

RUPTURE OF THE LIGAMENTUM PATELLÆ, AND ITS TREATMENT BY OPERATION.¹

By HENRY B. SANDS, M.D.,

OF NEW YORK,

PROFESSOR OF THE PRACTICE OF SURGERY IN THE COLLEGE OF PHYSICIANS AND SURGEONS; SURGEON TO THE ROOSEVELT HOSPITAL.

THREE forms of injury to the knee are closely allied by their causes, effects and principles of treatment. These injuries are, simple transverse fracture of the patella, subcutaneous rupture of the tendon of the quadriceps extensor muscle above that bone, and a corresponding lesion of the inferior division of the tendon, known as the ligamentum patellæ. The experience I have gained in the management of two cases of the last-named accident which have fallen under my observation, has led me to a brief study of its literature, from which I have gleaned a few facts of sufficient interest, perhaps, to justify me in bringing the matter to the notice of the Society. At the same time I desire to put on record a number of cases of this injury hitherto unpublished, and to describe an operation for uniting the ends of the divided ligament by suture, which I have performed upon the patient now exhibited before you.

Compared with the fracture of the patella, rupture of the ligamentum patellæ is a rare event. Maydl,² whose statistics are the largest I have yet met with, was able to collect only sixty-five examples of the latter form of injury. In this paper I am able to report thirteen other cases treated in the Bellevue, New York, St. Luke's and Roosevelt Hospitals. In order to form a rough estimate of the comparative frequency of the two forms of injury, I have caused a search to be made of the entire records of the four hospitals above mentioned, and have obtained the following result:

¹ Read before the New York Surgical Society, Dec. 8, 1885.

² *Zeitschrift für Chirurgie*, vols. xvii and xviii, 1882 and 1873.

	<i>Fracture of patella.</i>	<i>Rupture of ligamentum patella.</i>
New York Hospital	150 cases.	3 cases.
Bellevue Hospital.	140 "	7 "
Roosevelt Hospital	44 "	2 "
St. Luke's Hospital	19 "	1 "
Total	353 cases.	13 cases.

A comparison of these figures gives a ratio of about twenty-five to one.

The relative infrequency of rupture of the patellar tendon may be ascribed chiefly to its great strength and thickness, its relatively slight exposure to direct injury, and to the great mechanical advantage with which indirect violence often acts in causing fracture of the patella. Thus, as has been remarked, when the knee is bent and a sudden and powerful contraction takes place of the quadriceps extensor muscle, as in endeavoring to prevent the body from falling backward, the patella is acted upon by two forces, which, as its upper and lower borders are then free from contact with the femur, may cause it to break, in the same manner as a stick may be broken by bending it across the knee.

The remarks which I wish to make may conveniently take the form of a commentary upon the cases which have come under my care, or which, as may be seen in the appended table, have been gathered from the hospital records above mentioned. I shall give only my own cases in detail.

CASE 1. Patrick F., a car driver, æt. 35, was admitted to my department of the Roosevelt Hospital, October 19, 1882. Ten years previously his right patella had been fractured by striking his knee against the pole of a truck. Five months later the same accident recurred, the final result being a fibrous union between the fragments, which remained separated a distance of two inches. On the day of his admission into the hospital, while in the act of hitching his horses to a street car, he missed his footing in attempting to ascend the plat-

form and felt something suddenly give way. An examination detected evidence of an old fracture of the right patella, which had been broken about its middle. The distance between the fragments measured two inches, and the interval was occupied by a broad, thick, fibrous band. In the normal situation of the ligamentum patellæ was found a shallow depression, dependent upon a complete rupture of the ligament, which seemed to have been torn close to its inferior extremity. Patient entirely unable to extend the leg. Much tenderness and swelling of knee.

Treatment.—Extension of limb to horizontal position. Ice bag applied to knee.

Oct. 28.—Pain and swelling subsided; vertical suspension of injured limb; rubber bandage to knee.

Nov. 14.—Apparatus removed; limb kept extended and raised on a pillow. The gap below the patella has filled up.

Dec. 3.—Waterglass bandage applied from ankle to thigh. Patient allowed to walk.

7th.—Discharged from hospital, wearing splint.

