

In the case of John J. Blair, of Brooklyn, with a transverse fracture just below the tubercle of the tibia, the union was delayed many months. He placed himself under my charge at St. Elizabeth's Hospital, in this city, and as he had been walking for some time, and his health was good, I perforated the bone with Brainard's drill several times, and, binding a firm splint upon the back of his thigh and leg, he was laid in bed. After the first week I pushed an ordinary shawl-pin between the fragments, and left it in place three days. This was repeated several times, and at the end of a few weeks union was complete.

## CHAPTER XXXII.

## FRACTURES OF THE FIBULA.

*Development of the Fibula.*—The fibula is formed from three centres of ossification—one for the shaft, and one for each extremity. Bone begins to be deposited in the shaft at about the sixth week of foetal life, in the lower extremity during the second year, and in the upper extremity during the fourth year. The lower epiphysis unites with the shaft about the twentieth year, and the upper about the twenty-fifth year.

FIG. 227.



Development of the fibula. (From Gray.)

*Epiphyseal Separations.*—Stimson relates that "in April, 1883, a child, about two years old, was run over by a street-car and brought to the Presbyterian Hospital. In addition to other wounds, which were promptly fatal, there was a lacerated wound on the outer side of the right leg exposing the upper end of the fibula and opening the knee-joint. The epiphysis of the fibula was completely detached from the shaft and from the tibia, and remained attached to the external lateral ligament and the tendon of the biceps; there was also an incomplete fracture of the shaft of the fibula three-fourths of an inch below the epiphyseal line, and the intermediate portion was denuded of its periosteum, which remained attached to the epiphysis."<sup>1</sup>

I am unable to refer to any other example of separation of either the upper or lower epiphysis of the fibula.

*Causes of Fracture.*—In a record of forty-eight cases I have been able to ascertain the cause satisfactorily in thirty-two, of which number six were the results of falls directly upon the bottom of the foot, but which were probably accompanied by a twist of the foot, eleven of a slip of the foot in walking on level ground or on ground only slightly irregular, and fifteen of direct blows.

<sup>1</sup> Stimson, op. cit., p. 586.

I shall here take the liberty of quoting the careful studies and observations of Poinsoot:

"Muscular contraction is sometimes the cause of fracture of the fibula. In this case, the superior extremity detaches itself from the rest of the bone. This variety of fracture, very rare however, was noted as early as 1854, by Professor Hergott, of Strasburg;<sup>1</sup> at the same time, two practitioners of the upper Rhine, Weber and Müller, reported each an observation of the same kind. Brand, in 1877, reported a case of fracture of the head of the fibula which complicated a dislocation of the leg forwards.<sup>2</sup> Similar facts were recently published by Messrs. Duplay, Perrin, and Terrier.<sup>3</sup> Hergott's patient, a woman fifty-two years old, fell; throwing herself quickly backwards, she felt a crack in her left leg on which her body was resting. A slight tumefaction was discovered opposite the head of the fibula, as also a manifest crepitus, felt by the patient as well as by the doctor. The fracture in Weber's patient, and probably also in Terrier's, was produced in the same way. In Müller's case, two young men were wrestling; one of them, on the point of being thrown, made a violent effort; but cried out so that his adversary let go; he did not fall, although he could not use his leg. Müller recognized a fracture of the head of the fibula. Brand's patient was knocked down backwards by a cow on a pile of stones and wood. The leg, in M. Perrin's case was caught between the ground and a fallen horse. M. Duplay's patients, men of forty-eight and sixty years, had been caught, one by the shaft of a machine, the other by a transmission belt, and their bodies, drawn in a rapid movement, struck a neighboring wall repeatedly. The patients explained perfectly, that in the movements of rotation to which they had been subjected, their legs came in contact with the ceiling, so that the inferior right limb (where the *arrachement* of the fibula existed) was struck from outwards inwards, and consequently tended to bend violently inwards. It seems to us that the mechanism admitted by Hergott can be applied to all the cases: the leg being slightly bent on the thigh, the biceps contracts with all its strength perpendicularly to the line of the fibula, which breaks at its feeblest point. This mechanism, which cannot be contested in Hergott's, Weber's, and Müller's cases, is equally admissible in Perrin's and Duplay's. One can well understand, that the upper part of the leg being fixed in slight flexion by contact with the ground or the ceiling, the biceps should act with more efficacy. As to Brand's case, it furnishes no details in reference to the mechanism of the lesion; it seems, however, that Hergott's theory may well be applied to it."<sup>4</sup>

