractures of the surgical neck (Fig. 10) [18]: the lower fragment is

Fig. 10 The mechanism of displacement in fractures of the surgical neck is shown. (Reprinted from Hoffa A. *Lehrbuch der Frakturen und Luxationen für Ärzte und Studierende* (first published 1888). Würzburg, Germany: Stahel; 1891).

drawn inward by the pectoralis major, teres major, and latissimus dorsi and outward by the deltoid muscle. The upper fragment is rotated by the teres minor, supraspinatus, and infraspinatus resulting in the upper fragment turning anteriorly and outward. The diaphysis is in the level of the glenoid and the tendon of biceps is loosened. Thus, the rotational displacement by the traction of the subscapularis in the lesser tuberosity also was not mentioned by Hoffa.

Discussion

During the nineteenth century, substantial progress in understanding fractures of the proximal humerus was obtained through a rational approach to understanding fractures by an appreciation of the underlying functional anatomy and subsequent pathoanatomy. I have reviewed important changes in diagnosis, classification, reduction, bandaging, and the understanding of mechanisms of displacement in fractures of the proximal humerus.

Historical reviews of this nature are subject to limitations. It may be doubted whether the written sources accurately represent the period. The recorded cases mirror learned medicine and not necessarily that practiced outside leading hospitals. Further, nineteenth-century textbooks by hospital-trained surgeons do not necessarily reflect the actual treatment of the majority of injuries. Until the early twentieth century, empirically founded manipulation and splinting were practiced by illiterate bonesetters. However, to the extent that we only have learned sources left to

posterity, we cannot safely draw definitive conclusions regarding widespread treatment of fractures. However, many of the cited authors also conducted autopsies and established collections of specimens available in the scientific literature. Some of these specimens are still available for reassessment.

New diagnostic procedures were developed over the period studied and may have facilitated a differentiated approach to shoulder injuries, especially by differentiation between fractures, dislocations, and fracture-dislocations. However, the true diagnosis of a described injury remains unknown unless pathologic specimens were obtained from autopsy and saved for posterity. Most specimens were obtained many years after the injury, and mainly healed lesions were seen, leaving studies of acute injuries to a few fatal cases.

New comprehensive pathoanatomic classifications have been developed. For example, the classification proposed by Thudichum contains most of the information found in modern classifications. By adding a notion of displacement, Thudichum's classification would come close to the Neer classification [27]. It also contains a notion of impaction, which is an important feature of the AO classification [26].

Since the era of this review, a more detailed biomechanical understanding of the mechanism of displacement and the deforming forces involved have enabled more gentle modes of reduction. This may have reduced the amount of iatrogenic damage to these fragile, elderly patients.

Functional bandaging based on pathophysiologic consideration to counter secondary displacement after reduction was developed in the nineteenth century. However, systematic recording of outcome was not practiced until the late nineteenth century. Our knowledge of outcome after bandaging relies on case reports potentially biased in favor of the author's preferences. Several non-operative treatments still in use can be traced to eighteenth- and nineteenth-century sources (Velpeau's bandage, Desault's bandage, and hanging casts).

Knowledge of the mechanisms of displacement and the deforming forces involved was remarkably advanced in the nineteenth century. The obstacles that needed to be overcome for the emergence of modern shoulder surgery were the need for radiography, antibiotics, and sterile technique, rather than the lack of advanced knowledge of pathoanatomy and pathophysiology in complex fractures of the proximal humerus.

Surgical treatment options for displaced fractures of the proximal humerus have developed dramatically in the second part of the twentieth century. Various techniques for open reduction and internal fixation have been suggested [35, 38], and joint replacement has been recommended for comminuted fractures [3, 20, 28]. However, randomized

trials are scarce, and systematic reviews [2, 17, 24] have been unable to document that surgical interventions produce better long-term outcomes than nonsurgical treatments. A couple of randomized trials of displaced fractures of the proximal humerus including a nonsurgical treatment arm are recruiting [7, 13]. Assessment of the benefits and harms of the nonsurgical managements proposed by our predecessors cannot be justified until well-conducted clinical trials of surgical versus nonsurgical treatment modalities are published in the scientific literature.

