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## FOREWORD



Jan Bartoníček and his colleagues have taken a lifetime of scholarship and surgical experience to produce a truly unique and comprehensive textbook related to injuries of both the adult and pediatric scapula. Twenty-two chapters start with a fascinating review of the history of scapula fractures. Throughout the book, the text is enhanced with reproductions of anatomical specimens prepared by the authors of the textbook at the Institute of Anatomy of the 1<sup>st</sup> Faculty of Medicine of Charles University in Prague. The text exposes the reader to contemporary information regarding anatomy, radiologic evaluation, clinical examination, and classifications. An informative chapter presents to the reader the authors' own classification based upon CT radiology. Each chapter is extraordinarily supported by clear clinical and artistic presentations of the specific structural injury to the scapula.

Each chapter devoted to injuries related to specific anatomic regions of the scapula perhaps may be the most exciting aspects of the text for the clinician. Covering anatomical fracture patterns, surgical exposures, methods of internal fixation, pitfalls and pearls, a vast array of clinical examples inclusive of preoperative, intraoperative, and postoperative x-rays and clinical function serve as excellent guidance to the surgeon faced with similar traumatic fracture patterns.

The text expands further to cover injuries to the shoulder girdle and proximal humerus as well as scapulothoracic dissociation and finally injuries to the growing scapula.

This is truly the most comprehensive textbook on the subject expanding on the documentation of over 500 scapula fractures seen and treated by the author and colleagues with over 900 references, the oldest dating back to 1579.

On a personal note, I am honored to be asked to provide this foreword as I have come to know Jan Bartoníček and observed first hand his clinical acumen. What also remains a unique interest of his is the history of orthopedics, contributing a number of clinical publications on this most interesting aspect of our specialty.

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# HISTORY OF SCAPULAR FRACTURE TREATMENT

Long-term efforts, sometimes supported by happy coincidence, have allowed a detailed mapping of the history of scapular fractures, starting from the prehistoric period [6, 8]. At the same time, the resulting concept is, in the future, open to accommodate additional pieces to be added to the current mosaic.

## THE TERM “SCAPULA”

According to Hyrtl [83], in the ancient world the term *Scapulae* (plural of *Scapula*) denoted the back of the body. The scapula was referred to as *Os latum scapularum* (e.g., by Aristotle and Galen). Celsus mentions that the Romans also used the term *Scutulum opertum*, or exceptionally *Palla* (Caelius Aurelianus).

The medieval world did not know the term scapula, either, most often using *Spathula* or *Scoptula* instead. **Andreas Vesalius (1514-1564)** was the first to describe this bone in great detail (Fig. 1-1), and he introduced the term *Scapula*, used ever since [177].

## PREHISTORIC PERIOD

Probably the oldest scapular fracture, from 250 million years ago, was described by Chinese authors in a study of the fossilized remains of a dinosaur, *Yangchuanosaurus hepingensis*. Based on their analysis, they hypothesized that the injury was caused by a fight with another dinosaur, *Mamenchisaurus hochuanensis* [186].



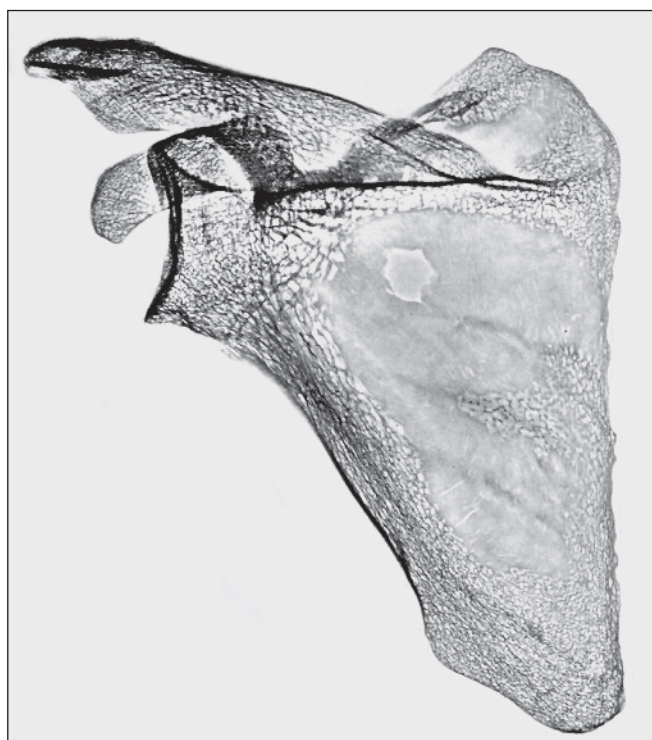
**Fig. 1-1** Illustration of a scapula in the textbook of anatomy by Vesalius. Reprinted from [177].

