

is retained upon their surfaces in sufficient quantity to furnish useful materials to the callus.

The general causes are inherent to the constitution. Remember, gentlemen, that this is a contest between two opposing forces; a tendency to repair, which exists for this bone as for all the others, and an effort constantly exerted by the tonicity of the quadriceps to keep up, and even augment the peculiar displacement which exists in this variety of fracture, displacement by separation through muscular action. Now, by increasing the separation, the quadriceps elongates the reparatory substance, disarranges it, and opposes its calcareous transformation.

Consequently, in fractures with considerable separation, you can have a bony or a very solid fibrous callus only if the surfaces of the fragments furnish materials capable of being rapidly transformed into solid substance, and if the muscles will remain inactive for a sufficient length of time during the treatment which you have instituted. We occasionally meet with patients in whom the reparatory tendency is sufficiently strong to furnish a solid intermediate substance during the time that we are acting upon the fracture. But we find more in whom the intermediate substance has not been able in this time to get the necessary solidity.

2d. Why do not our means of treatment always succeed in preventing this imperfect consolidation? You know why, if you have well understood the preceding details. We do not succeed for three reasons.

The first is that we find it difficult to bring the broken surfaces together, and to successfully oppose the action of the quadriceps. We sometimes succeed in bringing them into contact with the aid of certain apparatuses of which I shall speak. But this contact does not last very long. The quadriceps ends by slightly overcoming our opposition. If by chance it does not reproduce the entire separation, it reproduces it partially; or the fragments remain together in front, but separated behind. The second cause is that, in spite of the retention, the patient instinctively flexes the knee a little on account of the pain, and thus reproduces some of the separation. The third reason is that the contention is so exact that the patient suffers and loosens the apparatus, thus allowing the separation to again take place.

All three causes, or only two of them, often act at the same time, and in any case the same effect is produced, effusion into the articulation and immersion of the reparatory materials in the liquid which it already contains.

But that is not all; suppose that the mechanical problem has been solved, and that the fragments have been kept in place by the apparatus which you have chosen. If the consolidation is not complete when you remove this apparatus, from the 60th to the 80th day, for example, the quadriceps will recommence its unfavourable action. Its tonicity separates the fragments again, the intermediate substance yields, lengthens, and if the patient moves a little (and how are we to prevent him from moving after so long a time?), consolidation is

arrested, and you have a separation with a soft intermediate substance, which amounts to about the same as if you had no intermediate substance. It is only in young and healthy patients that, during the eight or ten weeks of the application of the apparatus, the exudation has the time to organize into a strong fibrous or fibro-calcareous tissue so solid that the quadriceps can no longer act successfully against it and reproduce or increase the separation.

LECTURE XIX.

FRACTURES OF THE PATELLA.—CONTINUED.

- I. Recent fracture of the patella with a separation of nearly three-quarters of an inch—Difficulty of the cure—Indications to be met—Different treatments by two kinds of apparatus; some closed, others open—Preference given to rubber rings. II. Sprain of the callus, and apparent relapse a year after a fracture of the patella.

GENTLEMEN: I. A man, 35 years old, a carpenter, whom we saw this morning during the visit (Ward Sainte Vierge, 28), caught his foot yesterday morning in his workshop among some pieces of wood which were lying on the floor. He fell forward, made a violent effort to save himself, and then fell backwards, feeling a painful sensation in his left knee. He was lifted up, and tried to walk, but could only take a few steps backwards, dragging his leg and leaning upon a comrade. He was at once brought to the hospital, and this is what we find:—

As physical signs:

1st. A notable swelling of the knee with a fluctuation that leaves no doubt of the existence of an effusion.

2d. A transverse depression in which the finger can easily lie, indicating a separation of nearly three-quarters of an inch, and increasing when the knee is bent.

3d. Above and below this depression a bony fragment, each of which can be easily moved sideways, and is evidently formed by one of the halves into which the patella has been divided.

As functional signs:

1st. Moderate pain when the patient does not move.

2d. Ability to flex the leg upon the thigh.

3d. Inability to then extend it without using his hands or pressing his heel forcibly upon the bed and making it slide downwards.

4th. Utter impossibility of detaching the heel from the bed, and notable increase of the pain in the knee when he makes the attempt.

By these signs you all recognize a transverse fracture of the patella

with a separation which indicates the complete rupture of the fibrous tissue in front of it.

This fracture has been produced by muscular action, for the patient fell, not forwards, but upon his back. I ask myself if these indirect fractures, by muscular action, should not be explained by a premature rarefaction and fragility of the cancellous tissue of the patella? However that may be, the lesion is not complicated by a sprain with lateral mobility, such as I have twice met with in fracture of the patella; but it is accompanied by an effusion into the articulation which, considering the rapidity of its production, must be principally formed of the blood furnished by the patella and the lateral fibrous tissues which were torn at the same time to a certain extent. But such an effusion does not take place after a traumatic lesion of the knee without causing the synovial membrane to inflame and promptly secrete an excess of synovia which increases the quantity of the effusion. There is then, together with the fracture, a beginning of the traumatic arthritis which is inevitable under such circumstances.

