Original Article

Surgical Technique of Reconstructing Patellar Tendon with Ipsilateral Hamstring Tendons with Preserved Distal Insertion

Feng-Chen Kao[1,2], Tzu-Chun Chung[1,2], Yuan-Kun Tu[1,2], Chi-Kun, Hsiao[3],

Pao-Hsin Liu[4]

Objective: To evaluate new technique of preserved distal semitendinous-gracilis insertion with newly designed detachable tendon stripper.

Method: For chronic or neglected patellar tendon rupture, reconstruction techniques with patellar tendon substitute were needed. We used our own designed detachable tendon stripper in the procedure of semitendinous-gracilis tendon harvesting which could preserved the distal insertion to from tendon to bone which was previously thought as the most difficult part of tendon transfer because it needed tendon to bone healing. We repaired the tendon and strengthened the repair with additional tendon transfer with distal insertion well fixed which could provide early range of motion.

Results: Those patellar tendon reconstruction have some technical difficulties to perform and there was no consensus of standard surgical technique of reconstructing patellar tendon. Here, we reported our modified surgical technique by only using semitendinosus-gracilis (STG) tendon grafts with preserved distal insertions to reconstruct chronic patellar tendon rupture. In our 5 cases, our patients had earlier range of motion and no recurrent disruption of patellar tendons during our follow-up periods

Conclusions: Our new technique with newly designed detachable tendon stripper has advantages in preserving the distal insertion of the semitendinosus-gracilis (STG) tendon grafts and early range of motion rehabilitation. It is a feasible and alternative method in reconstruction of chronic patellar tendon disruption.

Key words: patellar tendon, rupture, semitendinosus, gracilis, hamstring

Introduction

The peak incidence of patellar tendon ruptures is in the age of 30 to 40 years old

From the [1]Department of Orthopaedics, E-Da Hospital, and [2]School of Medicine for International Students, I-Shou University, and [3]Department of Biomechanics Research Laboratory, I-Shou University, and [4]Department of Biomedical Engineering, I-Shou University, Kaohsiung, Taiwan.

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Address reprint request and correspondence to: Feng-Chen Kao, Division of Internal Medicine, E-Da Hospital, I-Shou University, No. 1, Yida Road, Jiaosu Village, Yanchao District, Kaohsiung City 82445, Taiwan.
[1]Tel: +886-7-6150011 ext. 2971, Fax: +886-7-6155352, E-mail: holdenhsu@gmail.com

of life.[1-4] This kind of injury typically happens during a sporting activity.[5-7] The ruptured patellar tendon is usually completely and located at the proximal insertion area.[8] Patellar tendon rupture is not a common injury but it is an extremely disabling injury resulting in an inability to extend the knee. If not correctly diagnosed, the patellar tendon rupture would become chronic or neglected.[3,9]

Surgical intervention is the gold standard of treatment for ruptures of the patellar tendon.[10] The management goal of this type of injury is aiming to restore the extensor mechanism that facilitates active knee extension. Treatment of acute patellar tendon ruptures involves direct tendon to tendon repair by end-to-end sutures or tendon reinsertion by transosseous sutures. The repaired patellar tendon is temporarily protected with an additional reconstruction procedure involving using wires, or synthetic sustention bands.[1,11]

Chronic patellar tendon rupture was defined as more than six weeks of rupture after first presentation.[39] For chronic or neglected patellar tendon rupture, direct repair of the ruptured tendon is often difficult. Therefore several reconstruction techniques with patellar tendon substitute have been reported. Those patellar tendon substitutes include synthetic material, the contralateral patellar tendon, an allograft such as the Achilles, the quadriceps tendon which is turndown, and isolated semitendinosus tendon alone, or together with the gracilis tendon.[12-16] Additional methods to relocate the patella to the optimal location and provide support to the reconstructed tendon include preoperative traction, intraoperative traction, external fixation, and quadricepsplasty.[17]

Those patellar tendon reconstruction have some technical difficulties to perform such as contractures, adhesions, and atrophy of the quadriceps muscle after surgery.[18] Besides, there was no consensus of standard surgical technique of reconstructing patellar tendon. However, previous report have described their surgical technique by using semitendinosus-gracilis (STG) tendon grafts with preserved distal insertions and concomitant with additional fixation with tension-reducing wire for reconstruction of the patellar tendon.[17] Here, we reported our modified surgical technique by only using STG tendon grafts with preserved distal insertions to reconstruct chronic patellar tendon rupture.