Appendix 1

Weblinks to Texts (Digitalized by Google™)

Boyer A. *Traité complet d'anatomie, ou description de toutes les parties de corps humain*. Paris, France: Chez l'auteur et Migneret; 1805.

http://books.google.com/books?id=IgtbAAAAQAAJ&pg=PA451&dq=boyer+trait%C3%A9+complet+parties+corps+1805&hl=da&source=gbs_selected_pages&cad=3#v=onepage&q=&f=false

Boyer A. *The lectures of Boyer, upon diseases of the bones: arranged into a systematic treatise by A. Richerand*. Farrell M, trans. London, England: John Callow; 1807.

<http://books.google.com/books?id=nXlrzmiyhjEC&pg=PR3&dq=boyer+lectures+1807&hl=da&cd=1#v=onepage&q=&f=false>

Cooper A. On the dislocation of the os humeri upon the dorsum scapulae, and upon fractures near the shoulder-joint. *Guy's Hospital Reports*. 1839;IV:265–284.

http://books.google.com/books?id=upEBAAAAYAAJ&printsec=frontcover&hl=da&source=gbs_v2_summary_r&cad=0#v=onepage&q=&f=false

Cooper A. *A treatise on fractures and dislocations of the joints*. Philadelphia, PA: Blanchard and Lea; 1851.

http://books.google.com/books?id=EK99doHVVY_AC&printsec=frontcover&dq=astley+cooper&lr=&hl=da&cd=2#v=onepage&q=&f=false

Cooper S. *A dictionary of practical surgery*. London, England: John Murray; 1818.

http://books.google.com/books?id=p_c6AAAacAAJ&printsec=frontcover&dq=samuel+cooper+practical+surgery&hl=da&cd=4#v=onepage&q=&f=false

Dorsey JS. *Elements of surgery for the use of students with plates*. Philadelphia, PA: Edward Parker and Kimber and Conrad; 1813.

http://books.google.dk/books?id=wFsSAAAAYAAJ&dq=dorsey+john+syng+elements+surgery&source=gbs_navlinks_s

Gross SD. *A system of surgery: pathological, diagnostic, therapeutic and operative*. 2nd ed. Philadelphia, PA: Blanchard and Lea; 1862.

http://books.google.com/books?id=Y5DrdHUBrK0C&printsec=frontcover&hl=da&source=gbs_v2_summary_r&cad=0#v=onepage&q=&f=false

Hamilton FH. *A practical treatise on fractures and dislocations*. 3rd ed. Philadelphia, PA: Henry C Lea; 1866.

<http://books.google.com/books?id=5mXC9gfvO7YC&printsec=frontcover&dq=Frank+Hastings+Hamilton&hl=da&cd=1#v=onepage&q=&f=false>

Liston R. *Practical surgery*. London, England: John Churchill; 1848.

<http://books.google.com/books?id=dgYTAAAYAAJ&printsec=frontcover&dq=practical+surgery+liston&hl=da&cd=1#v=onepage&q=&f=false>

Malgaigne JF. *Traité des fractures et des luxations*. Paris, France: JB Baillière; 1847

http://books.google.com/books?id=MFNtibWCgHEC&printsec=frontcover&hl=da&source=gbs_v2_summary_r&cad=0#v=onepage&q=&f=false

Smith RW. *A treatise on fractures in the vicinity of joints and on certain forms of accidental and congenital dislocations*. Dublin, Ireland: Hodges & Smith; 1850.

