CHRONIC PATELLA TENDON RUPTURE REPAIR USING AUTOLOGOUS EMITENDINOSUS AND GRACILLIS TENDONS WITH PRESERVED DISTAL ATTACHMENT

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ABSTRACT

Background: Acute patella tendon injuries are rare and require prompt surgical treatment and primary repair for the best outcomes. Chronic patella tendon injuries happen when an acute injury is missed, or an acute repair fails due to poor surgical technique or lack of patient adherence to a prescribed rehabilitation protocol.

Objective: The study describes our experience with an anatomical repair using ipsilateral semitendinosus and gracilis tendons with preserved distal attachment.

Methods: Three male patients aged between 38 and 65 years of age, presented between three and five months after their initial injuries, two with missed injuries and one with a failed repair. Two patients had injuries to the right knee and one to the left. All three had extensor lags between 40° and 60° with impairment of activities of daily living. All three had repairs of the remnant patella tendon performed with augmentation of the repair using ipsilateral semitendinosus and gracillis tendon with preserved distal attachment.

Results: All three patients had good outcomes with restoration of full extension without extensor lag and resumption of activities of daily living at a minimum of one year follow up.

Conclusions: Repair of chronic patella tendon ruptures using ipsilateral semitendinosus and gracillis tendons with preserved distal attachment provides ideal functional outcomes with the advantage of minimal donor site morbidity without increasing cost or risk of infection.

Key words: Semitendinosus, Gracillis, Patella tendon, Extension lag, Rupture

INTRODUCTION

Patella tendon ruptures are rare injuries of the extensor mechanism. The common mechanism of injury is eccentric contraction of the quadriceps against a flexed knee. Pre-existing tendinopathy in patients with systemic conditions such as systemic lupus erythematosus, diabetes mellitus or patients using systemic corticosteroids are at increased risk of ruptures, particularly bilateral ruptures.

Acute patella tendon ruptures require prompt surgical intervention to restore function. Evolution of sutures and suturing techniques such as the double Krackow technique allow fashioning of repairs that allow early mobilisation, reducing the incidence of patellofemoral pain and patella cartilage chondrosis, which develop in fixations requiring immobilisation of the limb. This mobilisation however must be graded during postoperative rehabilitation with respect to magnitude and timing of loads applied to the limb. In the absence of graded rehabilitation, the repair can be significantly displaced with development of gaps between the ends of the repair, preventing healing and resulting in clinical failure and transition into a state of chronic patella tendon rupture(1).

Chronic ruptures can also develop if there is failure to identify acute disruption and manage them appropriately. Surgical management of chronic patella tendon ruptures is complicated by development of adhesions, retraction of the patella and significantly, deterioration of the quality of the patella tendon tissue (2). The poor quality of the patella tendon tissue makes the solitary repair of the patella tendon disruption tenuous. The questionable strength of this repair necessitates some form of augmentation of the patella tendon repair to allow restoration of function of the extensor mechanism (3).

A number of techniques have been outlined in literature. We describe our experience with one such technique in treatment of chronic patella tendon ruptures in a case series of three patients.

MATERIALS AND METHODS

Three patients with chronic patella tendon ruptures were operated on between August 2016 and August 2018. One had a failed primary repair of the patella tendon injury and two had neglected injuries. Their clinical presentations were as follows:

Patient A

A 65-year-old male presented with inability to straighten his left leg having suffered a fall down a flight of stairs. Following development of his symptoms he presented to a peripheral health facility where the diagnosis was missed. He presented to us 4 months after the injury. On examination he had an extension lag of 70^0, measured using a goniometer, power of 3/5 on the MRC scale for extension of the knee, passive range of motion from 0^0 to 130^0 and wasting of the quadriceps muscle with the girth of the thigh measured 10 cm above the superior pole of the patella being 3cm less than the right. Plain radiography demonstrated patella alta and MRI demonstrated complete rupture of the patella tendon.