*Pathology of the True Fractures.*—In all of the fractures recorded by me which have been produced by falls upon the bottom of the foot, and in all except one produced by a slip of the foot, the accident was accompanied by a partial dislocation of the ankle; the foot being turned out-

<sup>1</sup> Hergott, Gaz. Med. de Strasburg, 1854, p. 344.<sup>2</sup> Brand, Bayr. artzliches Intell., 1877, No. 52, p. 543.<sup>3</sup> Bull. Soc. de Chir., 1880, p. 218.<sup>4</sup> Poinsoot, op. cit., p. 652. See, also, Lésions du Sciat. poplit. ext. dans frac. de l'ext. sup. du peroné. Duplay, Prog. Med., Paris, 1880, viii. 257.

wards. In the one exceptional case mentioned, the dislocation may also have occurred, but the fact is not known.

Both Malgaigne and Dupuytren have noticed a dislocation in the opposite direction, or a turning of the foot inwards, more often than a turning outwards. I cannot think their observations were carefully made.

Moreover, in at least ten of the fifteen fractures produced by direct blows, the tibia has been thrown more or less inwards, and consequently the foot has turned out. Occasionally the tibia slides a little forwards upon the astragalus. But this seldom happens as the primary accident; it occurs later, perhaps within the first ten days after the accident, when the heel has been insufficiently supported.

In thirty-seven examples the fracture of the fibula has taken place within from two to five inches of the lower end of the bone. Three times the external malleolus was broken off, and eight times the internal malleolus.

FIG. 228.



Fracture of fibula near lower end.

Five of the fractures occurring in consequence of direct blows were compound, and one was also comminuted.

It will be seen, therefore, that the most frequent form of fracture of the fibula is that first described by Pott as follows: "This is the case when, by leaping or jumping, the fibula breaks in the weak part already mentioned; that is, within two or three inches of its lower extremity. When this happens the inferior fractured end of the fibula falls inwards toward the tibia, that extremity of the bone which forms the outer ankle is turned somewhat outwards and upwards, and the tibia, having lost its proper support, and not being of itself capable of steadily preserving its true perpendicular bearing, is forced off from the astragalus inwards, by which means the weak bursal or common ligament of the joint is violently stretched, if not torn, and the strong ones, which fasten the tibia to the astragalus and os calcis, are always lacerated; thus producing at the same time a perfect fracture and a partial dislocation, to which is sometimes added a wound in the integuments made by the bone at the inner ankle."<sup>1</sup>

Maisonneuve<sup>1</sup> thinks he has established, by experiments upon the cadaver, that the fracture of the fibula at its lower extremity is caused not by forced abduction of the foot, but by violent outward rotation. While M. Tillaux,<sup>2</sup> by the same mode of experimentation, has reached a different conclusion. According to M. Tillaux, the first effect of the forced abduction is to tear the internal lateral ligament, or to fracture the internal malleolus. The force, continuing to operate in the same direction, presses the astragalus against the external malleolus and tends to separate the

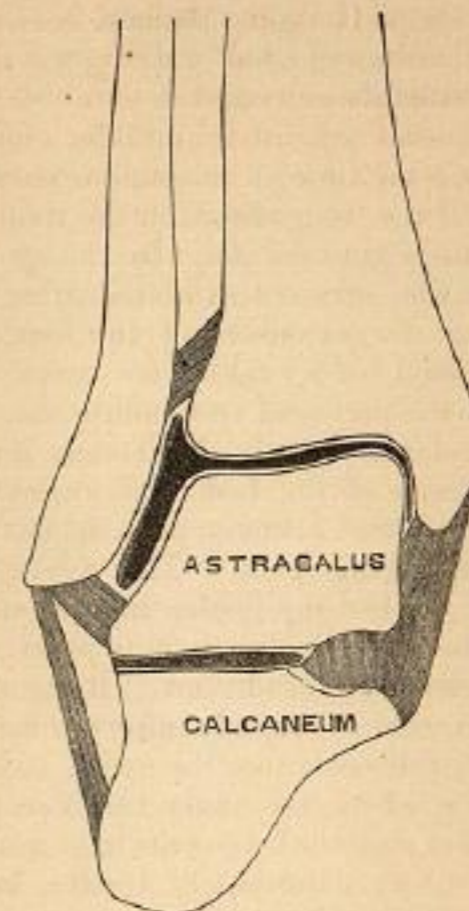
<sup>1</sup> The *Chirurgical Works of Percival Pott, F.R.S., Surgeon to St. Bartholomew's Hospital.* First Amer. ed., 1819, p. 248.

