

Horner, having refractured it, was able at once to restore it to a nearly straight line.¹

Mary McCormick, æt. 5, 342 E. Twenty-third Street, broke her left leg near the upper end of the lower third. A doctor was called who did not recognize the fracture. Probably it was a green-stick fracture, and no splints were applied. Six months later she was taken to another excellent surgeon in this city, who found it greatly bent at the seat of fracture, and he refractured it. The child remained a long time in bed with splints, and when I was consulted in 1868, about eighteen months after the refracture, no bony union had taken place.

T. B. Johns, of Terre Haute, Indiana, had his right leg broken near its middle. Under the care of Prof. John E. Link, of the same place, it united. In Nov. 1876, ten years after the first accident, he was thrown from a horse, and it was refractured at the same point, after which the tibia refused to unite. Six months later he consulted me, and I advised perforation at the seat of fracture. I am informed that Dr. Pancoast, of Philadelphia, subsequently brought about union by perforation, but that extensive suppuration ensued, and that the cure was not accomplished in less than six months.

In the case of Blair, related in connection with fractures of the tibia, and which was finally treated successfully by me by perforation, the fragments united after the original accident, and were refractured at the end of six weeks by an attempt to overcome an ankylosis at the knee-joint. They refused thereafter to unite until placed under my charge.

CHAPTER XXXIV.

FRACTURES OF THE TARSAL BONES.

Causes.—The astragalus is generally broken by a fall from a height, the patient having struck upon the bottom of the foot. Monahan, in an analysis of ten cases, found it had been broken by a fall upon the foot nine times,² and only once by a crushing accident.

Dr. F. J. Shepherd,³ of the McGill University, Montreal, has called attention to a fracture of the "little process of the astragalus external to the groove for the tendon of the flexor longus hallucis muscle," to which is attached the posterior fasciculus of the external lateral ligament of the ankle-joint. He has met with four examples in the dissecting-room. All of them without a history. The first was a man about 25 years old; right foot; and it had united to the main portion by fibrous tissue. The second was also in a young man; right foot; with neither fibrous

¹ Horner, *New York Journ. Med.*, May, 1851, p. 432.

² Fracture of the astragalus, with analysis of the recorded cases of this injury. An inaugural thesis, presented to the faculty of the Buffalo Med. Col., March, 1858, by Bernard Monahan, M.D.

³ Shepherd, *Journ. Anat. and Physiology*, vol. xvi. p. 79.

nor bony union. It remained attached to the posterior fasciculus of the external lateral ligament, but it was displaced slightly outwards, and was quite movable. In the third case the process had been broken off; right leg; and it had become reunited by bone. The fourth case was found in a woman aged about 69, whose bones had undergone fatty degeneration. The fragment had united by fibrous tissue.

Dr. Shepherd was unable to produce this lesion upon the cadaver; but he calls attention to the fact that this process is much more prominent in some persons than in others; and furthermore, since in none of these cases was there a noticeable deformity of the foot, it would naturally be overlooked, or be regarded as a mere sprain.

The calcaneum is also occasionally broken by violent lateral pressure, but much more often by a fall upon the foot, or rather upon the heel.

Abel, of Stettin,¹ has called attention to a fracture of the little apophysis of the calcaneum (lesser process, or sustentaculum tali; the tubercle situated above the groove for the tendon of the peroneus longus, and called by Henle, the "trochlear apophysis"), the apophysis being broken by a fall upon the foot when in the position of varus. Biddle² has seen the same lesion, caused in the same manner in a man 39 years old, and which he ascribed to the action of the peroneo-calcanean ligament (middle fasciculus of the external lateral ligament). After the lesion the foot becomes everted, and flattened as in valgus, and the length of the heel is apparently shortened by a slight displacement of the calcaneum forwards.

In some instances both heel-bones have been broken at the same moment.

