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PART I.

ORIGINAL COMMUNICATIONS.

ART. VI.—*Treatment of Fractures of the Patella with Separation.* By W. I. WHEELER, M.D., and Master of Surgery of the University of Dublin; Fellow, Member of Council, and Past President of the Royal College of Surgeons; Surgeon to the City of Dublin Hospital, &c., &c.

MANY years ago I brought under the notice of the Surgical Society in Ireland an apparatus for the treatment of fractures of the patella with separation of the fragments, and I subsequently read a paper upon the subject at the annual meeting of the British Medical Association held in Cork in 1879.

This subject had previously occupied my attention from the knowledge that there was a considerable difference of opinion as to the most efficient way of adjusting the fragments, many like myself up to that time holding there was not any satisfactory method of securing bony union by any of the numerous plans advocated—*e.g.*, by position, Malgaigne's hooks, pinning the fragments together, to finally opening the joint and suturing the bones. I was then able to record results of cases treated by the apparatus which I had invented for this purpose, and also exhibited a specimen of osseous union. In that communication I alluded to the most common form of fractured patella in which separation between a superior and inferior fragment occurs.

As may be observed (Fig. 1.), the apparatus I use is a hollow wooden splint extending from above the middle of the thigh to

the sole of the foot, at which point a foot-board (E) is attached by means of a hinge. This splint having two transverse bars, is fitted into a long box splint, in the sides of which it travels horizontally. That portion of the splint where the limb rests can be elevated or depressed, as required, by means of perpendicular slots cut through the sides of the box splint. Thus the splint can be adjusted to suit a long or a short limb, which can be elevated or lowered at pleasure, and the foot can be placed at any angle.

Fig. 1.—A A, Adjusting Pads; B B, Straps securing Limb; C, Slots; D, Brass Cover to Lock; E, Foot Board; *e e*, Buttons on adjusting pads for strap.

The hollow splint is fixed in position by means of thumb-screws, which fit into the transverse bars before mentioned. Two semi-lunar pieces of metal, softly padded, are fixed, one above, the other below, the fractured patella, by means of leather straps which pass round the limb. The leg is secured to the splint by two broad web straps, one round the calf, the other at the ankle (B B). The foot is bandaged to the foot-board. A roller with rack-adjustment is fitted in the box-splint below the foot-board. From this roller start four cords fitted through brass sheaves. The cords are attached, two to the upper and two to the lower metal pads by means of chains and light hooks. The roller is turned with a key, and, acting upon the cords, causes the metal pads simultaneously to approach each other, thereby bringing the fragments into apposition. The rack is covered by a brass box (D), which can be locked so that the adjustment of the splint cannot be interfered with by the patient.

In adjusting the apparatus which is here depicted much care must be taken in the first application of the adjusting pads. Both time and patience are required. If the pads are once properly adjusted they need not be altered until union is obtained. The surgeon should hear or feel the fragments grate together, and should draw the soft tissues well upwards and downwards before applying the pads; the danger of the soft tissues becoming an impediment to union is thus prevented. There is not any occasion to raise the aponeurosis from between the bones with a needle; the crepitation that should be obtained is a sufficient guarantee of the perfectness of the adjustment.

The person from whom the bony specimen (Fig. 2) was taken

Fig. 2.—*a a*, Line of Fracture; *b b*, Signs of an incomplete longitudinal Fracture.

died of phthisis two years and five months after being discharged from the City of Dublin Hospital, where he was admitted under my care in September, 1875, suffering from transverse fracture of his right patella, the separation between the fragments being $2\frac{3}{8}$ inches. Muscular action was the chief cause of this displacement. He was placed upon my apparatus immediately; the effusion was subdued in 11 days, when the fragments were brought together by means of the adjusting pads. On the 5th of November a starch bandage was applied; on the 13th of December he was discharged cured. His avocation

required him to get up and down out of his cart (which he did over the wheel) about 440 times a week. This was a crucial test of the firmness of the union. He had all the normal motions of his knee-joint, the patella moving freely upwards, downwards, and laterally. In the man from whom the specimen described (Figs. 2 and 3) above was taken the measurements

Fig. 3.—Showing perfectly continuous Bone.

of the limbs corresponded. After his death I obtained the patella that had been fractured. On the 22nd of November, 1878, my friend, Professor Macalister, then of Trinity College, Dublin, now of Cambridge, wrote me that he had macerated and cleaned the specimen. Having made a longitudinal section through the patella he found it bony throughout, and removed the articular cartilage from its posterior surface. On the anterior aspect of the bone there was no visible trace of fracture, save a slight depression on the inner side, upon the lower fragment and outer facet there were signs of an incomplete longitudinal fracture (Figs. 2 and 3).