The first hominid known to suffer a scapular injury was “Lucy” from the *Australopithecus afarensis* species. Her skeleton, discovered in Ethiopia in 1974, showed a number of injuries, including an extraarticular fracture of the right scapula [92].

In humans, the oldest known scapular fractures date back to the prehistoric and early historic times [185].

Ötzi, the Iceman, who lived about 3300-3100 B.C., died most likely due to an arrow that hit him in his left scapula [181]. In 1909, Baudouin [12] described a scapular fracture in an individual found in a neolithic grave, who had sustained a fracture of the surgical neck combined with a coracoid fracture. Bilateral scapular fractures suggest physical punishment, or torture, as the cause of injury [14].

A fracture of the acromion was described in the treatises of **Hippocrates** [64, 145]. However, the medical literature only began to deal with scapular fractures in greater detail as late as at the onset of the Modern Age.



**Fig. 1-2** Radiograph of the right scapula of John of Luxembourg, penetrated by an arrow. Archives of Professor E. Vlček, MD, DSc.

**SCAPULAR INJURIES IDENTIFIED IN MEMBERS OF THE LUXEMBOURG DYNASTY 1296-1378**

Anthropological research of members of the House of Luxembourg, namely *John of Luxembourg (1296-1346)* and his son *Charles IV (1316-1378, Roman Emperor and King of Bohemia)*, conducted by Emanuel Vlček in the 1970s and 1980s, revealed, among other things, a scapular injury in each of them [9, 178]. John of Luxembourg sustained it at the battle of Crécy (France, 26 August 1346). In his case, the injury was fatal when one of the arrows shot by the English longbow archers penetrated through the right scapula into the chest (Fig. 1-2).

In Charles IV, a fracture of the glenoid fossa of the right scapula was detected during review of Vlček’s original documentation by one of the authors [9]. Avulsion of the antero-inferior rim of the glenoid fossa, as in this case, often results from anterior dislocation of the glenohumeral joint. In the case of Charles IV, the fragment healed in displacement, with consequent enlargement of the glenoid fossa (Fig. 1-3).

