

gives the percentage as high as sixty-nine. I have never met with them except in the case given above, although they have been looked for. They must be of much less frequent occurrence here than among the children coming under that gentleman's observation.

The cause of abnormal increase in the internal condyle has never been satisfactorily explained. Whether the theory of increased nutritive activity in the epiphyseal cartilage over the condyle is the correct one has never been proved.

Genu valgum is seen after convalescence from disease, as typhoid and scarlet fever. The deformity has been known to develop during rheumatic fever, but the pathological process has never been recorded. Gould¹ exhibited, at the London Pathological Society, a specimen removed by amputation, in which, together with obliquity of both epiphyses, there were marked symptoms of rheumatic arthritis. Haward² mentions a case in which marked hypertrophy of the external condyle was found in a knee joint affected with rheumatism. Richardson³ demonstrated the intrinsic enlargement of the condyle from disease. I have never seen a case of true knock-knee in disease of the knee joint, although a great many joints have been examined for this purpose. There is often an appearance resembling this deformity, but I have never been able to satisfy myself that true knock-knee existed.

Morris⁴ mentions the case of a boy who, some years before, injured the upper portion of his tibia.

¹"Brit. Med. Jour.," January 21, 1882, p. 87.

²"St. George's Hosp. Report," 1879, p. 466.

³"Med. Press and Circ.," 1879, xxvii, p. 322.

⁴"Brit. Med. Jour.," May 21, 1881, p. 809.

This was followed by necrosis. At the time of observation the inner head of this bone was found greatly enlarged, so that it occupied a higher plane than the external, producing well-marked genu valgum of the limb.

Beauer¹ records a case of genu valgum, due to diastasis of the lower epiphysis of the left femur subsequent to an injury, in which the lower portion of the bone had become dislocated outward, and for the correction of which excision of the knee joint was performed.

A case of deformity, having all the characteristics of genu valgum, due to a fracture at the lower end of the femur, is reported by Mollière.² It was corrected by refracture by Robin's osteoclast.

It is evident then that genu valgum can not be explained on any one theory, but that many causes combine to produce it, and that the deformity is due to changes in the bones forming the knee joint.

That true genu valgum is capable of a *spontaneous* cure—that is, without any treatment—is doubtful. From the nature of the deformity it is difficult to understand what reparative or corrective force could act so as to obliterate the abnormal curvature of the bone or change the relation of the condyles when the deformity is due entirely to differences in their plane. Macewen,³ in speaking of spontaneous cures, says that "there can be no doubt that cases have occurred during childhood when the deformity, though at one time marked, has undergone rectification without

¹"Orthopædic Surgery," 1868, p. 192.

²"Lyon méd.," December 23, 1883, p. 549.

³"Osteotomy," p. 92.

operative interference," yet in the following line mentions the necessity for some kind of treatment.

It is true that limbs affected with this deformity have been reported as having become straight in later years without any treatment whatever, and that children have "outgrown" it. But the details of such cases have been so meager as to raise a reasonable doubt as to the nature of the deformity. No case has fallen under my own observation, nor have I been able to satisfy myself that they have occurred.

Symptoms.—A person with genu valgum to any marked degree walks with difficulty, is easily fatigued, and locomotion is often painful and almost impossible. In infancy and early childhood these patients are often able to get about, but with frequent falls. Later they seem to acquire the habit of balancing themselves better, and walk and even run, but awkwardly. In later years locomotion often becomes again difficult and painful, so that crutches have to be used.

The more relaxed the ligaments the greater is the difficulty in getting about. The deformity may be so great that the knees are crossed in standing. Genu valgum may affect both limbs or only one. If the former case, it is generally more marked on one side than on the other.

In marked cases the patella is dislocated outward, and is found riding over the external condyle, being forced into this position by the change in the axis of the tibia, or it may slip during flexion to the outside of the condyle. I have met with several cases of the deformity in adults complicated with effusion into the joint, accompanied with considerable

pain. Loose bodies are found in rare cases in the cavity of the joints in those well advanced in years, but these may have had no connection with the deformity. The shape of the foot varies in knock-knee. Macewen¹ states that the foot is well arched, the instep high, and the patient walking principally on its outside. When the foot is nude and the patient walks, the extensor and the flexor muscles are seen to be brought well into action, and the toes seem to grasp the floor in endeavoring to maintain the equilibrium. I do not think that this statement is strictly correct. I have seen advanced cases in which the arch of the foot was flattened, although the child was walking about. And in one of the patients with genu valgum adolescentium there was marked dropping of the arch. In many, however, the condition mentioned by Macewen is found to exist. Knock-knee is often, in rachitic subjects, complicated with other curves of the long bones, as in Fig. 20, taken from a photograph of a patient at present under treatment.

Mikulicz² has recorded the result of some post-mortem examinations of limbs affected with genu valgum. He found that there had been an increase of that portion of the diaphysis of the femur over the internal condyle, placing it on a lower plane than the external.

Contraction of the biceps is seen in some cases of long standing. It is not a primary condition. It is due to the patient attempting to stiffen the knee joint in walking and standing. In advanced cases there may be some flexion of the leg on the thigh,

¹ *Loc. cit.*, p. 34.

² "Archiv. klin. Chirurg.," vol. xxiv, 1879, p. 192.

and secondary contraction of the fascia on the outer aspect of the limb. These may also exert some rotation of the tibia outward.

The treatment of knock-knee is mechanical and operative.

