ON THE TREATMENT
OF
RICKETY DEFORMITIES OF THE LEGS
BY OPERATION.

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AMONG the cases brought in the course of the year to the Children's Hospital are a large number of rickety deformities of the legs. The majority of these are easily dealt with. If cod-liver oil is given the deformity disappears as the bones grow; or, if not, it can be corrected by some simple form of splint. But a few cases remain in which treatment even with the aid of expensive mechanical appliances is rendered difficult, and sometimes hopeless, either by the extreme degree of curvature which has been developed, or by the occurrence of those remarkable changes which the bones undergo when the acute stage of rickets is past, and which make them much stronger and more rigid than they are in their natural state. In these otherwise intractable cases I have performed an operation for dividing the bones. Two methods have been adopted. In three patients, in whom the legs were curved

outwards, the tibia was so far divided with a fine saw that I could, by bending, fracture it. In a fourth, in whom the curvature was almost directly forwards, a wedge of bone was removed from the tibia, and the fibula was cut in the right leg, and broken in the left.

[The patients were in the next room, so that the result of the different operations could be seen.]

The following is a short account of each case, taken from the notes of Mr. Butlin, who was Registrar at the Children's Hospital when they were under treatment there.

CASE 1.—A. H—, a girl, æt. 4½, was admitted on July 1st, 1871. Curvature of the legs had begun two and a half years previously. She had been out-patient for a year and a half at the Orthopædic Hospital, where she was ordered to wear short splints extending from the inner side of the knee to the sole. Both legs were much deformed by external curvature. The deformity was said to be still increasing. On July 18th, before using the saw, I attempted to produce, as I have in some cases, a "green-stick" fracture by forcibly bending the leg; but though the tibia appeared to yield it would not snap. Having chosen the point at which the concavity of the curve was greatest, I passed a tendon-knife down to the subcutaneous surface of the tibia, and divided the periosteum transversely. The knife was then withdrawn, and a fine saw introduced, with which, by a series of very short to-and-fro movements, the bone was so far divided that I was able, by a somewhat suddenly applied force, to snap it across. There was some difficulty in getting the leg quite straight, but this was overcome when the fibula had been broken, and the tendo Achillis cut. The limb was then placed in good position on a back splint, and swung beneath a cradle, and side splints were applied. In the next few hours some venous oozing took place, and formed a puffy swelling under the skin, but this was not so great as to call for interference. The child passed a restless night, and was sometimes in a good deal of pain. On July 19th, the leg was not much swollen. The evening temperature was 101·6°. July 20th,

the patient had slept well after taking five drops of tincture of opium. The temperature both morning and evening was $100\cdot6^{\circ}$. For the next few days the case went on well, there was little pain, and the temperature, which never rose above $99\cdot6^{\circ}$, was on July 26th down to 98° . On August 3rd the leg was red and swollen, and fluctuation having been detected, an incision was made, which let out a small quantity of healthy pus from the neighbourhood of the operation wound. On August 21st swelling had disappeared, and on August 28th the wound was soundly healed, and the limb was put up in plaster of Paris. A few days later the child was sent to the Highgate Convalescent Hospital. She returned on September 28th. The tibia was found to be straight, and firmly united; the wound was quite sound; and the leg considerably longer than its fellow.

On October 4th the opposite tibia was divided by a similar operation, except that I bent the fibula without breaking it; and found it unnecessary to divide the tendo Achillis. The child passed a very good night after the operation, and next day her temperature in the morning was $98\cdot2^{\circ}$, in the evening 100° . On October 6th she had an attack of diarrhœa, and the temperature rose to 102° . From 6th to 12th the temperature was never higher than $99\cdot4^{\circ}$, and the leg was doing well. On October 12th the splints were readjusted. Nothing further occurred worthy of note, except the gradual closing of the wound, and this was complete by November 12th. At this date a linear depression or fissure could be felt in the tibia where it had been divided. This had disappeared on November 24th, when it was found that the bone was firmly united.

CASE 2.—E. C—, a girl, æt. 2 years, was admitted on November 23rd, 1871. An external curvature of both tibiæ had been gradually increasing for the previous twelve months, and was now so extreme that as she lay on her back with her legs extended, the soles of her feet were turned almost directly inwards. As in the former case, an attempt was made to produce a green-stick fracture of the bones by forcibly bend-

ing them; but they would not give way. On December 2nd the right tibia was partially sawn through, and then fractured; and the fibula was broken. The tendo Achillis was not divided. After fracturing the tibia I did not attempt to straighten the leg, but placed it, still curved, upon the splint, for it seemed important to learn whether the gradual straightening of the limb by carefully regulated pressure with side splints was not preferable to the forcible bending at the time of operation. I found, however, in this case much more difficulty in the subsequent moulding of the leg than I expected, and came to the conclusion that it is better to straighten the limb at once. On December 4th the child had suffered little or no pain until the previous evening, when she complained a good deal, but was soon relieved by a few drops of laudanum. On December 9th there was very little discharge from the wound, and scarcely any swelling of the leg. On December 11th the child disarranged her dressings, and drew her leg out of the splints. These were readjusted, and no mischief followed this disturbance of the limb. On February 2nd the note states that there had been no discharge from the wound for some time. The bone was firmly united, though not quite straight. On February 28th the back splint was removed, and simple side splints were employed.