That there are, and have been many diversities of opinion as to the best method of obtaining bony union in cases of fracture of the patella with separation of the fragments, is evident from the multitudinous writings upon the subject. The late Mr. Syme advocated a modification of Malgaigne's method by not attaching the screw-hooks directly through the skin, but to a layer of thick mole-skin plaster applied above and below the joint, the limb being placed on an inclined plane, or slung on a corresponding inclination.

The late Mr. Callendar pursued a method, which is described in St. Bartholomew's Hospital Reports, consisting of the application of Neville's Splint, to the foot-piece of which is clamped an iron with two arms projecting beyond the foot-piece. The fragments are approximated by plaster with the assistance of a pulley.

Mr. M'Gill supports Mr. Pridgin Teale's rest of the limb between sand bags.

Mr. Lund, in a paper upon a new method of treating simple fracture of the patella, assumes that the chief, if not the only cause of non-union in such cases, is imperfect apposition of the broken fragments. Having for the first six or eight days kept the limb extended on a back-splint and slightly raised, an evaporating lotion of ice is applied until nearly all effusion within and external to the joint has subsided. Then while the patient is under the influence of an anæsthetic, a strong steel pin is drilled through each portion of the patella from the extern to the anterior border. A small hole is made in the skin by the entrance and exit of the pin, great care is taken in piercing the patella fragments so that the point of the screw pin does not injure the articular surface of the bone. It is directed that these screw pins should be placed as nearly as possible in parallel lines, and drawn very closely together until the broken surfaces of the bone are brought into perfect contact by means of a double screw instrument which holds them firmly in position. While so placed the ends of the pins are enclosed in the coils of very thin copper wire so arranged in repeated turns as to gain great strength; and then when the pins are completely fixed the double acting screw instrument is removed, the broken surfaces of the bone thus remaining, it is claimed, in absolute contact.

Mr. Mayo Robson has also detailed a plan he states will secure a bony union in transverse fracture of the patella, without opening the joint. The skin over and around the joint is cleaned and rendered aseptic, and the joint is then aspirated. He uses two long steel pins with glass heads, then draws the skin well up over the upper fragments, and introduces one pin transversely through the skin and muscle just above the upper fragment, repeating the operation with the other pin at the upper end of the ligamentum patellæ. Gentle traction of the pins then easily brings the fragments into apposition.

There are many other inventions for the treatment of fracture of the patella too numerous to be mentioned. I have only alluded to those methods which have received more attention than others, and to exemplify the diversity of opinion concerning treatment.

Mr. Macewen, in a communication upon "The Chief Cause of

Want of Union in Transverse Fracture of the Patella, and How to Obviate it," advocates suturing the patella together.

An examination of the causes of separation of the fragments shows that the continued action of the quadriceps extensor muscle plays an important part. So, also, does the effusion (which is not purely synovial, or hæmorrhagic, but mixed); also the folding of the aponeurosis of the extensor muscle over the fractured extremities, and in some old cases the permanent shortening of the extensor muscle itself. The theory has been propounded that, when the effusion is subdued, the quadriceps extensor muscle remains in a state of inaction. This is not my experience. I have observed a spasmodic action of the quadriceps, and the patients were able to make the muscle act, although it was difficult to persuade them to do so. I have also felt it contract thirteen days after the accident that caused the fracture of the patella, and have seen increased separation consequent upon contractions.

When the position of a limb is lowered there is an increased space between the fragments; nor is this caused entirely by the falling down of the lower fragments, for I have frequently marked the inferior edge of the lower fragments before lowering the limb. What, then, is the cause of increased separation when effusion has subsided? In every case of fractured patella that I have seen, position has influenced the upper fragments, except in two, where the quadriceps extensor muscle was antagonised by the ligaments of Barkow being intact. In such cases only is the treatment by position at all admissible. In no case have I found the quadriceps weakened or thin when bony union has been obtained.

The only way in which I can account for the weakness and atrophy of the quadriceps, which is said to follow this accident, is by altered blood or nerve nutrition to the muscle, caused perchance by the method of treatment, or that the result has been weak ligamentous union, or the muscle not having a fixed point upon which to work, and the patient consequently not exerting the limb as much as the other—in fact, sparing it. The muscle from such causes becomes weakened and thinned. This is in a measure verified by a case that died in the City of Dublin Hospital some ten years ago. The man, who had been treated for fractured patella by the late Professor Geoghegan, had very close but ligamentous union. He was five-eighths of

an inch less round the circumference of the injured limb above the patella than the sound one; and he told me although he had excellent use and strength in his leg, he "did not make so free with it as with the other one."

There is nothing to show that it is from want of power in the bone to produce osseous material that bony union does not take place. If the fragments are kept in perfect contact by means of a suitable apparatus, bony union becomes so complete that not a vestige of the injury can be traced. Besides, perpendicular fractures readily admit union by bone.