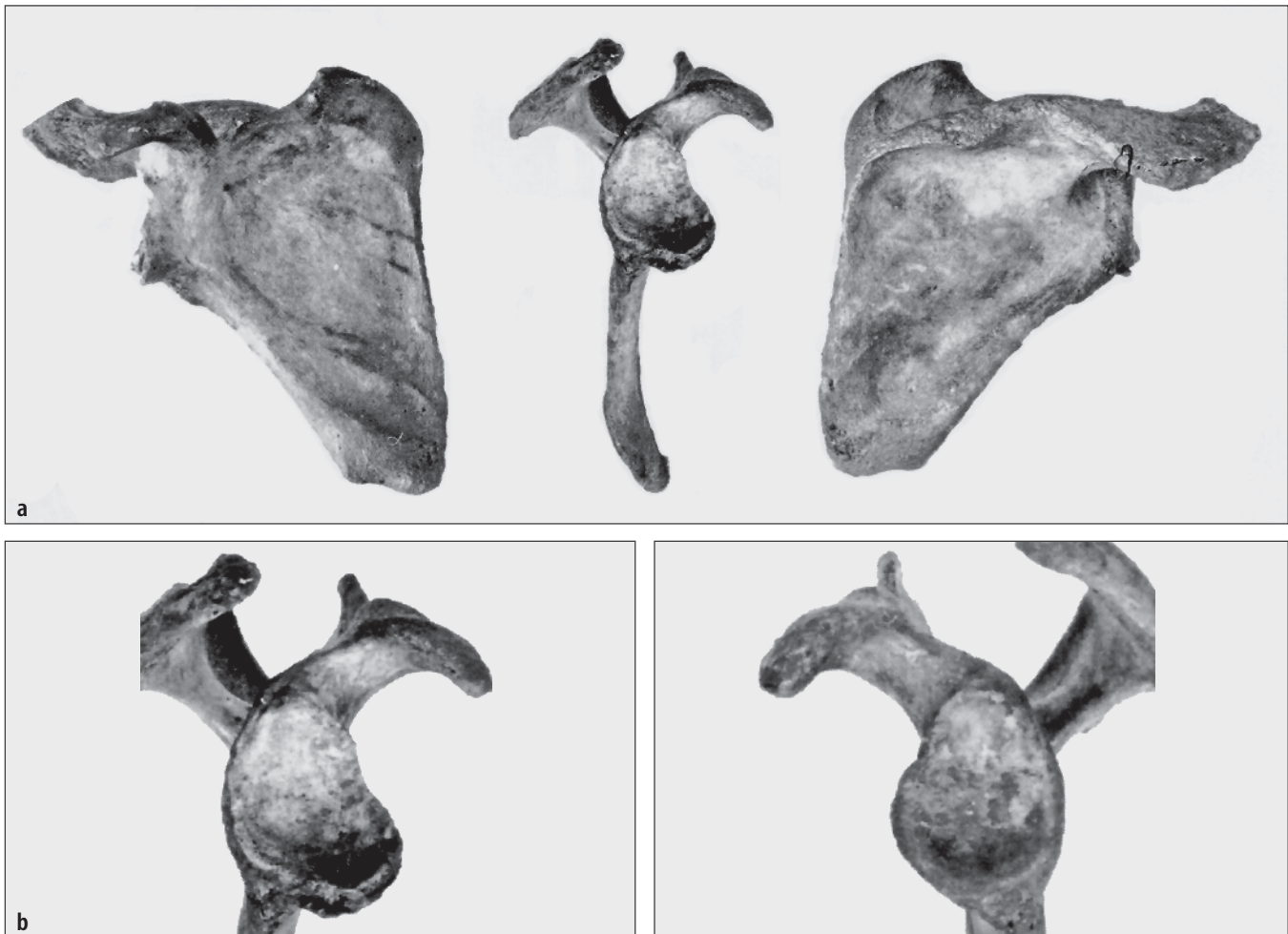
The exact date of this trauma is not known. It may have happened during the first battle he joined, the battle of San Felice (Italy) on 25 November 1332, where he suffered an un-

specified injury to the shoulder, or later, at the battle of Crécy in 1346, where his father died as described above. In any case, the two Luxembourgers are, so far, the oldest known historical personalities with documented injuries to the scapula.

**FRENCH PERIOD 1579-1798**

In the Modern Age, the first mentions of scapular fractures may be traced in the works of outstanding French surgeons of 16<sup>th</sup> to 18<sup>th</sup> centuries.

The oldest description of a fractured scapula, caused probably by a war injury, was presented by **Ambroise Paré (1510-1590)** in 1579 [138]. Paré, the personal physician to four French kings [140], stated “...in case of fracture, if the parts move and prick the flesh, an incision should be made to remove them with a “*bec de corbin*” (a special device named “crow’s beak”). But if the pieces of bone do not prick the flesh and are still attached to the periosteum, they do not need to be removed since they will heal. If they are completely free from periosteum, they have to be removed because anyway they will be ultimately forced out, since they do not live anymore,



**Fig. 1-3 a)** The right scapula of Charles IV. Anterior, lateral and posterior views. Archives of Professor E. Vlček, MD, DSc.; **b)** Comparison of both glenoids shows enlargement of the glenoid fossa of the right scapula anteroinferiorly. Reprinted from [9].

