Journal of the British Islamic Medical Association

History

Vol 10 - No. 4 | April 2022 | www.jbima.com

Bone Fractures in ibn-Sina Medicine

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Keywords: *Ibn Sina, Avicenna, al-Qanun fit-Tib, History of Trauma*

Abstract

Ibn Sina, or Avicenna as he is known in the west, was a well-known Islamic philosopher and physician. He composed 276 works, the most famous of which is "al-Qanun fit-Tibb." This paper highlights the bone fractures that may occur, described in ibn Sina's book "al-Qanun," and reveals his accomplishments and contributions to this field of medicine, especially in what is called now the Theory of Delayed Splintage.

Introduction:

Ibn-Sina, or Avicenna as known in the west, was born in the year 980 A. D. in Afshana near Bukhara in Turkistan, which is now called Uzbekistan. He left Bukhara when he was 21 years of age and spent the rest of his life in various towns in Persia.

When he died in the year 1037, he was known as one of the greatest philosophers in Islam, and in Medicine he was so highly regarded that he was compared to Galen, so he was known as the Galen of Islam. Because of his great celebrity, many nations disputed and competed to celebrate his anniversary.

The Turks were the first who revived his anniversary in 1937, when they held a great meeting for the occasion of nine hundred years after his death. Then Arabs and Iranians followed them by holding two festivals in Baghdad in 1952, then in Tehran in 1954. To appreciate his contribution in developing the philosophical and medical sciences, in 1978 UNESCO invited all its members to celebrate the anniversary of one thousand years since his birth. All the members participated in the celebration, which was held in 1980.

Ibn-Sina composed 276 works: all of them written in Arabic except very few small books written in his mother tongue Persian. Unfortunately, most of these works were lost, but there are still 68 books or treatises available in the eastern and western libraries.
He composed in all branches of science, but he was more interested in philosophy and medicine. Some recent historians consider him more a philosopher than a physician, but others consider him to be a prince of the physicians during the Middle Ages.

The classification of ibn-Sina's works according to their content is as follows:
43 works in medicine, 24 in philosophy, 26 in physics, 31 in theology, 23 in psychology, 15 in mathematics, 22 in logic and 5 in the interpretation of the Holy Koran. In addition, he published many treatises in asceticism, love, music, and some stories too.

Al-Qanun fit-Tibb

Al-Qanun fit Tibb (or Code of Laws in Medicine) represents the most important work of Ibn-Sina, which is written in Arabic, and as William Osler described it, the most famous medical textbook ever written [(1)]. This book is considered a unique reference or document containing all medical knowledge, as it accumulated through many civilizations until the time of Ibn-Sina himself.

In his way of explanation, ibn-Sina was very close to the

way which modern medical textbooks follow regarding classification, causes of diseases, epidemiology, symptoms and signs, treatment, and prognosis. In this respect we can say that the excellence in its arrangement and comprehensiveness made al-Qanun book the most widespread in the Islamic and European countries.

Al-Qanun book was known to the Europeans through the Latin translations of Gerard of Cremona, in the 15th century, and remained in use in medical schools at Louvain and Montpellier until the 17th century. According to the Journal of UNESCO, October issue, 1980, Al-Qanun remained in use in Brussels University until 1909.

By the 12th century, awareness set in that these compendia were too large to be really useful for ready reference. Consequently, epitomes of al-Qanun were produced to make the ideas more quickly accessible, and commentaries were written to clarify the contents. The most popular of all the epitome of al-Qanun was that called Kitab al-Mujaz fil Tibb or the Concise Book in Medicine. It was written in Syria by ibn-al-Nafis, who died in 1288.

Ibn-Sina begins his book al-Qanun by defining medicine and saying: Medicine is a science, from which one learns the states of the human body, with respect to what is healthy and what is not, in order to preserve good health when it exists, and restore it when it is lacking.

The Al-Qanun book consists of five books, the first concerned with general medical principles. The second with materiamedica.The third with diseases occurring in a particular part of the body. The fourth on diseases not specific to one bodily part (such as fevers), in addition, to traumatic injuries such as fractures and dislocations of bones and joints.With the final book containing a formula giving recipes for compound remedies.

Ibn-Sina devoted two treatises in the fourth book of al-Qanun, to fractures. The first treatise is entitled: “Fractures as a Whole”, and the second is “Fractures of Every Bone Separately”.

In the first treatise, he described the causes, types, forms, methods of treatment, and complications of fractures. While in the second treatise, he determined the special characteristics of fractures of each bone. Ibn Sina, by this way of explanations, was very close to following the format of modern medical textbooks.