Malgaigne has collected eight cases of fracture of this bone by muscular action, as in jumping upon the toes, the posterior portion of the bone being thus violently acted upon by the tendo Achillis. South, in his *Notes to Chelius*, has mentioned two other cases, one of which was seen by Lawrence, and has been reported in the second volume of the *Lancet*. This person had received the injury by jumping off a stage-coach. The fragment was found to be drawn upwards slightly, but not so far as to prevent crepitus when the muscles on the back of the leg were relaxed. The other example mentioned by South is a cabinet specimen contained in the museum of St. Bartholomew's Hospital. The fracture had taken place just below the attachment of the tendo Achillis, but the upper fragment was not displaced.³ Mr. Cooper mentions two other cases, both produced by violent efforts on the part of the patients to sustain themselves when falling. In one of these the fragment was immediately drawn up three inches.⁴ Burggraëve,⁵ Coote,⁶ Anningson,⁷ and Poinsot⁸ have met with the same accident from a similar cause.

The other bones of the tarsus are generally broken by crushing acci-

¹ Abel, *Arch. für Klin. Chir.*, 1878, Bd. xxii. Hft. 2.

² Bidder, *Cent. für Chir.*, 1881, p. 733 (Poinsot).

³ South, *Notes to Chelius's Surgery*, vol. p. 639, Amer. ed.

⁴ B. Cooper's ed. of *Sir Astley*, Amer. ed., p. 311.

⁵ Burggraëve, *Bull. Acad. Roy. de Méd. de Belgique*, t. 6, p. 886, 1863.

⁶ Coote, *The Lancet*, 1867, t. 1, p. 270 (Poinsot).

⁷ Anningson, *Brit. Med. Journ.*, 1878, vol. 1, p. 128.

⁸ Poinsot, *op cit.*, p. 695.

dents, such as the fall of heavy weights upon them, by the passage of loaded vehicles, etc.

Pathology.—The astragalus often, indeed generally, escapes without injury in those crushing accidents which break many or most of the other bones of the foot, and, as we have seen, it is seldom broken except when the patient has fallen upon the bottom of his foot; but at the same moment, the foot being turned forcibly out or in, a dislocation of the tibia takes place, and the fibula is broken. In nine of the cases collected by Monahan, one or the other of these forms of dislocation had occurred, in eight of which the dislocation was compound. The direction of the fracture is found to vary greatly; thus, it has been found broken in its length antero-posteriorly, in its breadth or transversely, and in one instance it has been divided nearly horizontally, so as to separate the upper face completely from the lower. Sometimes it suffers a species of impaction, the fragments being actually driven into each other; at other times, as in one case related by Amesbury, the bone may be split without the occurrence of any displacement.

The calcaneum also may be broken in any direction, and it is equally with the astragalus liable to impaction, by which its vertical diameter is sensibly diminished, while its transverse diameter is increased. If the fracture is a consequence of muscular action, the line of fracture is always posterior to the astragalus, and in some cases only that portion is broken off to which the tendo Achillis has its attachment. It may be broken also vertically, directly underneath the astragalus, in which case the lateral and interosseous ligaments will prevent anything more than a slight displacement of the posterior fragment. When the fracture takes place posterior to the lateral ligaments, the detached fragment is liable to be drawn very far from the body of the bone, even to the extent of four or five inches, and possibly farther when the leg is extended upon the thigh and the foot flexed upon the leg. Constance relates a case in which the tuberosity, having been broken off by a direct blow, was drawn up five inches.¹

Fractures of the calcaneum produced by contraction of the sural muscles are generally simple, but those which result from a crushing of the bone are more often compound. The same remark is applicable also to the other bones of the tarsus, the fractures of which, being only produced by direct blows, are generally complicated with external wounds.

Symptoms.—All fractures of the bones of the tarsus demand especial care in their diagnosis, since only a few of the usual signs of fracture are in a majority of the cases presented. The explanation of this fact will be found in the number, size, and strength of the bones of the tarsus, and in their close and firm union by ligaments, by which they give to each other a mutual support, so that the fracture of a single bone does not necessarily or usually result in displacement or deformity, and even crepitus is with difficulty detected; and when we consider, moreover, that the fracture is generally produced by great violence,

¹ Constance, Amer. Journ. Med. Sci., vol. v. p. 222, Nov. 1829, from the Midland Med. and Surg. Reporter.

directly applied, in consequence of which the foot in most cases becomes rapidly and enormously swollen, we shall understand the true nature of the difficulties which are usually presented in the way of an accurate diagnosis.