Surgical technique

Under general or spinal anesthesia, the patient was positioned in a supine position on the operating table. A small rolled-up sheet was put beneath the buttock at the site of the injured limb (Fig. 1 and 2A). The affected limb was prepared and draped with standard steril-

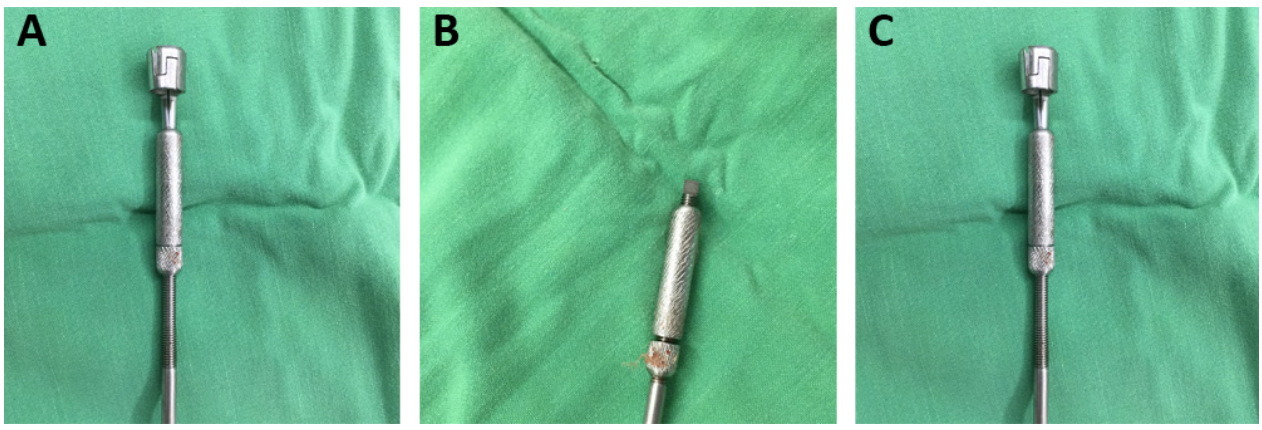

Fig. 1 (A)The round blades of tendon stripper which are disassemble. (B) The disassemble stick part of the tendon stripper. (C) The assembled tendon stripper.

ized technique with a tourniquet for making ischemia of the knee after harvesting tendon grafts during operation. We adopted a modified technique for patellar tendon reconstruction based on previous literature.[6,17,18] An longitudinal anterior midline skin incision was made from 4 cm above the proximal pole of the patella to the tibial tuberosity and continue with a 4 cm curve incision above the pes anserinus.