Patient B

A 42-year-old male presented with inability to extend the right knee following an attempt to lift a heavy load during which his right knee buckled. He was diagnosed to have an avulsion of bone from the inferior pole of the patella and an attempt was made to repair the injury using tension band wiring and repair of the torn medial and lateral extensor retinacula. One week postoperatively he developed purulent discharge from the surgical site which was treated with oral antibiotics. He presented three months later and was noted to have a persistent extension lag of 40^0. A repeat radiograph showed escape of the distal patella fragment from the repair construct.

Figure 1

X-ray showing patella alta and MRI showing disruption of the patella tendon for case 1

Patient C

A 38-year-old prisoner who presented with complaints of inability to extend the right knee for 5

Figure 2

X-rays showing the avulsed fragment on the left and the escape of the fragment from the repair on the right for patient 2

months following a fall during heavy labour. On examination he had an extensor lag of 60° as measured using a goniometer, an MRC of 3/5 for knee extension and wasting of the quadriceps muscle with the girth of the thigh measured on left being 2.5cm less than on the left 10cm above the superior pole of the patella. Plain radiography showed patella alta and MRI demonstrated a complete rupture of the patella tendon.

All three patients were diagnosed with chronic patella tendon injuries and the surgical intervention was to perform a repair of the patella tendon augmented with an ipsilateral semitendinosus and gracilis tendons with preserved distal attachment.