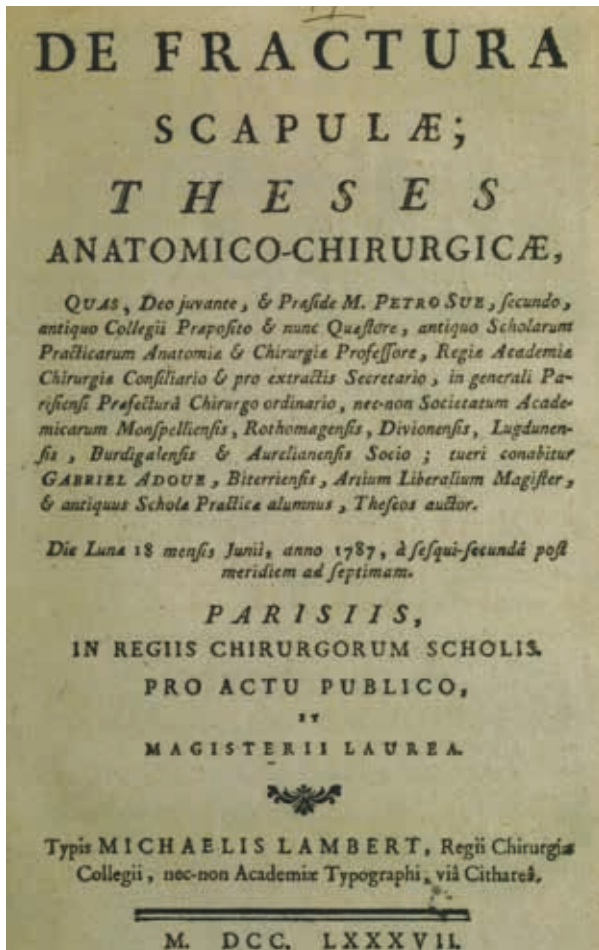


Fig. 1-4 Title page of the Adoue's dissertation thesis of 1787 [3].

and, as stated by Hippocrates, 'the living will always oust the dead'. When the fracture involves the neck of the scapula the prognosis is almost always fatal, as was also the case of some famous people, for instance the King of Navarre".

**Jean-Louis Petit (1674-1760)**, an extraordinary French surgeon, dealt in detail with scapular fractures in his work "*Traité des maladies des os*" [142] published in 1723, distinguishing between fractures of the body, the neck and the processes (acromion, coracoid, spine) of the scapula. He subdivided fractures of the scapular body into transverse, oblique, or longitudinal ones. He provided the first recorded description of subcutaneous emphysema associated with scapular fractures, and also discussed the possibility of fracture of the glenoid rim associated with dislocation of the humeral head. For fixation of scapular fractures he used a bandage of his own design.

**Joseph-Guichard Duverney (1648-1730)**, a French anatomist and surgeon, preceded Petit, [141] but his works under a similar title "*Traité des maladies des os*" were published by his pupils only after his death in 1751 [42]. He used the same classification of scapular fractures as Petit. He was also the first author to describe a fracture of the scapular neck, revealed by autopsy, in a 20-year-old woman.

**Josias Weitbrecht (1702-1747)**, a member of the St Petersburg Academy, published in 1742 in St Petersburg a textbook

"*Syndesmologia*", an outstanding work where he laid foundations of the anatomy of joints, including descriptions of the articular and ligamentous connections on the scapula [182].

**Gabriel Adoue** [3] published in 1787 probably in Paris, a short (11-page), but a very interesting, treatise on scapular fractures "*De fractura scapulae*", divided into the anatomical and surgical parts (Fig. 1-4). The author describes the various mechanisms of injuries to individual parts of the scapula, including stab and gunshot wounds, and discusses displacement of various fracture patterns. He mentions emphysema in the wound and abscesses associated with stab wounds that required drainage. In gunshot wounds he recommends removal of fragments by a scalpel. He also deals with reduction maneuvers and sequelae of certain fractures (acromion).