<http://books.google.com/books?id=DjgAAAAQAAJ&printsec=frontcover&dq=editions:0Eo3MtVxh5sCO2jA&hl=da#v=onepage&q=&f=false>

Appendix 2

Case Report 1

“William Mills, aged 72, fell down during the severe frost upon his shoulder, three days after which he was admitted into Guy’s Hospital. The arm and shoulder were much swollen, there was also acute pain and discoloration of the integuments; crepitus could not be felt, at from the degree of swelling, it was impossible to ascertain the precise nature of the accident. Leeches and evaporating lotions were applied. The shoulder was again examined on the second day, after the swelling had somewhat subsided, and a fracture of the neck of the humerus was discovered. The pain and swelling again became greater, and gradually increased, the integuments inflamed, having the appearance of erysipelas; the skin became discolored and gangrenous. He was feverish and irritable, then delirious, and gradually sunk on the tenth day from the accident.

Appearance found on dissection - The integuments and cellular membrane, on the inner part of the shoulder over

the clavicle, were considerably thickened, having a sloughy appearance; and on cutting through the deltoid muscle, a large quantity of blood matter mixed with serum was effused. The capsular ligament was extensively lacerated, the humerus was fractured through the cervix, also obliquely through the head, and a small spicula of bone was separated from the cervix” [11].

Case Report 2

“I examined the body of Mr. Hollingsworth, who died of stricture of the urethra, and diseased bladder and kidneys. When these parts had been traced, to see the changes which they had undergone, I said to the surgeon who attended him with me, “Had he any accident, or other disease, to your knowledge?” and he answered: “Why, he once broke the neck of his scapula, for which I attended him; and he never recovered the use of his arm.” Upon looking at his shoulder, I found it sunken, and altered in shape; and I observed that I thought I had seen the accident in living patients, but I never had an opportunity of observing the morbid appearances of the dead; and therefore; I said, “We must not neglect to look into this accident, and to add the fractured parts, as a preparation, to my Collection.” Upon inspecting the shoulder-joint, I found the neck of the scapula uninjured; but the head of the os humeri was dislocated into the axilla, and broken from the shaft; and it remained upon the inner side of the inferior costa of the scapula, to which it was firmly united. The tubercles of the neck of the os humeri were broken off with the head of the bone; and the fractured extremity of the head of the os humeri was placed in the glenoid cavity of the scapula. The underhand motions of the shoulder were restored; but the elevation of the bone, beyond a right angle, was strongly resisted, and even with difficulty could be accomplished in the dead body” [11].

Case Report 3

“In the year 1843, I laid before the Pathological Society of Dublin a very remarkable specimen of impacted fracture of the neck of the humerus, accompanied by fracture of both tubercles. It was removed from the body of a woman, aged 40, who, many years previous to her death, had fallen down a flight of stairs and struck her shoulder with great violence against the edge of one of the steps, but it could not be ascertained whether she had applied for surgical assistance or not, at the time of the occurrence of the accident. For the opportunity of examining the specimen I am indebted to Doctor Kirkpatrick, surgeon to the North Union Workhouse in this city.

The external characters of the injury resembled those of luxation into the axilla, the acromion process being unnaturally prominent, and the region of the deltoid muscle flattened; but the arm was shortened, the glenoid cavity could not be felt, and the shaft of the humerus was drawn upwards and inwards, so as to be almost in contact with the coracoid process; the motions of the joint were extremely limited, and the scapular muscles atrophied.

When the soft parts were removed, and the capsular ligament opened, the head of the bone was found to have been separated from the shaft by a fracture, which traversed the anatomical neck of the humerus. It was reversed in the articulation, so that the fractured surface was directed upwards towards the glenoid cavity, and the cartilaginous articulating surface thrown downwards towards the shaft, and having assumed this position, it was driven to a considerable distance into the cancellated structure between the tubercles.

From this violent impaction of the head of the bone into the lower fragment, a second fracture resulted, which split off the lesser tubercle, along with about two-thirds of the greater, and a small portion of the shaft of the humerus, corresponding to the upper part of the bicipital groove" [36].

An anterior view of a right shoulder with a fracture of the anatomic neck with rotational displacement of the humeral head is illustrated. (Reprinted from Smith RW. *A treatise on fractures in the vicinity of joints and on certain forms of accidental and congenital dislocations*. Dublin, Ireland: Hodges & Smith; 1847.)

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