On April 15th a similar operation was performed on the left leg, but the limb was forcibly straightened at the time. The fibula yielded without breaking.

On the 25th the note says there had been no discharge from the wound, and scarcely any swelling of the leg.

May 20th.—The wound had never discharged, and was now soundly healed. The leg was in good position. The right leg, which had been treated with firmly applied side splints had become quite straight. After the second operation on E. C— the temperature, taken every morning and evening, was never found above 99.5° . In the evening of the day after the operation it was 99° , and in the following week it rose above this point (to 99.5°) only on one occasion.

CASE 3.—A. L—, a boy, æt. $3\frac{1}{2}$, was admitted on November 29th, 1871. He was healthy looking but very rickety, and subject to prolapsus ani. The curvature of the legs was not simply external, as in the previous cases, but also to some extent anterior.

On December 2nd the right tibia was cut about half through and then fractured, and the fibula forcibly straightened. The leg when placed upon the splint was still rather curved forwards; though much less so than before the operation, and I could not get it quite straight.

On December 15th a small abscess on the inner side of the leg in the subcutaneous fat behind the posterior border of the tibia was opened. This prevented for some days the satisfactory application of the side splints.

On January 10th the operation wound was closed, but the abscess was still discharging.

On February 26th the boy was found to be desquamating freely, and as he had complained of sore throat it is probable he had passed through a mild attack of scarlet fever, although no rash had been seen.

On March 14th, as the fracture was firmly united, the child was sent to Highgate.

On June 29th the left leg was treated in a similar manner, and when the limb was placed upon the splint the external curvature was seen to be almost entirely removed; but I found that, as in the opposite limb, I could not correct the anterior curve.

On July 6th the child had had no unfavorable symptom, the temperature had never risen above 100° , and was generally below 99° ; but very little discharge had occurred, and this, along with all swelling, had now ceased. From this date there was nothing to notice, and he was sent to Highgate on August 15th, with his leg in very good position.

Here, with the permission of the Society, I will offer a very few remarks on these three cases, which form a group by themselves, before I relate the fourth case, in which a much more severe operation was performed. I wish to state in the

clearest terms my belief that in English practice there are very few cases of rickety curvature of the legs in which an operation is either necessary or justifiable. Those just related, however, could not, I think, have been successfully treated in any other way. Although I was not aware of it at the time, I afterwards learnt that Professor Billroth had operated in a similar case, with extremely good result, in 1861; but instead of using a saw he partially divided the bone with a fine chisel. The principle is the same; but I think, remembering the ease with which it can be performed, the operation with the saw must be the simpler, and probably also the safer method. In Billroth's patient, a little girl, aged three years, the wound, as he particularly mentions,¹ healed without suppuration.

Mr. Champneys (Radcliffe Travelling Fellow) informs me that while he was at Vienna last summer he saw Billroth repeat his operation on several occasions with very good result. Some might consider it unjustifiable to produce a compound fracture of the leg merely to remedy a deformity. But it must be borne in mind that these children were not only deformed but crippled too; they could travel but slowly and with great fatigue, and were very liable to lose their balance and fall; and the two girls as well as the boy were thus debarred from many occupations that would otherwise have been open to them as they grew up. The three cases present a series of six operations. In no instance was any serious symptom observed. In one the child had intercurrent scarlet fever, which raised his temperature and delayed his convalescence. After the remaining five operations convalescence was complete within six weeks; the temperature was never above 100°. In one abscess formed, but very soon healed. I venture to think it unnecessary to discuss the probability of non-union of fractures thus artificially produced. In all these cases union occurred quickly; and in cases of fracture in children resulting from accident, non-union, although it has been met with, is extremely rare.

¹ 'Archiv für Klin. Chir. von Langenbeck,' vol. ii, p. 657.

CASE 4.—John B—, æt. 7, was admitted on February 20th, 1871. He was very rickety in all parts of the skeleton. Both legs were curved almost directly forwards at the junction of the middle with the lower third to such an extreme degree that he could walk only a few steps at a time, and this with great difficulty. In standing or walking he lost so much of his height that he looked no taller than an ordinary child four years of age (see Plate III, fig. 1). The acute stage of rickets had passed by, and the curvature of the bones was not increasing; but although this was the case, both his deformity and his incapacity for walking were constantly aggravated by the yielding of the ligaments of his ankle-joints under the enormously increased strain to which, in the altered relation of parts, they had become subject.