<sup>2</sup> Maisonneuve, *Arch. Gén. de Méd.*, fév. et avril, 1840.

<sup>3</sup> Tillaux, *Anat. Top.*, Paris, 1877, pp. 1172-1175.

fibula from the tibia, and may so far rupture the inferior peroneo-tibial ligament as to cause a diastasis of the articulation; or a portion of the lower end of the tibia upon which the ligament is attached may be torn off; or, the diastasis not having taken place, the fibula may break above the peroneo-tibial ligament. To this fracture M. Tillaux gives the name "bi-malleolar by abduction." It is essentially the typical Pott's fracture, although it was not so described in all points by him.

FIG. 229.



Vertical and transverse section of the tibi-tarsal articulation. Right foot. (Tillaux.)

In the forced movement of adduction, on the other hand, the external lateral ligament is first put upon the stretch, perhaps ruptured, or the external malleolus is torn off, sometimes at its summit, but most often at its base. In this case the fragment is not usually displaced, nor is the foot in any way deformed. It is a fracture by *arrachement* alone, and is not complicated with any other fracture.

But the astragalus released by the rupture of the external lateral ligament, or of the malleolus externus, and continuing to press inwards upon the malleolus internus, finally causes a fracture of this latter also, at its base. This he calls the "bi-malleolar fracture by adduction."

It may happen, also, that neither the external lateral ligament nor the malleolus externus having given away, the fibula will break above the inferior peroneo-tibial ligament, and, the force continuing to act, the lower end of the body of the tibia will be torn off in whole or in part. This he terms a "transverse supra-malleolar fracture."

These observations made by Tillaux, like all similar observations made exclusively upon the cadaver, must be accepted, as applied to the living subject, with some degree of reserve, since they lack the conditions of rigidity of the muscles, with force and direction of impact which in a degree more or less contribute to the peculiar lesions in the latter.

*Prognosis.*—Says Poinot:<sup>1</sup> “The prognosis of fracture of the fibula (at its upper end) by *arrachement* is grave; this is not due so much to the bony lesion, as to the consequent wounding of the external popliteal branch of the sciatic nerve. This wound is noted in all the observations mentioned by me. In the case of Hergott’s patient, flexion made the primary pain cease, but for two months and a half walking was impossible. Weber’s patient experienced a permanent incomplete paralysis of the flexors of the foot; in Müller’s case, the calf remained painful for a long time. In Brand’s case, there persisted for some time an incomplete paralysis of the muscles and a local anæsthesia of the integument, in the treatment of which the inducted currents had to be resorted to. In the two patients observed by M. Duplay, the one who survived exhibited, after the lapse of a year, a complete paralysis of the extensors of the foot and of the lateral peroneal muscles; he could hardly take a few steps with crutches. In M. Perrin’s patient, after a period of two months, the paralysis remained the same as on the first day. Finally, M. Terrier noticed in his patient violent pains in the dorsum of the foot with anæsthesia, from the beginning; but before long, these primary phenomena were succeeded by secondary accidents producing pain. The relations of the external peroneal nerve with the head of the fibula, the contour of which it follows before lodging into the interosseous space, explain the reason why it is frequently wounded under those conditions. Being torn by the bone at the time of the accident, that nerve may, afterwards, be included in the effusion which, later on, will constitute the callus.”

In a majority of cases, where the fibula has been broken from two to five inches above the lower end, the fragments have united inclined toward or resting against the tibia; occasionally I have seen them displaced backwards or forwards. Once the fibula refused to unite altogether.

The malleoli have generally united nearly or quite in place, but in two instances the external malleolus has been found displaced very much downwards.