Nov. 21, 1885.—Patient reexamined three years after injury. He states that, disobeying the instructions he had received on quitting the hospital, he removed the splint a few days afterward, and began to use the limb more freely. His knee remained stiff, however, until five weeks later, when, in descending a staircase, and being within two steps of the bottom, he imagined he had reached the end; and, putting forward his left foot, a strain came on his right knee, which was suddenly and forcibly bent. Some pain followed, and he thought he was severely hurt; but the next day he discovered that he was better, and that he could readily flex and extend the leg. At present, as he is now exhibited before you, he can flex it a little beyond a right angle, and can make complete extension with some force. He says he is not aware of any difference in the strength of the opposite limbs. Separation of patellar fragments two inches. Length of ligamentum patellæ same on both sides.

Evidently, in this case, the rupture of the ligamentum patellæ was due to the severe strain to which it had been subjected by the weight of the body, and the forcible contraction of the quadriceps extensor muscle. Whether transverse fracture of the patella usually results from direct or indirect violence is an open question. I agree with those, however, who contend that this injury may generally be traced to the latter cause; and I am sure that the same is true regarding rupture of the

ligamentum patellæ. Maydl, in investigating the etiology of this accident, analyzed forty-four cases, in only five of which the rupture could be attributed to direct violence. Most often it is occasioned by a powerful contraction of the quadriceps, occurring in an attempt to save the body from falling backward; at other times, from falling forward or sidewise. Violent flexion of the leg, accompanying a fall from a height, may produce it; and it has been known to occur spontaneously during an attack of convulsions, as also during forced flexion practised with the object of overcoming an ankylosis of the knee. In the last case muscular contraction cannot be concerned in the rupture, which must be ascribed in part to pathological changes in or around the affected joint. Adhesion and fixation of the patella, or rigidity and contracture of the quadriceps muscle, may, by preventing the descent of the patella when the knee is bent, cause the ligamentum patellæ to be lacerated during forcible flexion, either manual or instrumental.

In some of the cases I have collected from our hospital records, the agency of muscular contraction in causing the rupture is plainly evident. The case just narrated (X¹) is one in point. In another case (IV.), the man, while wrestling, was thrown down, striking the left knee. As he fell, he was conscious that something had given way; and on trying to get up, he found himself unable to extend the right, or opposite, leg. Another man (VII.) stumbled while carrying a barrel of flour; and in a violent but unsuccessful effort to save himself from falling forward, heard something snap, and felt his knee suddenly give way as he came down with his left leg helpless. Another (VI.), whose heel had been caught between two flagstones, and who squatted quickly to pick up his hat, felt something give way, and immediately fell to the ground, unable to extend his legs. In this case the rupture occurred on both sides. In Case XIII. the man slipped while crossing the street, and did not strike the knee. In Case XII., to be related presently, the injury was certainly due to direct violence, a heavy piece of timber having fallen across the knee. One patient (IX.) fell from a roof, sus-

¹ These figures refer to the table of cases appended at the close of this article.

taining fracture of the left thigh and rupture of the left ligamentum patellæ. Here the violence may have been direct, as also in Case II., in which a sailor fell from a jibboom a distance of thirty feet, striking his knee; and in Case XI., in which a fireman was buried beneath a falling building, and, on being extricated, was found to have received a fracture of the femur, a rupture of the ligamentum patellæ, and severe contusion of the injured limb. In Case I. the patient fell from a wharf into the water, hitting his knee against a boat. Whether, in the four cases last described, the rupture of the ligament was caused by direct injury, by extreme flexion of the knee, or by muscular contraction, must be a matter of doubt; and, in the remaining examples, the doubt concerning this point must be still greater. Thus, one man (V.), while engaged in carrying a plank, fell upon his left knee; another, who was assaulted and knocked down in front of his lodging house, struck his knee against the doorstep. In Case III., the patient, while walking, stumbled and fell, striking his knee against the ground. Now, in all these cases, the circumstance that the knee was hit seems to favor the supposition that the rupture was occasioned by direct violence. But it is quite likely that such an inference would be wrong, and that the fall upon the knee may have been the result, not the cause, of the rupture. This explanation is corroborated by the probability that, in all these instances, the extensor muscles were forcibly contracted at the moment the accident happened.

It is well known that rupture of the ligamentum patellæ is far more frequent in the male than in the female sex. I have been unable to find more than five published cases in which females have sustained this injury, and the thirteen subjects, whose cases I have recorded, were all males. The relative frequency of the accident in the latter may be accounted for by their greater exposure to its exciting causes, and by the greater strength and activity of their muscles.