Of all the usual signs of fracture, crepitus alone is pretty generally present, but even this often fails to tell us which bone is broken, and still more often does it fail to inform us as to the direction and extent of the bony lesions.

If the whole or a portion of the tuberosity of the calcaneum is separated by the action of the muscles, and the fragment is drawn upwards, it may be discovered in its new position, and the heel will be flattened or shortened, but no crepitus can be felt unless the fragments are again brought in contact.

Treatment.—Not any of the fractures of the tarsal bones in themselves demand the use of splints, and it is only when complicated with a dislocation of the ankle and fracture of the fibula that it is proper to employ apparatus of this sort; certainly the exceptions to this rule must be very rare; so that our practice in these cases will be confined chiefly to the prevention and reduction of inflammation. This will be the sum of the treatment demanded during the first few days after the receipt of the injury in probably all cases of simple fracture, and in many cases of compound fracture.

If single bones, or fragments of single bones, are displaced to any considerable extent, and there is an external wound communicating with the fracture, I have no doubt it would be best in all cases to remove at once by dissection the projecting bone, even although it were possible, or perhaps easy, to force it back again to its place, as has been done successfully by Ashhurst, of Philadelphia.¹ The same rule I would apply to examples of fractures uncomplicated with any external wound, if the fragments were very much displaced, and could not by the application of moderate force be replaced, since the bone left to project would prevent the patient from ever wearing a boot with comfort, and would entail as much weakness upon the limb as would be likely to follow from its complete separation. But such cases as I have last supposed are exceedingly rare; indeed, I have never met with a simple fracture of a tarsal bone accompanied by displacement.

Norris has, however, reported a case of fracture of the astragalus accompanied by displacement of about one-half of the bone, but without any lesion of the soft parts. This was in the person of a man æt. 30, who was admitted into the Pennsylvania Hospital on the 26th of Sept. 1831. "An hour previous to admission, while descending a ladder, he slipped and fell in such a manner as to throw the entire weight of his body upon the outer part of his left foot. Upon examination, the foot was found to be turned inwards and nearly immovable. A slight depression existed immediately below the lower end of the tibia, and there was a considerable hard and rounded projection on the outer part of the foot, a little below and in front of the extremity of the fibula. The skin

¹ Ashhurst, Amer. Journ. Med. Sci., April, 1862.

covering this projection was reddened, but not excoriated. There was no fracture of either bones of the leg."

These appearances led Drs. Norris and Barton, under whose care the patient was placed, to regard the accident as a simple luxation of the astragalus forwards and outwards; and a short time after admission efforts were made to reduce it. "This was done, after relaxing in as great a degree as possible the muscles of the leg, by flexing the knee, and having assistants to keep up extension, by seizing the heel and front part of the foot; at the same time the bone being pushed inwards and toward the joint by the surgeon. These efforts were continued for a considerable time, but had no effect in changing the position of the bone.

"Six hours afterwards Drs. Huston and Harris saw the patient in consultation, when efforts were again made at reduction, which not proving more effectual than in the first trial, the excision of the bone was determined on.

"The patient being properly placed, an incision was made through the integuments, parallel with the course of the tendons, commencing a short distance above the projection on the foot, and extending down far enough to expose fairly the astragalus and its torn ligaments. The bone was then seized with forceps, and easily removed after the division of a few ligamentous fibres that continued to connect it to the adjoining parts. Very little hæmorrhage occurred, two small vessels only requiring the ligature.

"After removal it was discovered that about one-half of the surface which plays in the lower end of the tibia had been fractured, and remained firmly attached to the extremity of that bone, and as it was judged that the efforts to remove this would be likely to produce more injury to the joint than would arise from allowing it to remain, no attempt was made to extract it.