Posthumous works "*Œuvres chirurgicales*" of another prominent French surgeon, **Pierre-Joseph Desault (1738-1795)**, edited by his pupil **Marie Francois Xavier Bichat (1771-1802)** and published in 1798, marked a watershed in the development of surgery at the turn of the 19<sup>th</sup> century [37]. Desault, the founder of the first surgical journal in the world, described, on the basis of case reports, fracture of acromion and fracture of the inferior angle of the scapula. His text contained also an original drawing of the Desault bandage designed by him for fixation of fractures of the clavicle and scapula. The book was promptly translated into English and published in the United States in 1805 [38].

## OUTSTANDING DISSERTATION THESES AND TEXTBOOKS OF SURGERY OF 19<sup>th</sup> CENTURY

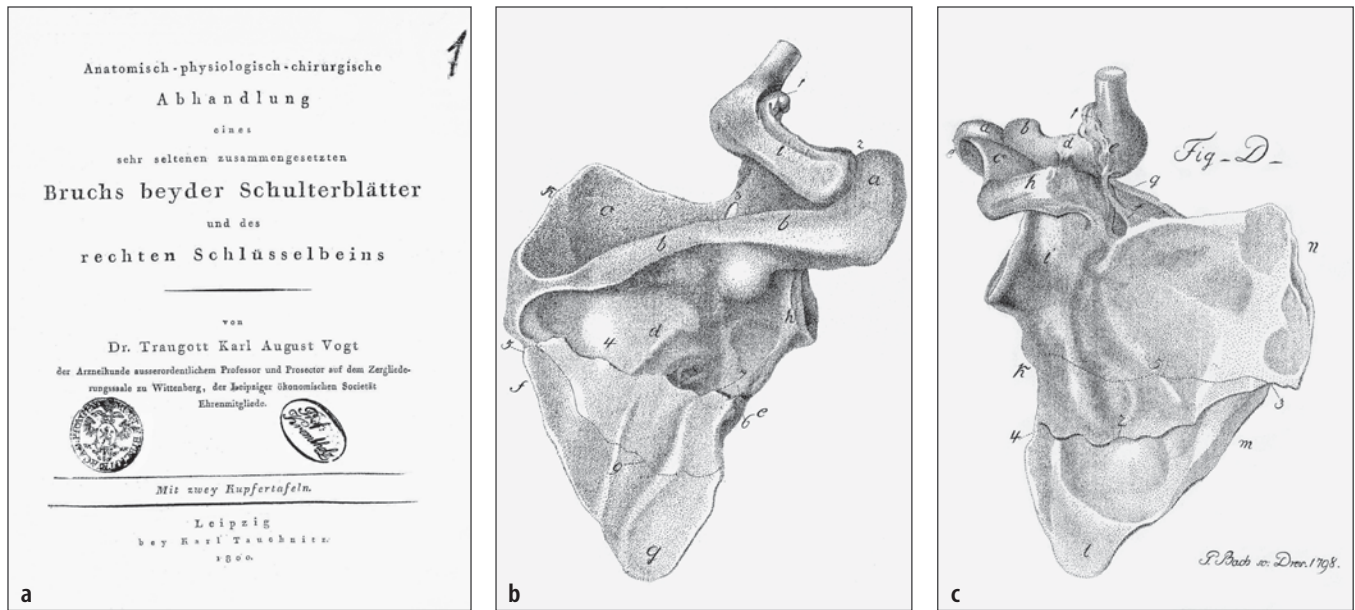
Publications dating back to this period were based, for the most part, on detailed descriptions of individual cases, starting with the mechanism of the trauma and the clinical course, up to the patient's death, with a special focus on autopsy findings. The most frequently discussed were fractures of the acromion, the scapular spine and the coracoid, mainly because of their ease of palpation. The published cases, based on clinical examination only, albeit quite detailed, could not be considered to be unambiguously proven fractures of the scapula. Scapular fractures were treated almost exclusively non-operatively at that period and discussions concentrated only on how and in what position the injured extremity should be immobilized.