In one case (VI.), already mentioned, the rupture took place on both sides simultaneously. Four other cases of this double injury have been recorded, namely, two by Shaw,¹ one by Gib-

¹ Trans. of Path. Soc. of London, vol. 5., 1854.

son,¹ and one by Hamilton.² In three cases (III., VII., X.), the rupture occurred in persons who had previously suffered from transverse fracture of the patella on the same side. In Case III. the patella had been broken one year previously, and ligamentous union had taken place. In Case VII. the fracture occurred eight months before the rupture, and the uniting band measured two inches in length. In Case X. the fibrous band was likewise two inches long, while a period of ten years intervened between the fracture and the rupture. I have found elsewhere only four other examples of this singular sequence,³ from which; I think, two conclusions may be drawn. The first is, that a fracture of the patella may establish a predisposition to rupture of the ligamentum patellæ. In Flower's case, in which the rupture took place at the patellar attachment, this end of the ligament seemed to have ossified during the repair of the fracture; and to this circumstance he was inclined to ascribe the predisposition. Such could not have been the explanation, however, in Markoe's case (III.) nor in the one I have reported (X.), as in both of these there was no evidence of ossification of the ligament, which, moreover was found to be ruptured at its tibial insertion. In the majority of instances, probably, the essential cause of the predisposition is a weakness of the limb induced by the earlier injury, which renders the individual less able to avoid the accidents that determine the later one. The second inference is, that the fibrous bond of union between the fragments of a broken patella may be able to bear a greater strain than the normal patellar ligament. This may be the fact, even when the uniting band is of considerable length, as in the two cases I have recorded. Additional evidence of the occasional strength of the ligamentous union of patellar fragments is afforded by the numerous examples of re-fracture of the patella in which the second fracture has taken place through a part of the bone hitherto uninjured. It is noteworthy that, when rupture of the ligamentum patellæ has been

¹ Gibson, *Surgery*, vol. i. p. 395, sixth edition.

² Hamilton, *Fractures and Dislocations*, sixth edition.

³ Nélaton, *Archives Générales*, 1858, p. 704, Obs. vi.; Flower, *Trans. Path. Soc. of London*, vol. vii., 1856; Bulley, *Med. Times and Gazette*, London, 1864; Zeis, *Archiv für klinische Chirurgie*, vol. vii. p. 755.

preceded by fracture of the patella, the two lesions have always been found to exist on the same side of the body. The longest recorded interval between the two accidents is ten years, in Case X.; the shortest, eleven weeks, in Flower's case.

In seven of the cases I have reported the seat of rupture is definitely stated. In three it took place at the upper, and in four at, or near, the lower attachment of the ligament. In two cases a small fragment of the patella was torn off; in one of these it could be distinctly felt, and in the other it gave rise to occasional crepitus when the ruptured parts were approximated. These results are in accordance with the general rule, that ligamenta is far less liable to give way in its middle than at one of its extremities—the lower being involved in about 50 per cent of all cases. The rupture, wherever it occurs, is usually complete; my notes of thirteen such cases furnish only a single instance in which a portion of the ligament remained intact.

The symptoms were in every case so plain as to leave no doubt concerning the nature of the injury. In one the amount of retraction of the patella is said to have been slight; in another it was two inches; but in all the gap between the severed parts could be made out. Prominent among the symptoms is inability to extend the leg. So far as I know, this loss of power is absolute when, as is usual, the rupture is complete. In transverse fracture of the patella, on the other hand, it occasionally happens that some power of extension remains immediately after the accident. An illustration of the preservation of this function to a remarkable degree came to my notice a few weeks ago, when a gentleman entered my office to consult me about an injury to his knee, which he thought he had sprained a few hours previously while playing in a tennis court. In the meantime he had been able to walk, and had gone down town to the stock exchange, and returned in a street car without suspecting the gravity of his injury, which, to my surprise, I found, on examination, to be a transverse fracture of the patella. The fragments, however, were in contact, and bony crepitus was well marked. We can readily understand why no such exception should ever be met with when the ligamentum patellæ is completely ruptured, since, under

these circumstances, nothing is left to transmit the force exerted by the quadriceps, except the insignificant aponeurotic attachment of a few of its fibres to the tibia.

The condition of the knee-joint was noted in six cases, and, in all but one, the joint is said to have been distended and painful soon after the accident. Whether, as seems probable in this form of injury, the laceration extends into the joint, and whether the distention of the latter is due to the presence of blood or of inflammatory effusion, are points which have not yet been demonstrated. In any case, the swelling generally subsides, under appropriate treatment, in the course of a week or ten days.