What is the prognosis and what will be the consequences of this fracture?

The prognosis is not serious, in this way, that life is not at all endangered, and in all probability the patient will recover the use of the limb to such an extent that he will be able to stand up, walk, and gain a living by the trade which he has heretofore exercised.

But the prognosis is bad in this respect, that the injury will compel the man to remain in bed for about two months, then to walk with crutches for one or two more, and finally to walk slowly with a cane for at least as much more. It is impossible to fix exactly the number of days, but it will be very long.

You will hear of patients who, after fracture of the patella, have remained only four or five weeks in bed, and have been able to walk without a cane at the end of two months. But those were patients who had fracture without rupture of the anterior fibrous tissue and without separation. In naming the approximative limits of the duration, I recall what I have observed in patients who, like this one, had fracture with considerable separation.

It may even happen that this duration will be longer than I said. I showed you that we have here also a traumatic arthritis; now, this arthritis may remain painful for a longer time, and compel the patient to take care of himself and not to work for six, eight, or ten months. I ought to tell you that I have but little fear of this prolongation, for he is still quite young, healthy, and not rheumatic.

The prognosis is also bad in this way, that the arthritis may possibly leave behind it an incomplete ankylosis, with very notable diminution of the movements of the knee, or even a complete ankylosis.

I had occasion to show here last year, a man, 56 years old, who after a well-managed treatment of a fracture of the patella, recovered without separation and with, very probably, a bony callus, but with almost complete ankylosis of the knee. I should have more fear of such consequences if our patient was older.

Suppose that the concomitant arthritis does not last long and is not followed by anatomical modifications injurious to the functions of the limb, the prognosis is still bad, in this sense, that this limb will not recover the integrity of its functions and the strength which it previously had. It would recover them if we should be so fortunate as to obtain either a bony callus or a fibrous one sufficiently short and solid to transmit the full effects of the contraction of the quadriceps to the ligamentum patellæ and the leg. Certainly such a result is not impossible.

I have preserved notes upon 20 patients whom I have treated during the last fifteen years for fractures of the patella with separation varying from one-third of an inch to an inch and a quarter, and in only two of them have I obtained a bony or fibrous callus, solid enough to allow the heel to be raised from the bed without bending the knee, and to cause the transmission to the lower portion of the patella of movements communicated to the upper portion, and reciprocally. And as one of them was twenty-two, and the other twenty-five years old, I ask myself if youth was not the principal condition which allowed this fortunate result to be obtained.

In the others recovery took place with considerable separation. The patients lost their ability to raise the heel from the bed or the sole from the ground without a previous involuntary bending of the knee. Their patellæ were composed of two pieces which could be moved independently of each other, and all had the same difficulty in descending the stairs when the knee was not supported by a knee-cap. Without that help they could only go from one step to the next by placing both feet upon the first and then advancing the uninjured one.

I fear still more a persistence of the separation when, pressing the two pieces towards one another with my hands, I do not succeed in bringing them into contact. That is the criterion which I recommend to you. When with your two hands you can bring the fragments into contact, there is hope of recovery without separation. This hope has less foundation when this contact cannot be obtained.

Dr. Lecoin, a former interne at the Vincennes Asylum,¹ had the good idea to record² the results which he observed during more than two years upon patients who, after having been treated in the different wards of the Paris hospitals, had been admitted to the asylum at Vincennes for their convalescence. These patients were 26 in number, but as one of them had had an iterative fracture of the same patella, the author makes the number 27. Well, in 23 of these there was a separation which varied from one-third to one and two-thirds of an inch, with independent mobility of each fragment. They had been treated by various apparatuses, some by the trough and elevation only, most of them by an immovable apparatus, two by M. Trélat's apparatus, one by this apparatus with Verneuil's modification, one by Laugier's rubber rings, two by Valette's (of Lyons) apparatus.

¹ Situated outside of Paris, and designed for the reception of convalescents coming from the hospitals.

² Lecoin, Thèses de Paris, 1869, No. 249.

Notwithstanding the incontestable advantages of these methods, which I shall explain more fully in a moment, notwithstanding the talent and care of the surgeons, the separation persisted with an imperfect consolidation which left the patients in conditions nearly the same as those of non-consolidation.

As for the other four, they are given as recoveries with a bony callus. But the author could not learn in each case whether the fracture had been originally with or without separation. In one of them alone was it known that M. Cusco had made the diagnosis of fracture without separation, a fact which easily accounts for that callus being favourable.