The first treatise: Fractures as a Whole

Ibn Sina defined a fracture as a loss of continuation in the bone [2]. Then, he determined the types of fractures such as transverse, longitudinal, or comminuted. When he talked about symptoms and signs of a fracture, he considered the pain, swelling, and deformity of the limb to be of great importance to the diagnosis.

In this chapter, Ibn-Sina distinguishes the fractures that reach the joint line. He says: “If the fracture was at the joint line and healed, the movement of the joint could be difficult as the rigidity of the callus needs more time to become soft,” [3]. It is well known now that fractures that occupy the joint line, cause stiffness of that joint after they heal, unless convenient physiotherapy is applied to the limb.

Factors that stimulate and inhibit bone healing

Ibn Sina mentions that fractures of children heal more rapidly than those of adults. He determined the time span necessary for bone to heal.

He said, for example, a nose bone fracture needs 10 days to heal, a rib needs 20 days, a forearm needs 30 to 40 days, and a femur needs 50 to 120 days. It is clear that these figures are similar to those written in modern medical textbooks.

At the end of the chapter, he pointed out the factors that negatively affecr bone healing, such as the lack of a splint at the site of the fracture, quickness in moving the affected limb, loss of blood (anemia), and the existence of a disease in the body [4]. These factors, and others, are now considered to have a considerable role in delaying bone healing.

Principles of splinting the bone

In this chapter, Ibn Sina talked about treating a bone fracture by splinting it. He warned the physician against over-tightening the affected limb, which could cause gangrene.

In respect to what is now called an open fracture, he pointed out the importance of taking care of the wound more than the fracture. If the fracture was complicated by hematoma formation, Ibn Sina advises the bone setter to make an incision at the site of swelling to allow the blood to get out.

In this chapter, Ibn Sina also focuses on a very important issue in the treatment of comminuted fractures. He said if the fracture is associated with a sequestrum, and is painful, it has to be mended and reduced into its position. If this is impossible, the sequestrum has to be excised using a thin saw or by drilling many holes at the base. Whatever the method, the physician has to be very careful not to injure an important structure. Sometimes the sequestrum is not visible; remarking the discharge from the wound can identify its position. In such cases, the wound must be enlarged to allow the removal of sequestrum [5].

Recommendations to the bone setter

Before treating any fracture, Ibn Sina advised that the physician should inspect and examine the fracture accurately and splint it quickly, because fracture reduction will be more difficult, and complications may develop if there is a delay.

At the same time, Ibn Sina drew attention to the necessity of not splinting the fracture immediately. He advised postponing it beyond the fifth day or more, until the swelling disappears. This is now called the Theory of Delayed Splintage, and Professor George Perkins is considered the pioneer of this theory today [6].

Fractures associated with a wound (open fractures)

In this chapter, Ibn Sina talked about treating fractures associated with a wound. He stressed the necessity of not applying a splint to the wound; ointment should be put on first, then the wound may be covered by a special dressing that would let out the wound discharges and allow the physician to apply medicine.

This method of treating open fractures as described by ibn-Sina is similar, in many aspects, to that used today, except the use of antiseptic procedures during the course of treatment.

Mal-union fractures

What ibn-Sina meant by mal-union fracture was a fracture that is joined in a non-suitable position, allowing the limb to become deformed. To treat this case, he suggested breaking the bone again at the site of old fracture and splinting it properly. If the callus is hard, this method should be avoided, otherwise a fracture may occur elsewhere. In such cases, ibn-Sina advised the bone setter to apply a material that softens the callus until the limb can be splinted in the correct position.

Today, all types of mal-union are treated surgically.

The second treatise: Fractures of every bone separately

Skull fractures

Ibn Sina clarified that a skull fracture may happen even if the skin above it is still intact. In such cases, a hematoma may develop under the skin. The physician should not omit fracture treatment because this may lead to bone decay. The patient may complain of tremors and mind loss. In such cases, ibn Sina advised the operator to make an incision at the site of fracture to treat it. Next, he described the signs of skull fracture such as unconsciousness, dizziness, and speech loss.

At the end of this chapter, ibn Sina said: “If the fracture is severely comminuted it should be completely excised, but if is linear and distended you should not widen the incision, as no damage could result from the fracture.” [7]

Mandible fractures

The method Ibn Sina described for treating these fractures resembles what is used today, except in some modern special surgical techniques. In this respect, he said that if the fracture is in the right side and displaced internally, the physician must insert his left index and middle fingers into the patient’s mouth to elevate the fracture edge outward. The complete reduction could be identified by a good occlusion of teeth.

If the fracture is comminuted or associated with a wound, ibn Sina said to make an incision at the fracture site and remove any sequestrum that may be present.