The treatment adopted in most of the cases herewith reported was essentially the same as that usually followed in fracture of the patella, comprising extension of the knee, elevation of the injured limb, cold applications to the joint, and the use of pads, straps and bandages for the purpose of approximating the ends of the ruptured ligament. As in the case of fracture of the patella, the retraction of the upper end appears to be largely owing to distention of the knee-joint with fluid; and, until this has been absorbed or otherwise got rid of, any attempt to force it downward will prove futile, and perhaps injurious. In one case (III.) in which compresses and tight bandages were employed very early, they certainly caused an aggravation of the symptoms, which compelled a suspension of this part of the treatment for a period of four weeks. The final result, however, was satisfactory.

As a rule, such treatment as that described is followed by a fair amount of recovery of the functions of the injured limb. I regret that the notes of some of the cases I have collected are so defective regarding the results obtained as to possess little or no value. We know, nevertheless, that the continuity of the ruptured parts is usually restored in the course of six or eight weeks, the knee meanwhile gradually regaining its normal size and shape. Afterward the joint generally becomes movable, and the power of extension returns to a variable degree. Occasionally both the physical and functional results are excellent, as in Weir's case (XIII.), in which, sixteen years after the injury, no difference could be discovered by measure-

ment between the length of the patellar ligaments of the opposite sides, and in which the patient declared that the limb injured was quite as good as its fellow. Such a result, however, is exceptional, and the patella is apt to remain permanently more or less retracted, sometimes to the extent of several inches. Generally, as after fracture of the patella, the impairment of the power of extension bears a direct ratio to the length of the fibrous band by which the severed parts are united; but this rule is not without exceptions. A case has been recorded in which a lengthening of six centimetres did not prevent complete voluntary extension of the leg; on the other hand, the power of extension may be seriously impaired, even when the uniting medium is short and firm. Here the disability is doubtless owing to some complication or sequel of the rupture, such as chronic inflammation of the knee-joint, atrophy of the quadriceps muscle, or adhesions between the opposed surfaces of the upper part of the synovial sac which lies underneath the quadriceps. In such cases flexion, as well as extension, is usually limited.

It is impossible to determine in what proportion of cases the power of extension is greatly damaged; but the number is larger than one would infer from a perusal of the published reports, in which very inferior results are often put down simply as "cures." We may be sure, however, that in a certain number of instances in which no union takes place between the ruptured parts, the power of extending the leg will be entirely abolished, and the act of walking rendered impossible without assistance. Hitherto such cases have been treated by some form of mechanical apparatus designed either to prevent the knee from being bent, or to make artificial extension by means of an elastic force; but, so far as I am aware, no attempt has been made to reëstablish the function of extension by an operation intended to restore the continuity of the ruptured ligament. Maydl states that, in a posthumous work by Veslingius (*Obs. Anat. et Posthum.*), published 1740, he found a notice of a case in which tenorrhaphy of the ligamentum patellæ was performed with success. He does not say, however, whether the injury was old or recent, and I have been unable to procure a copy of the work to which he

alludes. In the case of the patient now exhibited I operated eight months after the accident, by bringing together the separated ends of the ruptured ligament, and uniting them by sutures. The history reads as follows:

CASE II. Charles K., a healthy man, æt. 44, by occupation a rigger, was admitted under my care in the Roosevelt Hospital seven months ago, and gave the following history: In September, 1884, a heavy piece of timber fell across his right knee, and he was at once disabled and could neither walk nor extend the leg on the injured side. The accident occurred at sea, and the patient received no treatment beyond confinement in bed on account of pain and swelling of the knee. In December he entered a hospital in Calcutta, where the joint was incised to allow the escape of fluid. He recovered from the operation, but remained as weak in the knee as before, being unable to walk except when he wore a splint applied to the back of the limb in order to keep it straight. When he came under my charge he was still wearing a leather splint, which, although apparently well suited to its purpose, did not render locomotion easy. The gait was slow and unsteady, and the patient, otherwise in good health, was greatly discouraged in consequence of his infirmity, and declared his willingness to undergo any operation in the hope of regaining the usefulness of his limb. On examination the right knee was found to be tender on pressure, and moderately swollen from an accumulation of fluid in the joint. The patella was displaced upward about two inches; it was freely movable laterally, but could not be drawn down to its normal position. Above, its relations with the quadriceps could be readily distinguished, but below, it evidently had no connection with the tibia.