On this point we know nothing in the other three. I will admit that all of them owed their bony callus to successful treatment of a fracture with notable separation; we should thus have three good results out of twenty-six, a proportion similar to mine (two good results out of twenty).

Can we obtain a better proportion? I believe so; but the proof is yet to be given.

Malgaigne¹ perhaps darkened a little the list of the inconveniences left by fracture of the patella which was healed with separation. Undoubtedly the limb remains weakened, in this sense, that the contractions of the quadriceps are no longer utilized except by means of the transmission of their effect through the fibrous tissues on each side of the patella, and by an elongated patella, the movable upper fragment of which consumes most of the effort which is communicated to it, and transmits but a very small part to the lower fragment.

We must also take into account the muscular diminution which I have often mentioned when speaking of fractures of the thigh and leg, and of which I showed you an example in a patient affected with an ancient fracture of the patella. But, nevertheless, most of the patients, all those who have retained neither arthritis nor ankylosis, and who suffer only the consequences relating to the quadriceps, become able to walk very easily without a cane, to take long walks without fatigue, and, in short, to no longer notice their fracture or the weakness of the limb, except when they go up, and especially when they come down staircases. Perhaps Malgaigne, in the estimate which he made of the results, did not sufficiently distinguish between that which was the consequence of the arthritis, and that which was the consequence of the weakening of the triceps, which was undoubtedly because he examined the patients too soon after the accident.

To exactly appreciate the consequences of a fracture of the patella they should be studied several years after the accident, and after being satisfied that the arthritis has left no bad result.

I must now mention another unfortunate element of the prognosis. The patient may perhaps break the other patella, and break it in the same way, by muscular action, and with separation of the fragments. I have seen an example of this, as have also Malgaigne,² Demarquay,³

¹ Malgaigne, *Journal de Chirurgie*, t. 1er, p. 201; and *Traité des Fractures*, p. 751.

² Demarquay, *Gazette des Hôpitaux*, 1866, p. 523.

³ Malgaigne, *Gazette des Hôpitaux*, 1853, p. 312.

and M. Trélat.¹ Now, if the second fracture should give the same results as the first, the patient would be really infirm. With one bad patella and a good one upon the opposite side, the functions are well enough re-established, as I told you; but with two bad patellæ the weakness is very much greater. The walk is uncertain, needs artificial support, and cannot be long continued.

The patient whom I treated in 1869, and who is now forty years old, had had his right patella fractured nine years before. There remained, after treatment by the dextrine bandage, a separation of from one to one and a half inches, and very little or no intermediate fibrous substance. The left patella was broken in June, 1869, in consequence of a mis-step and a fall backwards. The separation was more than three-quarters of an inch before the treatment. At the end of a fortnight we treated him, Dr. Philippeaux and I, by means of an apparatus invented by the former which resembled in some points Fontan's and Vallette's. The fragments were kept almost in contact, but the pressure occasioned sometimes so much pain, especially at night, that the patient turned the screw and allowed the separation to be reproduced, tightening it up again the next day. This apparatus remained in place for seventy-eight days, at the end of which time we removed it, hoping that the intermediate substance had become solid. The patient remained in bed fifteen days longer with the leg raised upon an inclined plane; commenced to sit up on the ninety-third day, and to walk with crutches, still without bending the knee, on the one-hundredth day. Little by little the fragments separated by the lengthening of the intermediate substance which was too soft to resist the action of the quadriceps. This separation finally amounted to one and a quarter inches, the patient could walk only with a cane and slowly, go up and down stairs with difficulty, and could not take long walks.

These consecutive fractures of the patella are not so frequent that we are authorized to believe them due to a peculiar predisposition of the subject, or to the insecurity of the walk, and the exposure to falls after the first fracture, rather than to chance. But in any case there is no harm in remembering the possibility of the fact in making the prognosis and in choosing the method of treatment.

Treatment.—How shall we treat this patient?

We have to distinguish two periods: a first, of from fifteen to twenty days, during which we have to occupy ourselves only with the arthritis and articular effusion; and a second, during which, the inflammation having gone down and the effusion having diminished or disappeared, we may think of some apparatus for bringing the fragments into contact.

1st. For the first period, the patient will be kept in bed with his foot raised as high as possible, so as to relax the quadriceps femoris; for that purpose we might use simply large cushions of chaff. But on these cushions it is probable that the knee would soon flex a little. A resisting surface, to prevent, or at least to greatly diminish this

¹ Trélat, *Gazette des Hôpitaux*, 1862, p. 523.

flexion, is necessary. We might follow the example of Gerdy, and place a chair in the bed, so that its back, covered with a cushion, could support the leg. I have sometimes used this, and would do so again if I did not have other means at my disposal. I gave it up because the chair takes up too much room and troubles the patient, and also because it happens quite often that the heel sinks into the interval between two of the rungs so as to produce the flexion of the knee which we are seeking to avoid. Still the limb might be placed in a trough and then rested on the back of the chair.