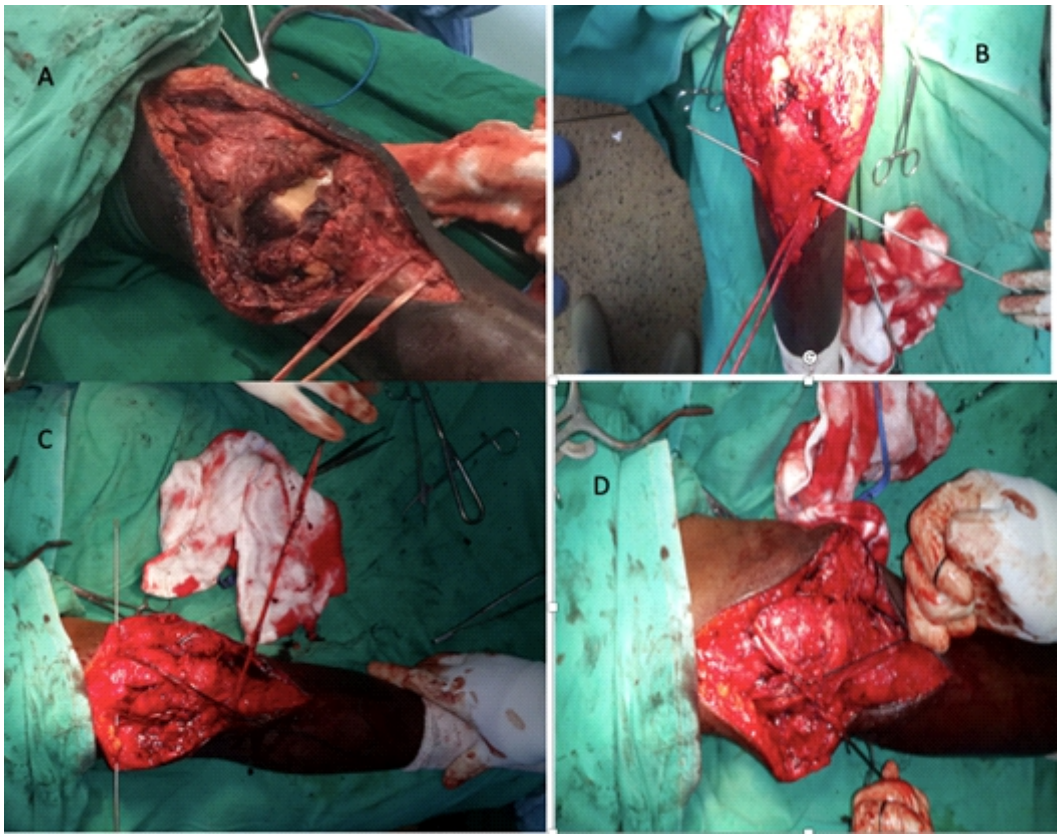
Surgical technique

Under spinal anaesthesia and with a pneumatic tourniquet applied and a midline incision extending from 4cm below the tibial tuberosity to a point 5cm above the superior pole of the patella was made to expose the tibial tuberosity, the patella tendon stumps, the patella and the quadriceps tendon. The medial flap was undermined exposing the pes anserinus and the distal attachments of the semitendinosus and gracilis tendons. The tendons were mobilised without releasing the distal attachment following which the tendons were harvested using a closed tendon stripper. This freed the proximal end of the tendons which were cleaned of the remnant muscle fibres, folded on themselves and sutured longitudinally with number two ethibond to facilitate application of traction during passage of the free tendon ends.

A guide wire was passed horizontally through the tibia at the level of the tibial tuberosity 2cm posterior to the anterior cortex. This was used to guide a cannulated drill bit of size 4.5mm to make a tunnel.

Figure 3

Stages of the surgery A: Both tendons mobilised B: Guidewire for drilling of the tunnel at the tuberosity C: Semitendinosus passed D: Tensioning both tendons to recreate InsalSalvati index



The free end of the gracillis tendon was passed to the inferolateral aspect of the patella, anterior to it then through the quadriceps tendon from the lateral aspect to the medial aspect along the superior pole of the patella. From the medial end of the quadriceps tendon, the free end of the gracilis tendon was passed once again anterior to the patella towards the lateral aspect of the tibial tuberosity.

The free end of the semitendinosus tendon was passed through the bone tunnel at the level of the tuberosity to the lateral aspect of the tuberosity. From the lateral aspect of the tuberosity the tendon was passed towards the inferomedial aspect of the patella over its anterior aspect to the medial end of the quadriceps tendon then through the substance of the quadriceps tendon to its lateral aspect along the superior pole of the patella. From the lateral end of the quadriceps tendon the free end of the semitendinosus tendon was once again passed anterior to the patella towards the medial aspect of the tibial tuberosity.

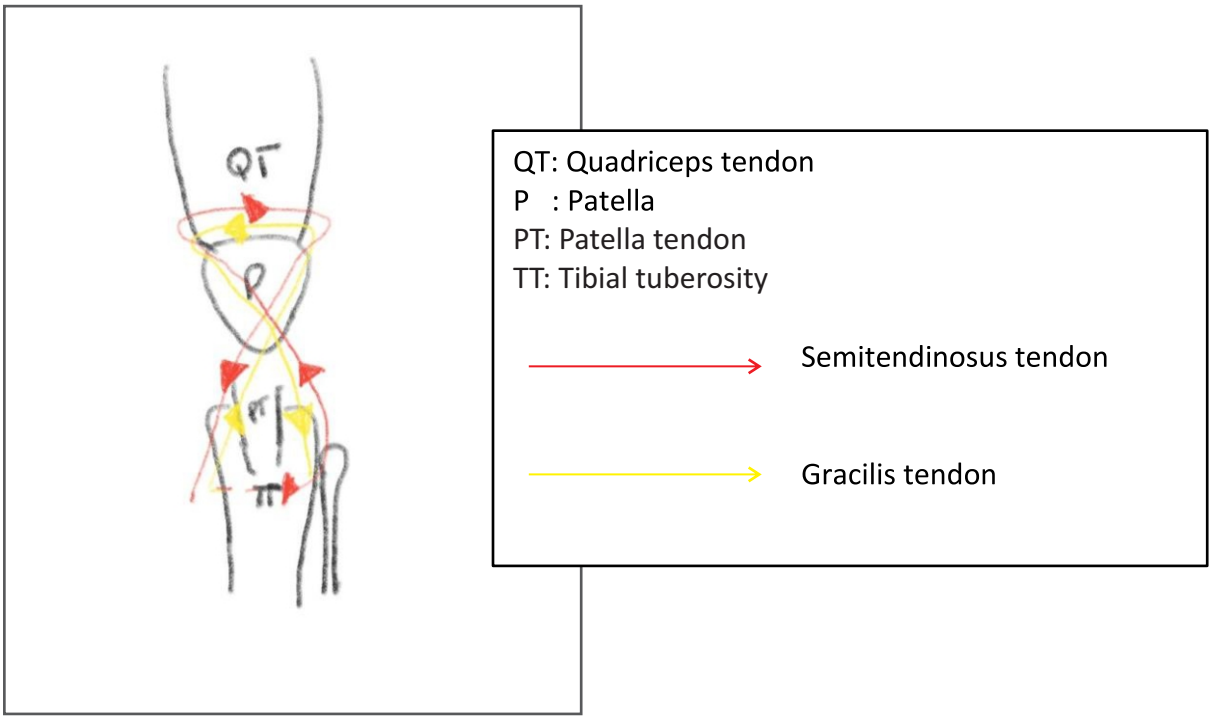
Both tendons defined a figure of eight anterior to the patella and overlapped at the medial and lateral aspects of the tibial tuberosity. The tendons were tensioned to bring the patella towards the tibial tuberosity and attempting to ensure the distance from the lower pole of the patella to the tuberosity was approximately equal to the height of the patella.