He advises the physician to suture the teeth using a gold wire in order to stabilize the correct position of the mandible. The patient is asked to remain at rest and avoid speaking. His diet should be liquids. The mandibular bone needs three weeks to heal; it is filled with bone marrow.

Nose-bone fractures

Ibn Sina stated that a delay in treating a nose-bone fracture may lead to tilting of this bone, and anosmia may develop. So, he insisted on treating this fracture during the first 10 days. If the fracture is comminuted, and the reduction is impossible, the bone setter should incise the skin and remove all the comminuted bone.

Clavicle fracture

Ibn Sina's treatment of clavicle fractures is extremely different from those known today. He considered clavicle fractures difficult to splint. He described a long method to achieve a complete reduction. Today, this fracture is considered easy to treat, and complete reduction is not required to achieve healing.

Shoulder fractures (fracture of scapula)

Ibn Sina said: "The shoulder is rarely fractured in its broadest part, but its borders and sides are commonly affected. The most common signs are pain and crepitation on palpation, and the patient may complain of anesthesia in the hand. This fracture is treated by pushing the shoulder from the anterior aspect as a trial to reduce it; otherwise, the physician has to use cupping glasses in order to tract the fractured part posteriorly. In cases of existence of some painful bone fragments, they should be excised. After the treatment, the patient is asked to sleep on the intact side." [8]

Now all types of scapular fractures need no more treatment than rest until the pain subsides.

Fractures of the sternum

Ibn Sina classified this fracture into types:

1. An isolated splitting fracture, which is diagnosed by the existence of crepitation on palpation.
2. A fracture that is displaced anteriorly and may cause bad symptoms such as difficulty in breathing, dry cough, and, sometimes, hemoptysis

The treatment of this fracture is similar to that of the shoulder.

Rib fractures

In this chapter, Ibn Sina stated that the seven true ribs are fractured at their lateral sides, while the false ribs are fractured at their medial sides. The diagnosis of a rib fracture is very easy to determine by palpation, which allows the physician to feel abnormal movement at the fracture site. The patient may complain of pleurisy and hemoptysis.

The treatment is accomplished by using cupping glassing to tract fractured rib. If the bone is compressing the diaphragm, the skin must be incised to excise carefully that bone.

Vertebral fractures

Ibn Sina talked about vertebral fractures very briefly, perhaps because of the rarity of information about these fractures at that time. He attributed all this information to Paulus Egine (who is famous surgeon from the Alexandria school who lived in the 7th century and wrote a medical book containing seven treatises on surgery and obstetrics, translated into Arabic by Hunin ibn Ishaq). [9]

Ibn Sina drew the physician's attention to the danger of this type of fracture that could cause death if the cervical vertebrae were involved.

Finally, he described the method for reducing coccygeal fractures by inserting the left index finger into the patient's rectum.

Humeral fractures

Ibn Sina elucidated that this fracture often tilts outside, so the physician must reduce it according to this tilting. It should be stabilized by using three bandages; the first one is ascending while the second is descending and the third is ascending. The upper limb must be stabilized in an angular shape with a sling. It is better to stabilize it to the chest to prevent movement.

After seven to 10 days, the bandages should be released and replaced by applying suitable splints for another 40 days.

Forearm fractures

Ibn Sina said: "Both ulnas or one of them may be fractured. The fracture of the inferior one is more bad, while the fracture of the superior one is more easy to treat." [10] At that time, the bones of the forearm were called the superior ulna (radius) and the inferior ulna (ulna).

Ibn Sina explained the methods for stabilizing the fractured forearm. He said not to tighten the bandage too much, otherwise severe swelling of the fingers may develop, and not to loosen it, so no swelling at all may appear. After that, he explained a very important item that still occupies a considerable role in the field of treatment of forearm fractures: the necessity of not applying the splints so they extend beyond the base of the fingers, which may cause these fingers to become stiff.

After accurate reduction and complete stabilization are achieved, ibn Sina advised the physician to sling the

affected forearm to the neck in an angular shape by using a wide rag so that it covers the whole length of the forearm. Forearm fractures heal quickly (within 28 days).

Wrist fractures

Ibn Sina said: "These bones rarely fracture, as they are very hard. And if they severely injured, dislocation may result, which could be treated as we had said in the dislocation section." [11]

It is well known today that wrist fractures are extremely rare, except for scaphoid fractures, which cannot be diagnosed without performing an X-ray on the wrist joint.

Finger bone fractures

In this chapter, ibn Sina said that finger bones are affected more by dislocation than by fractures. To treat finger fractures, the patient is seated on a high chair and is told to put his hand on a flat chair, an assistant should extend the fracture bones, and the physician reduce them with his thumb and index fingers.