1. *Mechanical Treatment.*—That genu valgum can be cured by the use of splints in both infantile and adolescent cases is a question concerning which there



FIG. 20.

is no doubt, if they are placed under proper treatment during the early stage of the disease—that is, before the bones have become hardened and the epiphyses fixed to the diaphyses. The period during which we may reasonably expect to correct the deformity depends upon the general health of the patient and the rapidity with which the earth-salts are deposited in the bone-cells. It should be remembered that the

degree of softening sometimes varies in different bones of the same individual, so that one limb may be straightened by braces while in the other they are useless. Braces for the correction of this deformity should extend from the trochanter to the external malleolus. They should permit of no flexion of the leg on the thigh, and they should be of sufficient strength to exert a continuous force on the bones of the limb in a direction from within outward. The power may be applied either with a bandage or leather straps. A simple well padded wooden splint may be used, to which the whole limb is firmly bandaged, or a steel instrument may be applied. The patient should not be allowed to walk more than is necessary.

The object aimed at in the treatment of genu valgum by orthopædic appliances is to so act on the femur that the leg will be thrown directly inward. If the femur is still pliable, and the external lateral ligament strong, this bone will be thrown outward at the lower third and the depressed condyle raised. If, however, the external lateral ligament is relaxed or weakened, the tibia will be drawn into a straight line with the long axis of the femur, but no change will take place in the femoral curve. The external ligament will allow the tibia to be swung inward on the internal condyle as a center, leaving a space between the external condyle and the outer head of the tibia, and thus no direct force can be applied to the femoral curve.

I am satisfied that this is one cause of the want of success in the mechanical treatment of infantile knock-knee. In such a case, if the tibia be held in

its normal position, and the patient allowed to go about, the weight of the body will fall upon the internal condyle, and, provided the bone is still soft, it may yield and the deformity be permanently corrected. It is evident that in cases where the external, lateral, and, of course, the crucial, ligaments are weak, care should be taken that but slight traction be made upon these tissues by much force being applied to the tibia. A relaxed lateral ligament is as much of a hindrance to walking as a valgoid knee with unrelaxed ligaments. Dr. N. M. Shaffer thinks that, in cases due to increased growth of the internal condyle, by relieving the external condyle from pressure it takes on a more rapid growth, and thus fills up the interval between the external portion of the femur and tibia. At an early stage of rickets, thus transferring the weight from the external to the internal condyle may cause the latter to become flattened, or even atrophied.

In adolescent cases the time of increase of the deformity is the only period during which we may hope for any change in the limb by mechanical means, and it should be the time of active treatment, as the new soft bony tissue soon becomes dense and hard, the epiphysis becomes united to the diaphysis, and correction is not possible.

In proof of the statement that the mechanical treatment of genu valgum is far from satisfactory, we would refer to the statistics of a well-known orthopædic dispensary in this city, at which patients receive the best of care and attention, and where they are placed, as far as the mechanical management of the case is concerned, under the most approved meth-

ods. From 1876 to 1883 there were treated 99 cases of knock-knee. Of this number only 13 were over five years; 17 were discharged cured; 48 relieved; 8 discharged for neglect; and 29 were still under treatment, making about 23 per cent of cures. In arriving at these figures, we have looked upon the 48 discharged relieved as though they had been dismissed unrelieved. Or, looking at these cases in the most favorable light—that is, deducting the 13 patients over five years of age as being incurable—we find that out of 60 cases 17 were cured; not quite 30 per cent.

The simpler the mechanical support the better. I have seen a perfect result from the use of a simple straight wooden splint in a girl three years of age, in whom the bones were very pliable.

No rule can be laid down as to the age beyond which mechanical treatment will fail from the hardening of the bones. I think, however, that the amount of spring there is in the tibia is something of a guide. If one grasps the leg just above the ankle with one hand, and below the knee with the other hand, and attempts to bend the bone in a healthy child of two or three years of age, it will be found that it will not yield with the use of any force that can be borne. In a rickety child, with soft bones, the tibia will be felt to yield, even up to the fifth or sixth year, provided the disease has not been arrested, and it would seem that this test is something of an index as to the hardness of the bone. At all events, I think that when one can spring the bone, a trial of braces should be made.

If no improvement is obtained after a few months'

treatment with braces properly applied and cared for, they are of no use, and further mechanical treatment is worse than useless, for, if braces do no good, they do harm by being a useless incumbrance. As stated before, a patient with relaxed ligaments is the most unfavorable subject for any kind of treatment, but especially mechanical.

2. *Operative Treatment.*—Section of muscles and ligaments has been practiced for the cure of genu valgum, but with no success. Bonnet, who first advocated and performed section of the tendon of the biceps, states that "in no instance was it followed by success." It has been performed by other surgeons, but with no better results. The danger of section of the popliteal nerve should not be forgotten. Division of the external lateral ligament, together with the tendon of the biceps, has had many advocates. It has been practiced by Langenbeck, Billroth, and others. Section of the ligament is always followed by lateral movement of the knee joint, and can not be an aid in rectifying the deformity.

Mr. Broadhurst, who still is an advocate of the operation, exhibited, at a meeting of the Clinical Society,¹ a patient on whom he had made a section of the tendon of the biceps and the external ligament of the knee joint five months previously. The patient was unable to walk without a splint, and there was much lateral motion at the knee joint.

Mr. Barwell, in some remarks on the operative treatment of this deformity, states that a section of these structures is worse than useless. Inflammation of the knee joint has been known to follow such an

¹ "Brit. Med. Jour.," June 14, 1879, p. 897.

operation. I had this happen in a case in which I foolishly divided these structures, and ended in the death of the patient. *Redressement forcé*, as advocated by M. X. Delore, as well as osteoclasis, will be referred to in another chapter.

Partial excision of the knee joint has been performed by Mr. Annandale,¹ resulting in a stiff knee, and by Mr. Howes for genu valgum due to atrophy of the internal condyle.²

¹ "Edinb. Med. Jour.," July, 1875, p. 18.

² "Guy's Hosp. Report," 1875, p. 531.