As nearly as I was able to ascertain, the ligamentum patellæ had been completely ruptured close to its inferior point of attachment, and no attempt had been made to repair the injury. In place of the ligament there was a gap into which the skin could be readily depressed until the fingers encountered the femoral condyles. The power of extending the leg was entirely absent, and the patient, when lying upon his back with his legs extended, was unable to raise his foot from the bed.

On May 19, last, I commenced an operation by making a longitudinal incision, six inches in length, in the median line on the anterior aspect of the knee, the centre of the incision being opposite the lower edge of the patella. The cut was subsequently lengthened both upward and downward until it measured nine inches. On exposing the injured parts, in doing which the knee-joint was freely opened, it

was found that the ligamentum patellæ had been torn away from the spine of the tibia, which was now covered by only a small amount of dense fibrous tissue, sufficient, nevertheless, to allow a firm hold for sutures. A little more than an inch of the ligament, in good condition, was normally attached to the patella. There was a complete lack of union between the ends of the severed ligament, and a great deal of difficulty was experienced in bringing them together after they had been freshened with the knife. Before the upper end could be drawn down and placed in contact with the lower one, it became necessary to make many deep oblique and transverse incisions into the median and lateral portions of the quadriceps; and even when this had been done as far as was deemed prudent, considerable force was required to secure apposition, which was maintained by two sutures of stout silver wire, the ends of which were twisted, cut short, bent flat-wise, and buried in the wound. The mucous and alar ligaments were found redundant, and were partly removed with the curved scissors. The incisions in the capsule of the joint were closed by catgut sutures, and the external wound was united, except at its upper and lower ends, in the same manner. Two bone drains, one on each side, were inserted into the joint through openings made for that purpose, and one into each extremity of the median incision. During the operation a solution of mercuric bichloride, 1:1,000, was applied freely to the wound, which was afterward covered with iodoform gauze. The limb was next enveloped in a moss-bag, moistened with the bichloride solution, and finally fastened to a long straight wooden splint, provided with a foot piece. Previous to the operation the knee and adjacent parts had been shaved, scrubbed several times with soap and water, then washed with oil of turpentine, and finally disinfected with a solution of mercuric bichloride.

The subsequent progress of the case was uneventful, except that, during the first four days, the patient complained of almost constant pain. This was so severe on the second day that I removed the dressing and examined the wound, which, however, showed nothing which would account for the man's suffering. The drainage-tubes were cleared of a few clots of blood, and a fresh dressing like the first was applied. On the fourth day the pain began to diminish, and soon afterward it disappeared altogether. The wound was not dressed again until July 7, seven weeks after the operation. It was then discovered that the wound had long before healed by primary union, except at its lower angle, where a minute skin ulcer remained, marking the site of one of the drainage-tubes. The wounds made for draining the joint were entirely closed. The patella was movable, as was

also the knee-joint; but no attempt was made to bend the leg beyond a few degrees. On July 21 the patient was allowed to get up, wearing a water-glass bandage. This could not be worn with comfort, and, a week later, was replaced by a leather splint, with which the patient walked about without much difficulty. He continued to use the splint until October, when he laid it aside. Meanwhile the knee has assumed nearly its natural size and shape, and it is evident that continuity of the ruptured parts has been reestablished.

My house surgeon, Dr. George S. Huntington, has, at my request, furnished me with the following precise description of the patient's present condition, which can be verified by the members of the society:

Measurements.—Thigh: Circumference at upper border of patella, right thigh $13\frac{3}{4}$ ", left thigh 14"; circumference at junction of middle and lower third, right thigh $13\frac{1}{4}$ ", left thigh $15\frac{1}{4}$ ".

Knees: Circumference of knee-joint over the patella, on both sides 13.9".

Leg: Circumference at junction of upper and middle third, right leg $12\frac{3}{4}$ ", left leg 13"; distance from tip of internal malleolus to lower border of patella, right side 15.6", left side 14.4".