For the three cases in this series, release of adhesions between the quadriceps and the fascia lata and those in the suprapatellar bursa sufficed to mobilise the retracted patella without performing a z plasty of the quadriceps tendon. The semitendinosus and gracilis tendons were sutured to each other using ethibond size 5 suture at the points they overlapped on the medial and lateral aspects of the tibial tuberosity.

The remaining patella tendon tissue was then repaired using a double Krackow technique. For case two this required excision of the avulsed patella fragments and repair using tunnels drilled into the inferior end of the patella and passing the ethibond suture used to apply the Krackow suture through the tunnels.

The final construct is demonstrated in the schematic diagram below:

Figure 4
Schematic diagram showing repair



Post-operative rehabilitation

Following surgery, the limbs were placed in a ranger knee brace with the knee in extension. Isometric contraction of the quadriceps was encouraged for the first two weeks with the knee in full extension in the brace. Patients mobilised using crutches without bearing weight on the operated limb. Starting at two weeks the brace was adjusted to allow flexion in increases of 30° every two weeks. Passive flexion was taught to the patients in physiotherapy with active flexion to the extent allowed by the brace. At four weeks patients were allowed to start toe touch on the operated limb and progressed to full weight bearing at 6 weeks.

RESULTS

All three patients achieved full extension without presence of an extensor lag. Surgical sites in all three patients healed without any complications. The patients had Lysholm knee scores between 90 and 95 6 months following surgery.

Figure 5

Showing extension without extensor lag for Patient A and Patient C at six months post-op

DISCUSSION

Patella tendon ruptures account for 3-6% of extensor mechanism injuries and are the third most common injury of the extensor mechanism after patella fractures and quadriceps tendon disruptions. These are debilitating injuries with significant impairment of function of the limb.

Chronic patella tendon injuries arise in the event of missed ruptures or failure of repaired acute tendon ruptures (4). They are distinct injuries given they are attended by several complications that make surgical intervention harder than in the acute setting including development of adhesions, proximal retraction of the patella and in particular, poor quality of residual patella tendon tissue (3). In this setting, solitary repair of the patella tendon is tenuous and cannot withstand the potential loads transmitted in the extensor mechanism. This places such repairs at risk of developing gaps between ends of the repair or outright disruption of the repair and consequently, development of clinical failure.

Questionable quality of patella tendon tissue necessitates augmentation of the repair of the remnant tendon tissue. A number of augmentation techniques have been described in literature. Repair techniques may use autologous grafts, allografts, or synthetic materials to augment the patella tendon repair.

Sundararajan *et al*. (4) described use of ipsilateral semitendinosus and gracillis tendon grafts without preservation of distal attachment. In their series, they similarly fashioned a figure of eight reconstruction but in addition to the tunnel drilled through the tibial tuberosity, they drilled a tunnel through the patella and passed the tendon graft through this tunnel instead of through the quadriceps tendon.