Ibn Sina pointed to what is called "Bennet's fracture 1982" when he said, "If the fracture was in the thumb and was displaced inferiorly, then you have to use the broad bandage from above to prevent the occurrence of the hot tumor." [13]

Ibn Sina said if the fracture is in the thumb, it should be bound to the hand; If it is in the index or small finger, it should be bound to the nearest finger.

Broad bones and hip fractures

This chapter represents the cases of central hip fracture-dislocation and fracture of the sacrum, which was called the broad bone at that time.

Ibn Sina said a central hip fracture-dislocation rarely occurs. The injured patient may complain of severe pain and anesthesia in his leg and thigh, resembling that of an arm or shoulder fracture.

In order to achieve a good reduction in broad bone fractures, he said the physician should put the patient in a prone position, and two strong people should tract the patient's two thighs while two other people use splints to try to reduce the fracture and put on the bandages.

Femur fractures

Ibn Sina said: "If the femur fracture needs severe traction to reduce it to the normal position, which is convex in its lateral side and concave in its medial side, the traction should be upward to be more effective." [14]

He said that when this fracture occurs, the distal fragments displace anteriorly and outside because the femur is broader at that side.

After the reduction is achieved by applying severe traction, a bandage should be applied above the fracture and another one below it if the fracture is in the middle of the femur.

Femur fractures heal within 50 days. The most common complication is deviation at the fracture site.

Patella fractures

Ibn Sina said: "The patella is rarely fractured, but it is sprained frequently. The fracture is diagnosed by the presence of crepitation, which can be palpated or heard. In respect to treatment, the leg should be extended, then the patella be reduced. But if the fracture was comminuted, the fragments should be gathered first then reduced." [15]

Al-Razi (who lived before ibn Sina) is considered the first who pointed to excision of patella before Brook (1903). [16]

Leg fractures

Ibn Sina stated that fractures of the small bone of a leg (which is now called the fibula) are better than fractures of the big bone (tibia). If the fracture is in the upper part of the tibia, the deformity is outside and anterior, and walking is possible. If the fracture is in the lower part of the tibia, the deformity is posterior and outside. If the fracture is in both bones, the situation is bad, and the deformity may be at any direction.

He said the physician should apply traction to reduce the fracture in the same method used for forearm fractures.

Talus fractures

In this chapter, Ibn Sina said the talus is protected against fracture because it is solid and surrounded by structures that guard it. This bone may be dislocated.

Today, this fracture may happen rarely; its diagnosis is difficult unless an X-ray is performed.

Calcaneus fractures

Ibn Sina said: "Calcaneus fracture is a bad case as its treatment is difficult. It occurs when a person falls down on his feet from a high place. It may cause severe signs like fever, confusion, tremor, and spasm. After Calcaneus fracture unites walking becomes difficult." [17]

This fracture is now called a parachutist's fracture. The most important complication of this fracture is the difficulty it causes in walking, due to the development of osteoarthritis in the talo-calcaneal joint after the union of this fracture.

Toe fractures

This is the last chapter on fractures. In this chapter, ibn Sina pointed out that the treatment of toe fractures is like that of the fingers.

Conclusion

A survey was conducted to find out the most important points related to fractures as described by ibn Sina in his medical book, al-Qanun-fit-Tibb.

From this survey we can conclude:

1. Ibn Sina played an important role in keeping the medical heritage that developed over thousands of years. His medical book, al-Qanun-fit-Tibb. represents a unique reference document containing medical knowledge in general and traumatology in particular as it accumulated through many civilizations until the age of ibn Sina.
2. In his way of explanation, ibn Sina was very close to the way which modern medical textbooks follow. At the beginning, he talked about fractures in general. He described their cause, types, forms, methods of treatment, and complications. Then he described the fractures that occur in every bone.
   In this respect, one can say that the excellence in its arrangement and comprehensiveness made al-Qanun the most widely used medical textbook in Islamic and European countries until the 17th century.
3. Ibn Sina drew attention to the necessity of not splinting the fracture immediately, advising postponing it beyond the fifth day. Today, this is called the Theory of Delayed Splintage; now Professor George Perkins is considered the pioneer of this theory.
4. Ibn Sina talked about what is now called "Bennet's fracture 1882." We know that neither al-Razi before him, nor ibn al-Quf after him, had described this type of fracture, this means that ibn-Sina is considered the first who described this fracture nearly one thousand years before Bennet.

In the west, it had been said: "Anyone who wants to be a good doctor must be an Avicennist." A word of truth was written by the European Physician De Poure who declared: Medicine was absent until Hippocrates created it, dead until Galen revived it, dispersed until Rhazes (al-Razi) collected it, and deficient until Avicenna (ibn-Sina) completed it.

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