Functional Result.—A line drawn from the middle of the upper border of the great trochanter to the centre of the outer surface of the external condyle is taken as the axis of the thigh. The axis of the leg is represented by a line drawn from the tip of the external malleolus to a point just anterior to the superior tibio-fibular articulation. On the left side in full extension of the leg, these lines form with each other an obtuse angle of 174° . On the right side, when patient is in the recumbent position, the amount of voluntary extension is as follows: The axis of thigh and leg forming an obtuse angle of 148° . When the patient is in a sitting posture, the amount of extension is increased to 155° .

Passive motion: Extension of leg possible to the normal limit. Flexion to a right angle. Rotation of the leg the same on both sides.

I will add that, in walking, the patient can easily and completely extend the leg; that for several weeks past he has been able to go up and down stairs without assistance, and that his limb is so steadily gaining in strength and freedom of action as to warrant the hope of further improvement.

At all events, I think it will be admitted that, in this case, the operation has conferred a great benefit upon him by restoring the usefulness of the limb; and that, in similar cases, sutur-

ing of the ligament deserves a further trial. The principal difficulty likely to be encountered, when the injury is not of recent date, is that of bringing into contact the ends of the ruptured ligament. In my case this was accomplished only after the rectus and the vasti muscles had been extensively scored, and even then the parts could not be brought together without decided tension. I am inclined to believe that the pain the patient complained of during the first four days after the operation was caused by the traction of the sutures, and that it was relieved only when the sutures had cut through and receded far enough to moderate the existing tension. And, although I neglected to note the level of the patella immediately after the operation, its present elevation may be held as proving that the segments of the ruptured ligament separated from each other to a considerable extent after they had been sutured, the gap so formed being now occupied by newly formed ligamentous tissue, like that which, in ordinary cases of this injury, is furnished to repair it.

That which has most interested and gratified me in this and in several other severe operations I have performed, in which the knee-joint has been involved, is the impunity with which this articulation may be opened, and indeed somewhat roughly handled, provided antiseptic precautions are scrupulously observed. This fact was especially forced upon my attention in a case of old fracture of the patella, in which I wired the fragments, one year ago, in the Roosevelt Hospital. The operation was performed in the usual manner, but the fracture was found to have been comminuted, and the fragments could not be brought into apposition without much difficulty, nor until the quadriceps muscle had been extensively exposed and repeatedly cut, in order to obtain the necessary elongation. Meanwhile, the bleeding was free, the knee-joint was frequently sponged out and irrigated, and the operation was prolonged, as well as severe; yet the patient recovered without an unpleasant symptom, under the use of a single dressing; and when this was removed, at the end of eight weeks, I discovered that the wound had healed throughout by the first intention, and that neither suppuration nor adhesive inflammation had taken place within the joint, which had a limited range of easy

motion. Such a case affords, according to my judgment, indubitable proof of the marvellous improvements in operative surgery which have been wrought by antiseptic methods; and, when I see it stated in a standard American text-book, published only three months ago, that "the alleged superiority of the antiseptic method cannot be said to have been as yet demonstrated," I am amazed at the author's incredulity. Even among those who practice antiseptic surgery, however, some hesitation is occasionally felt about opening the larger joints, and operations involving the healthy knee-joint are at present regarded by many with the same kind of apprehension which, not a great many years ago, deterred surgeons from invading the peritoneal sac. The latter procedure is, as we now know, reasonably safe, and I cannot doubt that the operation of opening the knee-joint is already, when properly performed, far safer. I confidently anticipate the time when skilful and careful surgeons will be able to divest it of all danger either to life or limb; and, whenever this period arrives, our time-honored, but clumsy, tedious, and uncertain method of treating both fracture of the patella and rupture of its ligamentous attachments may well be abandoned in favor of some form of operation calculated to secure an immediate union of the divided parts.

CASES OF RUPTURE OF THE LIGAMENTUM PATELLÆ.