It would be unnecessary to discuss the obvious advantages of bony over ligamentous union. M. Desprès appears to advocate the latter because he can relate cases where patients sustained fractures on two different occasions in the same bone. He states that it was the bone and not the ligamentous union that gave way, and thus attempts to prove that the fibrous union is stronger than the bony. Anyone upon reflection will understand that the seat of the fracture depends upon the position of the limb at the time the fracture takes place.

I have not found it necessary to deviate from the line of treatment I advocated some years ago. I will therefore give an epitome of three out of some fourteen cases which have come under my notice during the last thirteen or fourteen years, and of which I have an accurate record:—

CASE I.—In November, 1881, a healthy, muscular man was admitted into the City of Dublin Hospital, suffering from a transverse fracture of his left patella. He fell when getting up on his car, and muscular contraction caused the fracture. The distance between the portions of the broken bone measured $2\frac{3}{4}$ inches. There was considerable effusion. His limb was placed upon my splint, and local and other treatment adopted to subdue the effusion. After a lapse of seven days the adjusting pads were applied, and the upper and lower fragments brought into apposition and proved to be in direct contact, as crepitus could be both felt and heard. The patient remained six weeks in hospital, a plaster bandage having been applied previous to his discharge. I examined his knee-joint very recently; there is perfect union. He wrote to me upon the 19th of February (1894):—"Since I recovered from the effects of the accident I have followed my usual vocation, and have never felt the least annoyance from the knee. So far it is as much use to me as if it had never been injured."

CASE II.—A young gentleman of about eighteen years of age, on the 14th of October, 1888, while crossing Lower Baggot-street, was knocked

down by a car and fractured his left patella horizontally by muscular action. There was separation of the fragments to the extent of $1\frac{3}{4}$ inches, and also extensive effusion into the joint. The case came under the care of Dr. C. F. Moore immediately, and as I had to leave town upon the next day but one, for the south of France, he remained under Dr. Moore's care until my return. He considered it necessary to have surgical assistance, and had a consultation upon the 10th of January. Upon my return on the 20th I met Dr. Moore; he told me that the idea was to aspirate the joint on account of the very extensive effusion. The effusion had not subsided, but with the application of ice bags, absolute rest, and other treatment, it was subdued by the 3rd of February, when my apparatus was applied, and the bones were brought easily into apposition. In March a plaster bandage was applied; union having taken place the second bandage was applied on the 18th of April. I kept this patient unusually long in plaster on account of the primary wide separation, and the pronounced muscular strength of his quadriceps muscle. This caused some slight stiffening in the knee, for which he was ordered Turkish baths and massage. I finally flexed the knee under chloroform on two occasions. There is complete osseous union between the bones. If it were not so, the amount of force used to flex his joint would have broken through or stretched any fibrous union. He writes in February, 1894:—"I have never experienced the slightest inconvenience in my knee from change of weather or otherwise. There has never been the slightest separation between the parts. I am quite as well as before the accident, and can walk any distance. The accident happened to the limb over six years ago."

CASE III.—On the 21st of August, 1890, a gentleman about thirty-seven years of age, broke his right knee-cap under the following circumstances:—He was walking on a slope of wet and slippery concrete when the heel of his left boot shot out from him, and on rising to regain his balance, all his weight came on his right leg. He suddenly felt a snap, and immediately sat down, his right leg bent under him, he was unable to rise and had to be lifted. He was brought in a cab to my house, when I found his right knee-cap had a transverse fracture. There was much effusion into his joint which considerably increased that night. Aperiens were administered, and ice-bags applied locally, the limb being fixed in my apparatus. About ten days after the accident I was able to draw the fragments together by means of adjusting pads, and eight weeks from the day of the accident I applied a plaster bandage. At the present time he writes that he feels no inconvenience. "I walk from my house to my office and back every day, and can walk very quickly; can go up and down stairs. I have never pain or trouble with my knee." I had an opportunity of examining this gentleman's knee

about four days ago. There was perfect osseous union, but he cannot flex his knee as much as the other, some very little stiffness remaining; he declined to allow me to flex the joint under an anæsthetic.

Of the fourteen cases of which I have notes I treated ten as recent fractures with results similar to the cases I have described, with the exception of two. One was in an unusually developed muscular pedestrian, who did not keep on his bandage long enough, and the osseous union, which, I believe, had taken place, gave way. The fragments are now considerably separated. He has, however, got fairly good use of his limb, and I think some long fibrous bands connect the bones. The second case in which osseous union did not take place, the patient would not submit to treatment long enough, having to leave this country, and only allowed my splint to remain on him three weeks. Therefore, out of ten cases of recent fracture of patella treated by my apparatus, bony union has resulted in all but two. Of the two in which bony union did not take place the result in one was due to the patient's impulsiveness, and in the other to non-compliance with the treatment.