The first study devoted solely to scapular fractures was published by **Traugott Karl August Vogt (1762-1807)** in 1799 [179] and 1800 [180]. The study, containing a precise anatomical description of the scapula, its muscles, blood vessels and nerves, was based on the case of bilateral fractures of the scapular body, associated on the right side with a fracture of the clavicle. These fractures are documented by original drawings (Fig. 1-5).

An excellent description of the clinical examination of scapular fractures may be found in the textbook by the German surgeon, **Johann Erdwin Christoph Ebermaier (1769-1825)**, published in 1802 [43].

In 1814, **Giovanni Battista Monteggia (1762-1815)** published a monumental eight-volume work "*Istituzioni*





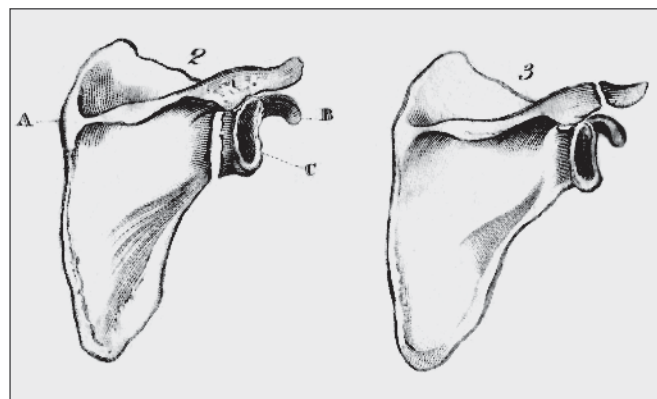
**Fig. 1-5** Vogt's dissertation thesis of 1800 [180]. **a)** title page; **b)** fracture of the infraspinous part of the scapular body, associated with a clavicular fracture, posterior view; **c)** the same fracture, anterior view.

*chirurgische*", of which quite a large part was devoted to scapular fractures [122]. He distinguished between fractures of the body, the acromion and the coracoid process. Fractures of the body he subdivided into transverse fractures, and fractures of the superior, inferior, or lateral angle. He also discussed the possibility of fracture of the glenoid fossa.

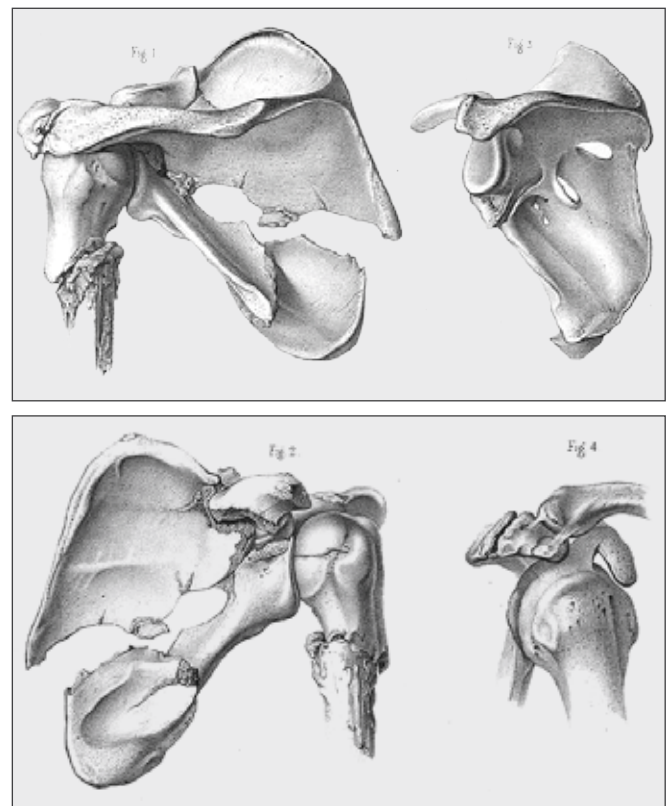
**Astley Paton Cooper (1768-1841)**, in his famous textbook *"Treatise on Dislocations and on Fractures of the Joints"*, published in 1822, described fractures of the acromion and a case of a fracture of the surgical neck of the scapula in a young woman after a fall from the horse [27]. The text was supplemented by the first-known illustration of a fracture of the surgical neck and a fracture of the acromion (**Fig. 1-6**).