Of the compound fractures, two required amputation, one was treated by resection of the lower end of the tibia, and two died without any operation. Douglas has reported a case of compound dislocation with fracture of the fibula, which being reduced, he was able to save the limb, but not without much difficulty, and the ankle remained stiff.<sup>2</sup> Other surgeons have met with similar success, but I shall refer to this subject again under the head of compound dislocations.

Of those which recovered, forty-six in number, twelve have been found to have more or less unnatural prominence of the internal malleolus, and in two of these the malleolus, or lower end of the tibia, projects very

<sup>1</sup> Poinot, *op. cit.*, p. 655.

<sup>2</sup> Boston Med. and Surg. Journ., vol. xxxiv. p. 336, from Southern Journ. of Med.

much. In nearly all of these latter examples the foot appears somewhat inclined outwards.

Generally the ankle-joint has remained stiff for some time after the bandages have been removed; and probably in all cases in which the accident was accompanied by a dislocation of the tibia. But this stiffness has usually disappeared after a few weeks or months. Twice I have noticed considerable stiffness after about six months; three times after one year; in one case after two years; and in one case after twenty years the ankle would occasionally swell, and become quite stiff. In one case it remained almost immovable after twenty years; and in a still more remarkable instance, I examined the limb thirty years after the accident, when the man was sixty-three years old, and although there existed no swelling or deformity, yet this leg was not as muscular as the other, and he declared that up to that time the ankle remained quite tender to the touch, and that occasionally it became painful.

When I come to speak of dislocation of the ankle, I shall adopt the usual nomenclature, and shall name all those dislocations in which the tibia projects inwards from the foot, “inward dislocations of the tibia;” yet I have some doubts as to the propriety of calling this a dislocation, either partial or complete. This accident seems to me to have been in general rather a lateral *rotation* of the foot, or of the astragalus, upon the lower articulating surfaces of the tibia and fibula. Of all the ginglymoid joints, the ankle approaches most nearly in form to a ball-and-socket joint, in consequence especially of the marked prolongations of the malleolus internus and externus. In other ginglymoid articulations lateral displacements are not unfrequent, but lateral rotation can scarcely by any accident occur. Here, however, the reverse holds true; lateral displacement is difficult, while lateral rotation is comparatively easy of accomplishment.

The majority of cases which occur, involving a disturbance of the relative position of the ankle-joint surfaces, are, I am satisfied, of this latter character, viz., lateral rotations within the capsule, rather than true dislocations; and although the restoration of the joint surfaces to position is, in general, easily accomplished, yet in consequence of either a fracture of the fibula or malleolus internus, or of a rupture of the internal lateral ligaments, it will generally happen that some deformity will remain. The fragments of the fibula will fall inwards toward the tibia, and the foot, unsupported by either its fibula or its internal ligaments, will incline perceptibly outwards. Nor can this be wholly prevented, in most cases, by any mechanical contrivance. Indeed, it would be easy to demonstrate, as I have often done to my pupils, that even Dupuytren’s splint, heretofore so much employed in this accident, must fail of success in a great majority of cases; since the subsequent deformity is due less to the fracture of the fibula and its consequent displacement than to the loss of the internal ligaments, which loss nature can seldom fully repair. As further evidence of the correctness of this view, I will state that in three of the examples in which I have found the fractured fibula united and resting against the tibia, the motions of the ankle-joint have been completely recovered.

I do not here refer to those cases in which a portion of the outer and

lower extremity of the tibia being also broken off obliquely, and more or less displaced, perhaps rotated upon its axis, the perfect approximation of the tibio-peroneal articulation becomes impossible. Such cases necessarily entail serious deformity.

If, however, it were true that a fracture and displacement of the fibula is the sole or essential cause of the subsequent deformity, it would still be found often impracticable to avoid the maiming, since it would still remain impossible to lift the broken ends from the tibia, against which, or in the direction toward which, they are so prone to fall. Inversion of the foot does not accomplish it, nor have I ever been able to make anything but the most trivial impression upon the upper end of the lower fragment by pressure upon the lower extremity of the fibula.

I think too much confidence has been placed in the efficiency of "Dupuytren's splint." I believe, indeed, that this splint is, in many cases, a very appropriate means of support and retention after this accident; but I doubt whether it is able to accomplish all that its illustrious inventor proposed, and especially in those cases in which, the fibula being broken, and the internal lateral ligaments torn, the astragalus is disposed to glide backwards; of which I have seen several examples, some of which have left a permanent and serious deformity, in the elongation of the heel and shortening of the foot in front of the tibia. It does not appear that either Pott or Dupuytren was aware of this form of displacement from this cause.