These cases have all been tested and examined from time to time. Except in two there is no trace of separation, the bones moving in one piece, and no inequality can be felt at the site of the fracture. The quadriceps extensor muscles have not got thin or wasted, the circumferential measurement being the same in both limbs. The description written by the patient in Case II. might truthfully be applied to the others.

In four cases of old standing transverse fracture of the patella I opened the joints and wired the bones together. From the length of time that had elapsed before I saw the cases, the considerable separation and very impaired usefulness of the limbs, no other treatment could have been then adopted with advantage. The results in these cases were good. Osseous union followed, and the patients regained full power of their limbs. In one of these cases the quadriceps extensor was so shortened that when I attempted to bring the fragments together, using all the force I possibly could, they were still separated three-fourths of an inch. I therefore adopted the V-shaped incisions which allowed me to bring the fragments together by lengthening the quadriceps extensor muscle. These cases were much slower in recovery, convalescence, and regaining the normal condition than the cases alluded to above.

I have thus recorded my experience in the treatment of fracture of the patella; and from the results I have obtained, I have no reason to alter the method I have pursued for several years.

The dangers of opening a knee-joint, and suturing a recently fractured patella are decried by some. I am aware there are surgeons who advocate the treatment by suturing at once; but, no matter how carefully this operation is performed, it goes without saying that there is risk and peril to the patient. As an example of this—I was called out of town about a year ago to see an officer who had fractured his patella by direct violence, followed by considerable effusion into his joint. I placed the limb in a suitable apparatus, ordered ice to be applied, and other treatment to be adopted until I should see him again in a day or so. But the splint I temporarily designed (not having my own with me) was removed by the surgeon in charge, and from a letter which I received, the patient did not wish to have any other apparatus applied. I was requested to see him again, but declined to do so, as I knew the result would be, at best, a weak fibrous union.

I was subsequently informed that, not having gained power in his limb, he was unable to perform his duties. He had his patella sutured in London soon after, and I heard he had had a drainage tube in his pleural cavity, and was slowly recovering from a pyæmia.

The great majority of the cases of compound fractures of the patella I have seen were caused by direct injury or gun-shot wounds, and necessitated amputation of the limb. Yet, a compound fracture of the patella must not be considered a necessary indication for amputation; for in suitable cases, and when the condition of the surrounding soft parts admit, removal of the fractured patella has been practised.* The patella has also been removed for permanent dislocation. The only cases of compound fracture of the patella I had the opportunity of successfully treating without loss of limb were two. One was caused by a kick from a horse. The patella was broken in the centre, and the synovial fluid flowed out. The patient, who was a young gentleman about twenty-five years of age, made a complete recovery. The second case occurred in a man about fifty years of age, who was admitted, under my care, into the

* Sir George Humphry (Cambridge).

City of Dublin Hospital, suffering from a compound fracture of his right patella, caused by falling upon the edge of the curb-stone, when carrying a heavy basket upon his back. The fracture was transverse, and situated at the inferior third of the bone; the fragments were readily adjusted. The tibio-patellar ligaments being intact, bony union followed, and his recovery was excellent.

The apparatus shown in Fig. 1 is suitable to any limb. Tilting of the fragments cannot occur; for should there be any tendency to do so a strap that can be fastened to the adjusting pads will prevent it. The traction is downwards and backwards. The splint provides for the position of the limb. There is no pressure upon the arterial supply of the patella. There is no risk to the life or limb of the patient (as might be caused by the hooks or by opening the joint and suturing the fragments). It will produce perfect co-aptation without injury to the soft parts. It can make well-maintained traction upon the upper as well as upon the lower fragment if required to do so. No fluid can separate the fragments. The patient cannot interfere with it when adjusted, as with plaster and other methods. It has produced the best result—bony union.

ART. VII. — *Nephrorrhaphy and Nephrectomy*.^a By J. S. M'ARDLE, F.R.C.S.I.; Surgeon and Lecturer on Surgery, St. Vincent's Hospital, Dublin.

THE cases which I shall bring before you cover a field so wide that discussion of them could not be attempted within the limit of this communication. I shall, therefore, narrate brief histories of each, and lay before you some points which I consider worthy of consideration.

NEPHRORRHAPHY.

CASE I.—B. H., aged nineteen years, came under my care on March 10th, 1888. She complained of severe abdominal pains of an inter-mitting character, and chiefly referred to the left of the umbilicus; pain was also felt up to the angle of left scapula, and down to anterior superior spine of left ilium and into thigh. Rest in the recumbent position relieved these symptoms, as also vomiting, which occurred whenever she

^a Read before the Section of Surgery of the Royal Academy of Medicine in Ireland, February 23, 1894.