**Adolph Leopold Richter (1798-1876)** dealt in great detail with scapular fractures in his *"Handbuch der Lehre von der Brüchen und Verrenkungen der Knochen"*, published in 1828 [148]. He presented two basic groups of these fractures,

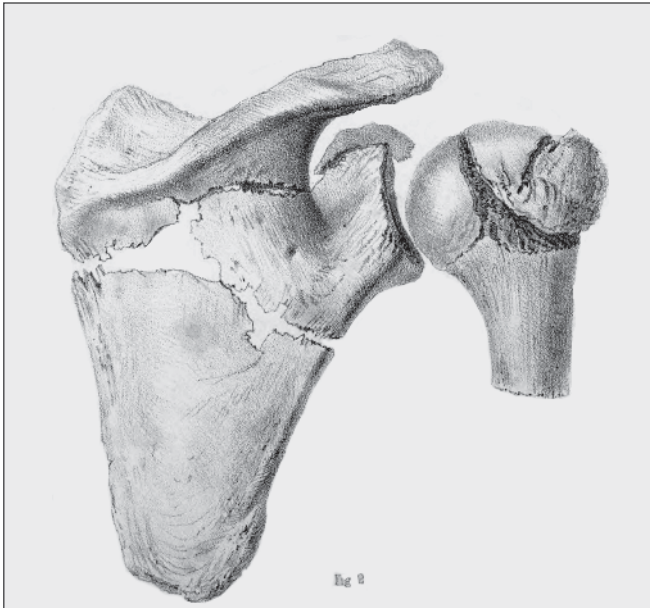
namely, fractures of the scapular body and fractures of the processes. Fractures of the scapular body were further subdivided into longitudinal fractures, supraspinous fractures, infraspinous fractures and fractures of the scapular spine. In



**Fig. 1-6** Drawings of surgical neck and acromion fractures in the Cooper's textbook of 1822 [27].



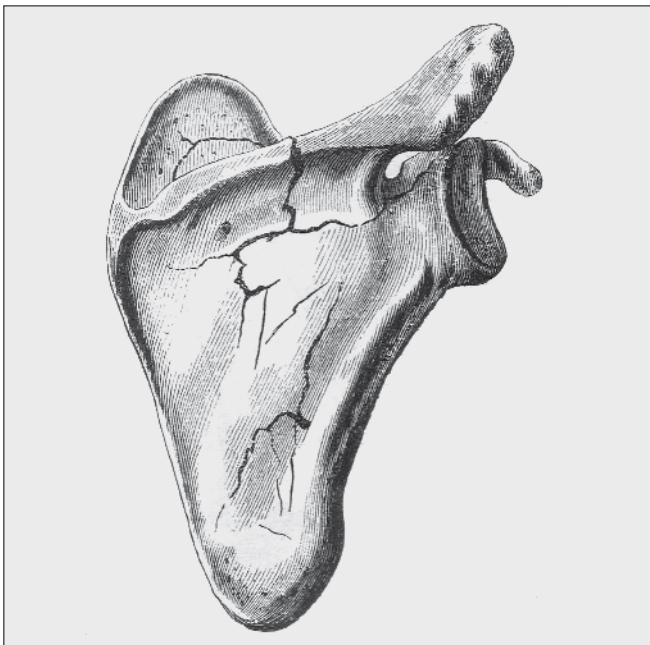
**Fig. 1-7** Drawings of scapular fractures in the Malgaigne's atlas of 1855 [114]. Drawing of a comminuted fracture of the scapular body and glenoid (**Figs. 1 and 2**), a healed scapular body fracture (**Fig. 3**) and acromial fracture (**Fig. 4**).