Ecker *et al*. (5) in a series of four patients described use of semitendinosus and gracillis tendon grafts but drilled separate tunnels through the patella for each tendon. In addition to the augmentation provided by the tendon grafts they also used cerclage wire to further strengthen the repair. Techniques that require the drilling of a tunnel through the patella carry the risk of patella fracture(6).

Dejour *et al* (7) described use of an autograft from the contralateral limb consisting of the middle thirds of the quadriceps tendon, the patella, the patella tendon and a portion of the tibial tuberosity. Other techniques describing use of autografts from the

contralateral limb include the use of the middle third of the contralateral patella tendon and free semitendinosus and gracilis tendon grafts (8-11). These techniques carry the disadvantage of transferring morbidity to the contralateral limb but may be necessary in the setting of multiple tendon injuries in the involved limb.

The use of allografts to augment the repair has also been described including use of semitendinosus and gracilis tendon grafts, patella tendon grafts, achilles tendon grafts and extensor mechanism grafts (12-14). Use of allografts carries the risk of transfer of infections and failure of take. In our setting the lack of legislation is a further impediment to use of allografts.

Synthetic materials can also be used to augment the repair including use of cerclage wire or dacron tape. Casey *et al.* (15) described the use of multiple strands of cerclage wire. Cerclage wire has to be tensioned in extension or some degree of flexion, frequently 90^0. Tension in extension limits the range of motion of the knee and this has been shown to increase the incidence of patellofemoral pain and patella cartilage chondrosis. The stiffness of the wire also limits the range of motion of the knee. Dacron tape carries the advantage of allowing greater range of motion and is postulated to allow for ingrowth of fibroblasts to form a new tendon-like structure. Synthetic forms of augmentation carry the disadvantage of requiring a second surgery to remove the implant. Being foreign they also carry the risk of infection in addition to increasing cost of surgery.

The technique used in our series, augmentation of the repair with semitendinosus and gracilis tendon grafts with preserved distal attachment, was first described by Chen *et al*. (16). He also augmented the repair further using cerclage wire. Biomechanical studies have shown augmentation of patella tendon rupture repairs with cerclage wire has no significant benefit preventing development of gaps in the repair at loads applied during early rehabilitation. Takazawa *et al* (2) used semitendinosus and gracilis tendon grafts with preservation of distal attachment in two patients with good outcomes. This technique has several advantages. It limits morbidity of surgical intervention to the same limb as the injury in contrast to techniques that use autografts from the contralateral limb. With respect to the involved limb, harvesting the semitendinosus and gracilis tendons has not been shown to have any significant detrimental effect on the flexion of the knee joint. Passage of the tendon grafts through the quadriceps tendon instead of through a tunnel in the patella also eliminates the potential complication of patella fracture. Preservation of distal attachment theoretically preserves blood supply to the tendon grafts potentially preserving functional integrity. Given tendon grafts are autografts, they don't carry risk of transmission of infections or graft rejection. The lack of need for synthetic material to augment the repair also reduces cost and stiffness of the repair, allowing for greater degree of knee flexion. Lack of synthetic material also eliminates need for secondary surgery to remove synthetic material.

CONCLUSIONS

Chronic patella tendon injuries are characterised by poor quality of the remnant tissue of the patella tendon. Primary repair of this tissue can prove challenging and if successful the strength of the repair is of questionable strength and may not withstand the forces transmitted through the extensor mechanism. The repair therefore requires some form of augmentation of which many have been described in literature. We present our experience with use of one such technique that makes use of the semitendinosus and gracilis tendons with preserved distal attachment. This technique has several advantages. Use of autologous grafts reduces the risk of rejection of the graft material as well as the risk of transfer of infections. Using the ipsilateral semitendinosus and gracilis grafts limits the morbidity of the surgical intervention to the same limb. The technique does not require the use of synthetic augmentation materials such as dacron tape or cerclage wire and consequently this reduces cost and eliminates the need for a secondary surgery to remove the foreign material. The technique also achieves good functional outcomes as demonstrated by the achievement of full extension without extensor lag in our series of patients. Taking all this into consideration it should therefore be one of the considerations in reconstruction of the extensor mechanism in patients with chronic patella tendon injuries.

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