"The joint being carefully sponged out, the sides of the incision were brought accurately together by means of sutures and adhesive straps, after which simple dressings and a roller were applied, and the foot, restored to its natural situation, placed in a fracture-box."

Subsequently that portion of the astragalus which was permitted to remain, having become carious and loosened, was removed also.

The case continued to do badly; all the bones of the tarsus, and even the lower ends of the tibia and fibula, becoming eventually carious; and on the 27th of March, 1853, more than a year and a half after the receipt of the injury, the leg was amputated; but no healthy action ensued, and the patient soon died.¹

The result of this case can scarcely be regarded as having settled anything in reference to the value of the procedure which I have recommended. For reasons which seemed satisfactory to the surgeons who made the operation, only one-half of the broken bone was removed; whether the result would have been different if the whole had been at once taken away, we cannot now determine.

¹ Norris, Amer. Journ. Med. Sci., vol. xx. p. 379.

Poinsot² has reported a case in which he practised resection. An insane woman, æt. 40, had jumped from a second floor, and was admitted to the Hospital St. André, Bordeaux.

Poinsot readily recognized the displacement of a portion of the astragalus of the right foot, which was accompanied with a marked deformity of the foot. There was no external wound. The extreme tension of the skin over the protruding bone determined him to proceed at once to remove the fragment, which was composed of the entire body of the astragalus exclusive of its neck. The fragment was rotated on its axis, so that its articular portion was directed downwards and inwards, and the broken surface presented toward the skin.

The neck retained its relations to the scaphoid. A second fracture had separated by *arrachement* that portion which articulates with the malleolus internus. Both of these latter fragments were removed, the head of the astragalus only being permitted to remain in place. Notwithstanding the utmost care to insure immobility, the indocility of the patient rendered this impossible; inflammation and gangrene ensued, and on the tenth day it became necessary to amputate. Death ensued two days later.

"Mr. Hancock² obtained," says Poinsot, "a magnificent result in a carpenter, aged 47 years, who presented a fracture of the astragalus at its inferior portion, with displacement forwards and outwards. There was no wound; but the skin was so stretched on the displaced bone that gangrene was imminent. Mr. Hancock immediately made, by excision, the total extraction of the astragalus. The wound was closed and dressed with lint dipped in a phenic acid solution; the leg was put on a posterior splint with a foot-piece, and suspended in a Salter's crib. Phenic irrigations were made without interruption. When the first dressing was taken off, after eight weeks, the wound was completely filled up. Three months after the operation the patient could lean on the injured foot, and walked easily with a high-heeled boot."

M. Poinsot, with characteristic frankness, ascribes Mr. Hancock's superior success to the antiseptic precautions adopted by the latter.

A fracture of the posterior portion of the calcaneum, especially when it has been produced by muscular action, constitutes one exception to fractures of the tarsal bones generally, and demands usually that apparatus of some kind should be employed in its treatment.

FIG. 252.



Apparatus for fracture of the posterior extremity of the calcaneum.

¹ Poinsot, French ed. of this treatise, p. 699.

² Hancock, Anat. and Surg. of the Human Foot, London, 1873, p. 251.

In order to replace the posterior fragment when displaced, or to maintain it in apposition until a bony union is accomplished, it may be necessary to shorten the gastrocnemii by flexing the leg upon the thigh and extending the foot upon the leg. But to retain the limb in this position it will be expedient always to employ apparatus. A very simple contrivance, however, will generally answer all the indications. A bandage, padded strap, or a stuffed collar may be fastened about the thigh just above the knee, and made fast to the heel of a slipper by a tape (Fig. 252). The apparatus is the same which has been recommended for a rupture of the tendo Achillis.