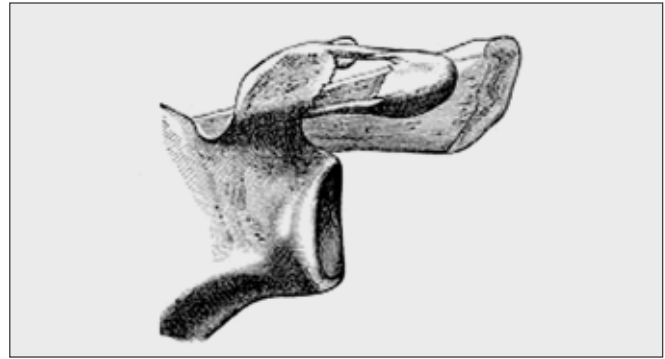
**Fig. 1-8** Drawing of a fracture of the scapular body and proximal humerus in the Callaway's dissertation thesis of 1849 [21].

the group of fractures of the scapular processes he included fractures of the acromion, of the coracoid process, of the neck (the surgical neck according to the description) and fractures of the glenoid fossa. Quite interesting is his mention of frequent injuries of the lungs associated with scapular fractures.

**Robert Adams (1791-1875)** in "*Cyclopaedia*", published in 1847-49, described three types of scapular fractures – the fractures of the acromion, of the coracoid process and of the scapular neck [1].



**Fig. 1-10** Drawing of a scapular body fracture in the Gurtl's "*Handbuch der Lehre von den Knochenbrüchen*" of 1864 [66].

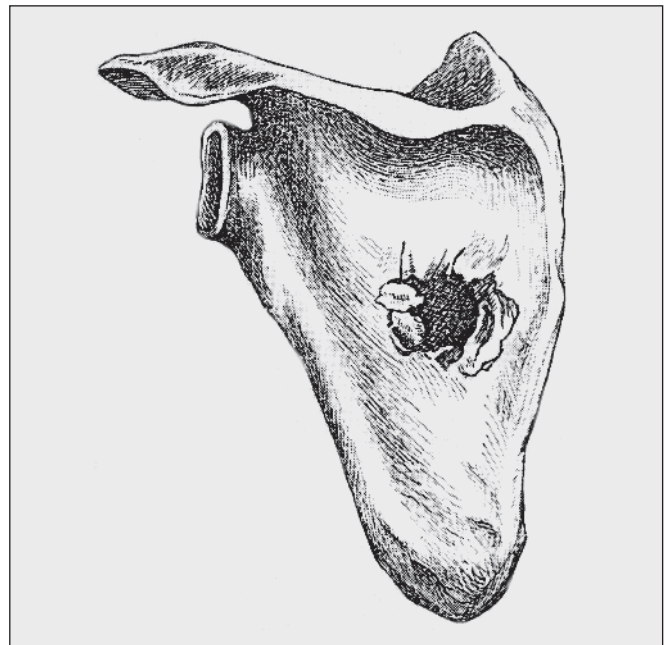


**Fig. 1-9** Drawing of a coracoid fracture from the Gross' textbook "*A system of surgery*" of 1859 [63].

In 1847, **Joseph François Malgaigne (1806-1865)** published "*Traité des fractures et des luxations*" [113], accompanied by a number of beautiful lithographs that were published in 1855 in the form of a comprehensive atlas [114]. Malgaigne recognized fractures of the body of the scapula, fractures of the acromion and fractures of the coracoid process. Fractures of the glenoid fossa are not specifically mentioned there, although such a fracture can be seen in one of his drawings (Fig. 1-7).

**Thomas Callaway (1822-1869)** published, in 1849, "*A dissertation upon dislocation and fractures of the clavicle and shoulder-joint*", in which he presented 18 cases of scapular fractures, including 8 fractures of the body, 8 fractures of the acromion and 2 fractures of the scapular neck [21] (Fig. 1-8).

**Samuel David Gross (1805-1884)**, an outstanding American surgeon, in his 1859 textbook "*A system of surgery*", presented and discussed a number of scapular fractures, including coracoid fractures [63] (Fig. 1-9).



**Fig. 1-11** Drawing of a stab wound to the scapula in the Hoffa's textbook "*Lehrbuch der Frakturen und Luxationen*" of 1888 [79].

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