No. Hospital.	Age and Sex.	Date.	Observer.	Side of rupture.	Cause.	Condition.	Treatment.	Results.
1. New York.	32. M.	1844.		Right.	Fall from a wharf into water, striking knee against a boat.	Joint much swollen; rupture at patellar insertion, carrying away a minute fragment of bone; patella not much retracted and easily brought down.	Leeches, poultices, low diet; at end of ten days pads and straps.	Firm union; discharged "cured" at end of four months.
2. New York.	26. M.	1854.	Watson.	Right.	Fall, thirty feet, striking knee.	Rupture of ligament just above tibial insertion; joint distended and painful.	Extension, cold lotions; crutches after four weeks.	Discharged "cured" at end of two months.
3. New York.	32. M.	1859.	Markoe.	Left.	Slipped and fell, striking left knee.	Marks of fracture of patella situated a year previously; fragments united by ligament; patellar ligament ruptured at tibial insertion; joint greatly distended and painful.	Single inclined plane; evaporating lotions; compress and bandage, which had to be removed on account of pain; reapplied four weeks later.	Discharged eleven weeks after accident with firm union.
4. Bellevue.	60. M.	1870.	Hamilton.	Right.	While wrestling, was thrown on left knee, and felt something give way; on attempting to get up, was unable to extend right leg.	Ruptured ligamentum patellæ.	Plaster-of-Paris bandage; figure-of-8 bandage to knee.	
5. Bellevue.	40. M.	1874.		Left.	While carrying a plank, patient fell, striking left knee.	Complete rupture of ligament; patient unable to stand or to extend leg; no pain or distention of joint.	Plaster-of-Paris bandage day after accident; renewed three times, and finally removed at end of six weeks.	Ligament united to tibia; knee somewhat stiff when patient was discharged, eight weeks after injury.

CASES OF RUPTURE OF THE LIGAMENTUM PATELLÆ. *Continued.*

No.	Hospital.	Age and Sex.	Date.	Observer.	Side of rupture.	Cause.	Condition.	Treatment.	Results.
6.	Bellevue.	50. M.	1874.	Wood.	Both.	Patient, whose heel had been caught between two flagstones, squatted quickly to pick up his hat, felt something give way, and fell to the ground helpless.	Each patella retracted from rupture of ligament; any extension of legs absolutely impossible.	Commenced 7 months after injury; posterior splint; figure-of-8 bandage.	Left hospital a fortnight after admission; result not known.
7.	Bellevue.	22. M.	1874.		Left.	Patient, while carrying a barrel of flour, stumbled and made a powerful effort to save himself from falling forward; heard something snap as he fell; found left leg helpless.	Signs of old fractured patella eight months previously; firm fibrous union two inches in length; immediately below patella a groove corresponding with ruptured ligament.	Posterior splint.	
8.	Bellevue.	52. M.	1878.	S. Smith.	Left.	Was knocked down, striking knee against doorstep.	Much swelling and effusion in joint; rupture of ligament close to its attachment to patella.	Posterior splint; ice bag; afterward figure-of-8 bandage and traction with adhesive plaster.	Patient discharged with stiff knee eight weeks after injury.
9.	Bellevue.	10. M.			Right.	Fall from a roof.	Fracture of left femur; rupture of right ligamentum patellæ; incomplete, a few fibres only remaining intact.		
10.	Roosevelt.	35. M.	1882.	Sands.	Right.	Slipped while getting on a street car, and felt something give way.	Marks of old fracture of patella; fibrous union band two inches long; ligamentum patellæ ruptured near its tibial insertion.	Ice bag; extension, at first horizontal, afterward vertical; rubber bandage.	Recovery, with useful limb.

11.	Bellevue.	34	M.	1884.	Dennis and Bryant.	Left.	Fallen beneath a falling building.	Rupture of ligamentum patellæ; fracture of lower third of femur; severe contusion of limb.	Double inclined plane for thirteen days; back's extension twenty-five days; plaster-of-Paris bandage six weeks.	Two years after injury patient has a stiff knee with the leg extended; flexion easy to the extent of 5 to 10 degrees, where it is suddenly checked, apparently in consequence of adhesion and shortening of the quadriceps at seat of fracture. Ligamentum patellæ reunited and firm, being lengthened only 1-2 an inch. Patella movable laterally, but not downward. Contraction of quadriceps causes no tension of ligamentum patellæ.
12.	Roosevelt.	44.	M.	1885.	Sands.	Right.	Blow from a heavy piece of timber.	Eight months after accident power of extension entirely lost; patella retracted two inches; a depression in place of ligamentum patellæ, which seems to have been ruptured near tibial attachment.	Joint opened; ligament sutured.	Six months after operation power of extension regained sufficiently to enable patient to walk with ease.
13.	St. Luke's.	47.	M.	1869.	Weir.	Left.	Slipped while crossing street; did not strike knee; walked with assistance twenty or thirty feet after accident.	Rupture of patellar ligament.	Limb extended in plaster-of-Paris splint for six weeks.	Began to walk soon after removal of splint. Sixteen years later (1885) injured limb as good as other. Ligament same width and length as others by measurement.