*Treatment.*—Dupuytren's mode of dressing is essentially as follows:

A pad, or long junk, made of a piece of cotton cloth, stuffed with cotton-batting, is constructed of sufficient length to extend from the condyles of the femur to a point just above the malleolus internus. This

FIG. 230.



Dupuytren's splint, incorrectly applied.

pad must be about five or six inches in width, and thicker by two or three inches at its lower than its upper end. This is to be laid upon the inside of the leg, with its base or thickest portion resting against the tibia just above the internal malleolus. Over this pad is to be placed a long firm splint, extending also from above the knee to three inches beyond the bottom of the foot. With a few turns of a roller the upper end of the splint must now be made fast to the knee, and with a second roller the lower end secured to the foot. The application of this last bandage requires, however, some care in its adjustment. Its purpose is simply to rotate the foot inwards, while at the same time the tibia is pressed outwards; and to this end it must be applied in the form of a figure-of-8 over both splint and foot, embracing alternately the heel and the instep. In order to be effectual, it must be drawn pretty firmly, and no portion of the bandage must pass higher than the malleolus externus. In some surgical books I have seen this apparatus represented with a roller embracing the whole length of the leg; and in others it is represented as encircling the limb two or three inches

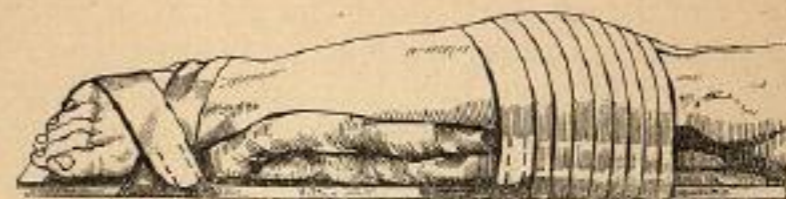
above the malleolus (Fig. 230); but it is evident that these modes of dressing must defeat the great object which Dupuytren had in view, namely, the throwing out of the upper end of the lower fragment.

When the limb is thus dressed, the knee may be flexed and the leg laid upon its outside, supported by a pillow, or upon its inside, as in the accompanying engraving (Fig. 231).

If it is only a fracture of the external malleolus, or if the fracture has occurred in the middle or upper third of the bone, this treatment is no longer appropriate, and it will generally be found sufficient to place the limb at rest for a few days upon a suitable cushion or upon a pillow.

Of late years I have not employed Dupuytren's splint, and especially because I have met with several examples of backward displacement of the foot following fractures of the fibula, which Dupuytren's splint is not competent to prevent or to remedy. This subject will be considered

FIG. 231.



Dupuytren's splint as originally applied by himself.

more fully in connection with forward luxations of the tibia at its lower end; but it is necessary to say here that this accident can be most certainly avoided by employing the plaster of Paris or starch dressing; taking care in applying the dressing to secure a thorough inversion of the toes and foot, the same as in case the limb were dressed with Dupuytren's splint. Care must be taken, also, not to permit the bandages to press upon the limb above the malleolus externus. The same results may be attained by well-adjusted leather, felt, shellac, or gutta-percha splints, which inclose the heel as well as the sides and front of the limb.

It is scarcely necessary to say that, since after the accident ankylosis is so frequent, early and unremitting attention should be given to the establishment of passive motion in the joint. Indeed, I cannot but think that a desire to accomplish the indications recognized and urged by Dupuytren has led to the neglect of the indication which ought to have been regarded as of equal, if not of the greatest, importance, namely, the prevention of contractions and adhesions around and between the joint surfaces.

I cannot too often call the attention of the surgeon to the danger of tight bandages, to which I have frequently made reference elsewhere; and especially does it seem necessary here because I have recommended the use of the plaster of Paris bandage in this form of fracture, from which the greatest dangers are always to be apprehended, unless it is used carefully and skilfully.

As a general rule, the dressings ought to be wholly laid aside by the end of the third or fourth week; and although it may be well for a somewhat longer time to keep the foot turned in, by having it properly supported as it lies upon the pillow, yet after this date I regard the use of splints and bandages as only pernicious.