In addition to this, the limb ought to be covered from the foot upwards as far as the knee with a snug roller, underneath which, on each side of and above the detached fragment, ought to be placed suitable compresses, the object of the roller being to diminish muscular contraction, and the compresses being intended to retain the detached piece in contact with the main body of the bone. Some surgeons have not found it necessary to flex the leg upon the thigh; but they have contented themselves with extending the foot upon the leg, and confining it in this position by a splint of wood or gutta-percha laid along the front of the leg, ankle, and foot. In still other cases, the fragment has shown so little disposition to become displaced as to render no precautions of any kind necessary, except to impose upon the patient complete quiet, with the limb resting upon its outside and flexed, as in Pott's fracture of the fibula. In this way I have once obtained a perfect union; and in the case seen by Poincot, there being no displacement of the fragment, union was effected while the foot was only kept at rest in a pasteboard splint.

In case also the sustentaculum tali is torn off, the foot should be kept in a position of dorsal flexion.

All fractures of the tarsal bones demand that as soon as the inflammation has sufficiently subsided, passive motion should be given to the ankle, in order to prevent, as far as possible, the ankylosis which is an almost constant result of these accidents. Indeed, the patient is fortunate who recovers a tolerable use of his foot after the lapse of many months; nor can he be assured that the inflammation will leave these bones and their dense fibrous envelopes for a long period, and that it may not result in caries of more or less of the tarsal bones, demanding finally amputation of the whole foot.

I have not intended to speak in this place of those severer accidents, accompanied with comminution and extensive laceration, which forbid the hope of saving the foot, and for which immediate amputation is the only proper resource, but which constitute, in fact, the great majority of all the fractures of the tarsal bones.

CHAPTER XXXV.

FRACTURES OF THE METATARSAL BONES.

THESE bones can scarcely be broken except by direct blows, and the great majority of their fractures are the results of severe crushing accidents, such as render amputation sooner or later necessary. Of those which do not demand amputation, by far the largest proportion are compound fractures; of which class the following example will serve as an illustration:

A man in the employ of one of the railroads which connect with this city was run over by a loaded car on the 14th of June, 1856, crushing his right arm so as to render its immediate amputation necessary. I found also a compound comminuted fracture of the fourth metatarsal bone of the right foot. Considerable hæmorrhage occurred from the wound, but this ceased spontaneously. Cool water-dressings were diligently applied, without splints or bandages, and although some inflammation and suppuration ensued, the parts finally healed over and the fragments united, with only a slight backward displacement at the seat of fracture.

When only one bone is broken, the displacement is usually very trivial; but when several are broken, it may be considerable. Malgaigne relates an example of this latter accident in which, the three middle bones being broken by the wheel of a carriage, and the integuments being badly torn and bruised, it was found impossible to retain the fragments in place. The patient recovered, and was able to place the foot well to the ground, but the proximal fragments continued to project upwards upon the top of the foot to such a degree as to require a special shoe.

In a majority of cases the direction of the displacement is backwards (upwards), especially when the middle metatarsal bones are the subjects of the fracture.

I have in my cabinet a second metatarsal bone broken obliquely near its middle, with only a very slight displacement of the lower fragment backwards; and also the cast of a bone which has united with an enormous backward projection.

In one instance I have seen the metatarsal bone of the little toe cut in two with an axe, and the fragments united in about thirty days, but with the lower fragments slightly displaced outwards.

Delamotte relates a case also in which the first four metatarsal bones were cut off, and complete union was accomplished on the fortieth day; at the end of two months the patient walked without lameness.

Treatment.—If the fragments are not displaced, nothing is required except that the foot shall be kept at rest, and the inflammation controlled by suitable means.

In case, however, a displacement exists, it ought to be remedied, if possible, since, if only very slight, it may become the source of a serious annoyance. If the fragments project upwards, they interfere with the wearing of a boot, and if they sink toward the sole, the skin beneath is liable to remain constantly tender, and the patient may thus be seriously maimed for life.