On April 8th a longitudinal incision was made over the front of the tibia, where the curve was most prominent, and the periosteum was divided and carefully raised. A chain saw was then passed round the bone, and a wedge-shaped piece sawn out. The fibula was fractured and the tendo Achillis cut. The periosteum was then laid down again over the ends of the divided tibia, and fastened with a horse-hair suture, and the limb, which was brought into very good position, was placed on a back splint and swung beneath a cradle. The edges of the wound of the soft parts were loosely brought together with a silver suture. In passing the saw round the tibia, care was taken to keep it in close contact with the surface of the bone, so as to avoid injury of the neighbouring vessels and nerves. There was some difficulty in working the chain saw, as it was unavoidably doubled upon itself in the form of a narrow loop. Hæmorrhage was slight, and was seen to come chiefly from a large artery in the interior of the bone.

9th.—The child had passed a fairly good night; the temperature in the morning was $100\cdot4^{\circ}$.

10th.—Doing well. Some bleeding took place to-day from the artery in the bone, but this was easily stopped by a small plug of lint soaked in a solution of perchloride of iron.

12th.—Appetite good; temperature in the morning

100·2°, in the evening 101°. The boy suffers a good deal of pain at times. The lint is to be removed from the wound, and a poultice applied.

21st.—There is great swelling on the outer aspect of the leg at the seat of the operation, and as this is evidently due to a collection of pus, an opening is to be made, and a small drainage tube inserted.

May 15th.—The splint was changed to-day. The wound looks healthy, and there is now but little discharge. No union of the bones has yet taken place.

29th.—Union of the tibia is progressing, but is not yet firm.

June 15th.—A thin plate of bone was removed this morning, consisting of an exfoliation of the whole of the cut surface of the lower piece of the tibia.

22nd.—A sequestrum with a second smaller fragment was removed from the upper piece of the tibia to-day.

July 5th.—The wound is nearly healed. The limb is very nearly straight, and the boy can easily lift it from the bed. He is to go to the Convalescent Hospital, at Highgate.

He returned on September 28th. Union of the tibia was perfectly firm, and the leg was straight, and more than an inch and a half longer than its fellow.

On October 4th the operation was repeated on the opposite leg; but in addition to the longitudinal incision a short transverse cut was made through both the integuments and the periosteum. When the chain saw was passed round the tibia rather sharp bleeding, apparently arterial, occurred, but this stopped spontaneously when the bone had been divided, and both the tibial arteries were felt beating at the ankle. As the fibula could not be broken by a moderate force it was divided with cutting bone forceps.

5th.—The boy was doing well. His temperature in the morning was 99·6°; in the evening 101·6°. He was, however, restless, and complained a good deal of pain, but he was soon easier after the bandages above the wound had been loosened.

6th.—The sutures were removed from the wound last

night, and a poultice was ordered. He was now in less pain. An erythematous blush extended from the wound down to the foot. He had passed a very good night.

On the 9th the blush had disappeared, and the wound was looking healthy. The periosteum had retracted from the ends of the bone, and the lower fragment was somewhat tilted forward.

10th.—Chloroform was given, and the ends of the bone were placed again in apposition.

24th.—An abscess behind the tibia was opened, and a small drainage tube introduced.

November 18th.—The wound had in great part healed, but there was no union of the bones. The boy's health was excellent.

December 30th.—Two small pieces of dead bone were removed from the cut ends of the tibia.

On February 18th another small piece came away.

On April 3rd the wound was almost entirely closed; the leg was straight, and the union of the tibia nearly complete. He was soon after this sent to Highgate.

When he returned he could walk well, and was in excellent general health (see Plate III, fig. 3).

The operation performed in this case may be compared to a compound fracture with a large wound. But, if such an expression may be allowed, it was a compound fracture without complication. There was no comminution of the bone, no injury of the periosteum beyond a clean cut, and no laceration of either muscles, nerves, or vessels. The operation was one, no doubt, of great severity; but, I think, under the circumstances in which the boy was placed, it was quite justifiable. It was followed by no dangerous symptoms, and it had the effect of lengthening the legs by a little more than an inch and a half, and of enabling the boy to walk without impediment. Before it was performed there was considerable distortion of the thigh bones, and it seems interesting to remark that during his prolonged confinement to bed and afterwards, as he walked on straight instead of crooked legs, this deformity was to a great extent corrected.

DESCRIPTION OF PLATE III.

Treatment of Rickety Deformities of the Legs by Operation.

CASE 4.—John B— (see page 151), in which a wedge of bone was removed from the tibia.

Fig. 1. Front view before operation.

Fig. 2. Front view after operation.