Desault recommended a long posterior splint and an appropriate cushion. This splint extended from the middle of the thigh to beyond the foot; a long cushion of chaff was interposed between it and the skin, and it was kept in place by a roller bandage. But this bandage has the double disadvantage of getting loose too soon, which permits a lateral displacement of the splint and consequently a flexion of the knee, and of masking the injured region. This might be avoided by fixing the splint with three long bands of diachylon rolled about the thigh and the upper and lower parts of the leg. But diachylon easily irritates the skin and causes erythema with itching, and for that reason I do not like to use it.

I prefer an inclined plane, made like a trough, which I have made by any carpenter, to suit the size of the patient and the dimensions of the limb. Our patient will be placed upon a plane of this kind, by which the knee will be kept extended and the quadriceps relaxed. Poultices sprinkled with lead-water will be placed every morning and evening upon the knee. As the articulation is greatly distended by the effusion, we may be tempted to make a puncture, as Professor Jarjavay recommended and did several times for traumatic effusions in the knee without fracture. I have not thus far been a partisan of his operation, for here the inflammation is more intense than in simple contusions, and there would be reason to fear that puncture might cause it to become suppurative. Now, suppuration of this large articulation is too dangerous for us to expose the patient to it.

2d. For the second, I shall have to choose between two methods of treatment: simple elevation, or a uniting apparatus.

I understand perfectly that surgeons, who, like myself, have been struck with the rarity of recoveries without separation, have proposed to treat fracture of the patella by simple elevation of the limb. This is the advice which Valentin¹ and Sabatier² gave.

I would willingly adopt this method, which has the advantage of avoiding the constrictions and painful pressures of most bandages, if I could be sure of curing my patient without separation. But from what I have already told you, we have at least one chance in eight or ten of obtaining, by means of a uniting apparatus, a better result, that is to say, a very short and solid intermediate substance, and consequently a more prompt recovery and a complete restoration of the functions of the limb. It is all the wiser to take this chance

¹ Valentin, *Histoire Critique de la Chirurgie Moderne*, 1772.

² Sabatier, *Mémoires de l'Académie des Sciences*, 1783.

because we can reduce the pain to almost nothing by multiplying the precautions and care.

It now remains to choose a uniting apparatus.

A great many have been invented. I counted fifty from an interesting memoir by Dr. Bérenger-Féraud.¹ Do not wonder at this abundance, gentlemen; it is explained by the difficulty which has always existed to obtain a good result, and by the eagerness to explain this difficulty by the insufficiency of the treatment; whereas a large, the largest, part should be attributed to the anatomical and physiological conditions of which I have spoken, and which no apparatus can completely suppress. The uniting means meet satisfactorily one important indication, that of bringing the fragments together and overcoming the action of the triceps; but while doing it they produce pain which causes the knee to bend instinctively, and thus re-establishes a certain degree of separation, which is one of the causes of non-consolidation. And then, whatever may be the patience of the patient, the apparatus cannot be kept long enough in place for the intermediate substance, at the time of its removal, to be solid enough to resist the traction exerted by the quadriceps. We succeed, as I told you, only when the subject is one of the few in which this solidity is promptly acquired.

Which one shall we choose?

I leave out first all completely closed bands which hide the injured region from view, and I advise you not to use them unless you find yourselves absolutely unable to procure the rather more complicated means of which I am about to speak. For whether it is a roller bandage with a double headed compress above the patella, and another one below perforated to receive the ends of the upper one, the bandage which you know under the name of *the uniting bandage of transverse wounds*, or whether it is a roller bandage with crossed compresses placed above the upper fragment and below the lower one, you will always have this disadvantage, that if you do not tighten sufficiently over the knee the fragments will not be brought near enough together, and if you do tighten sufficiently you will have a painful compression. On the other hand, the apparatus soon loosens and the displacement is reproduced. It is in vain that you renew it every day or every second day; if you have taken care, by making it only moderately tight, not to cause pain, you allow the separation to be reproduced to a certain extent. Of course, if the roller bandages are used they must be accompanied by Desault's posterior splint and elevation of the limb. These two adjuncts correct the insufficiency of the method by at least relaxing the quadriceps and extending the knee.

Immovable closed apparatuses, made with dextrine, plaster, or silicate of potash, and applied about the fifteenth or twentieth day, when the articular swelling has gone down, have been much employed recently. These bandages are inferior to the preceding ones for the following reasons: during the first few days they keep the fragments

¹ Bérenger-Féraud, *Revue de Thérapeutique Medico-chirurgicale*, 1868, p. 481.