In case the displacement is not due to the action of the muscles, but only to the nature and direction of the force producing the fracture, or to entanglement of the broken ends, and it is likely to cause any of the inconveniences which I have mentioned if permitted to remain, it will be advisable at once to employ considerable force in the way of pressure, or to elevate the fragments through an opening previously made upon the dorsum of the foot, calling to our aid even the saw or the bone-cutters, if necessary. After which the fragments may be retained in place by carefully applied pasteboard splints and compresses.

CHAPTER XXXVI.

FRACTURES OF THE PHALANGES OF THE TOES.

IF fractures of the other bones of the feet are generally of such a character as to require immediate amputation, these fractures demand this extreme resort still more often. Our experience, therefore, in the treatment of fractures of the phalanges of the toes is extremely limited.

Lonsdale observes that it is not uncommon to find great irritation arise after fracture of the great toe; an inflammation extending along the absorbents on the inside of the leg to the groin, causing abscesses to form in different parts of the limb, and producing sometimes great constitutional disturbance. An illustrative case has come under my own observation at the Buffalo Hospital of the Sisters of Charity. The patient, Morgan McMann, æt. 18, was admitted Dec. 23, 1853, having several days before received an injury upon the great toe, which contused the flesh severely and broke the first phalanx. He was then suffering from severe pain in the foot and leg, and the absorbents were inflamed quite to the groin. Poultices being applied to the foot and cool lotions to the limb, the inflammation soon subsided, but not until a portion of the toe had sloughed away. Eventually also it became necessary to remove some portion of the phalanx, which had died; after which the wounds healed kindly.

When any of the smaller toes are broken, it will be found easier to support the fragments by a broad and long splint which shall cover the whole sole of the foot and all the toes at the same time, than to attempt to apply a splint to the broken toe alone. If, however, we prefer this latter mode, a thin piece of gutta percha will be found altogether the most convenient material for the purpose.

If the great toe is broken, its great breadth may prevent any displacement, and a well-moulded gutta-percha splint will generally secure a perfect and rapid union.

CHAPTER XXXVII.

GUNSHOT FRACTURES.

GUNSHOT fractures have already been considered, more or less in detail, in the several portions of this work, wherever it seemed to be necessary to call especial attention to them. This chapter will be devoted, therefore, to a brief *résumé* of my own observations and conclusions in this department; to which will be added a few general statistical statements, drawn chiefly from the published records of the late war.

Causes.—Gunshot fractures are caused by a great variety of missiles, such as musket and rifle balls, solid shot and shell, grape, canister, Shrapnel, chain and bar shot, fragments of iron, stone, splinters of wood, etc., etc. The only qualities which these missiles possess in common is, that they are all projected by the elastic power of gunpowder, and generally strike the body with great force; and that they cause fractures by direct violence—seldom, if ever, by counter-stroke.

Round, smooth balls frequently impinge upon bones without causing a fracture, for the reason that they are easily deflected; and this happens especially when they are not moving with great velocity.

Conical rifle-balls seldom fail to fracture the bones which lie in their direct course; never, perhaps, when, at the moment of contact, the ball is moving with its average velocity. The peculiar destructiveness of this missile is due to its weight, momentum, and form.

Canister, grape, Shrapnel, solid shot, shells, chain and bar shot, are still more destructive; generally tearing the limbs from the body in such a manner as to render readjustment and restoration impossible.

Pathology.—These fractures may be simple, compound, comminuted, or complicated; and in addition to these common varieties of fractures there is occasionally presented an example of simple "perforation," or mere penetration of the bone without fissure or other fracture; and still more frequently are seen examples of perforation with fissures.

Probably ninety-nine per cent. of all gunshot fractures are both compound and comminuted; the comminution being, in general, excessive.

As in gunshot wounds of the soft parts it has been generally observed that the point of entrance is more round, more smooth, and somewhat smaller than the point of exit, and that the tissues are a little depressed at the entrance, while they are slightly protruded at the exit; so also in gunshot fractures it will often be found that the side of the bone on which the ball has entered, or upon which it first impinged, is less comminuted than the opposite side; and, if it is a "perforation," that the opening is smaller upon the one side than upon the other; that the edges are