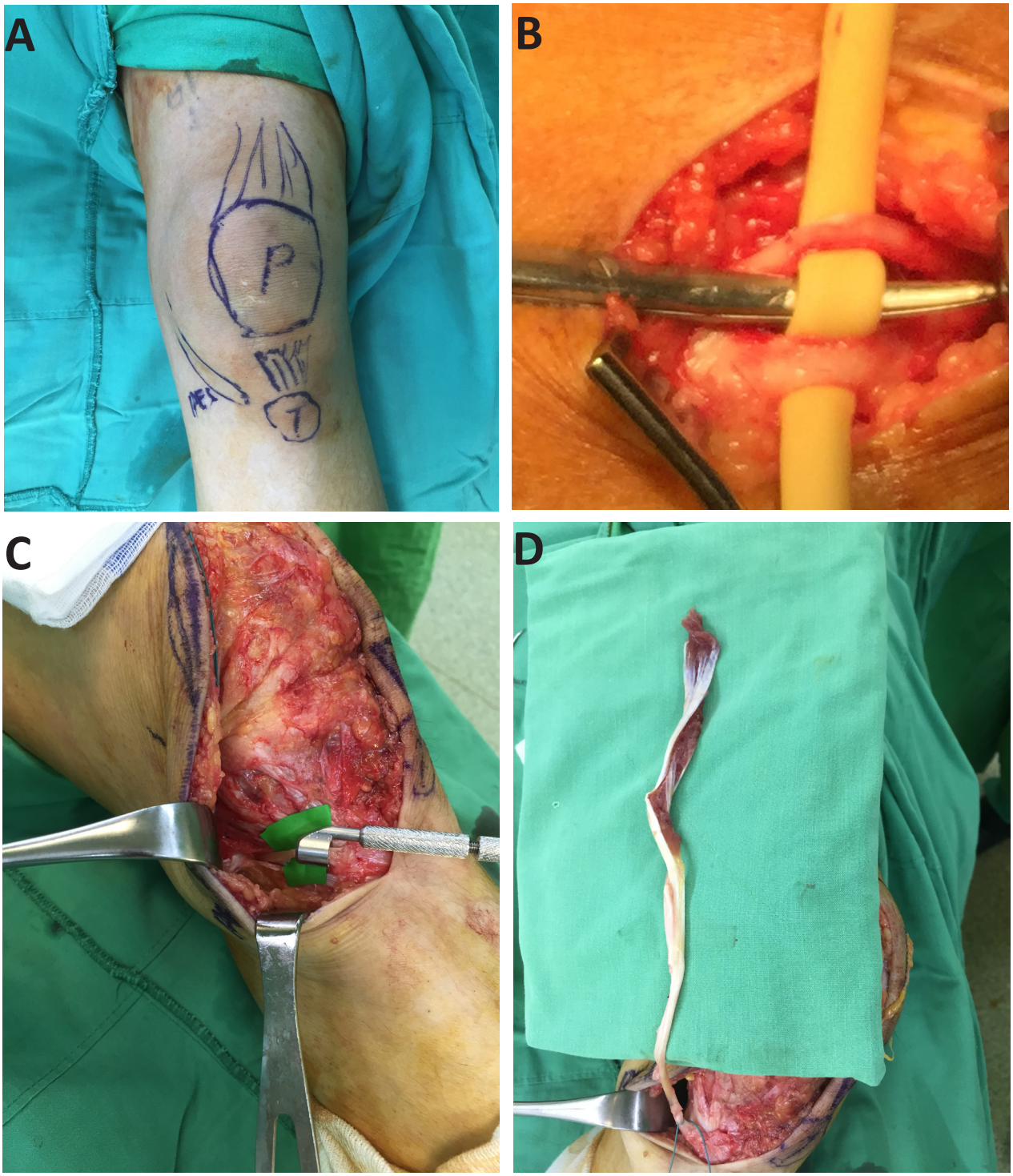

Fig. 2 (A) The demography of the knee area ,where P means the patellar bone; T means tibial tuberosity ;PES means Pes anserinus. (B) We identified the distal insertion of the gracilis and semi-tendinous tendons and marked them with rubber tube. (C) We used the assembled tendon stripper for harvesting the tendons with preservation of the distal tendon insertion. (D) The harvested tendons was showed as the figure showed with well preservation of the distal insertion

First we harvest the hamstring tendon grafts by identify the semitendinosus and gracilis tendons at the medial ridge of tibia. The distal insertions of the semitendinosus and gracilis tendons were exposed and preserved. We then apply the Krachow suture at the distal end for up to 3 cm from the bony insertion as reinforcement for traction. A rubber tube was put between the tendon and the medial ridge of tibia to facilitate the application of tendon stripper (Fig. 2B). The semitendinosus and gracilis tendons were cut as far proximally as possible at the boundary of the muscle belly by a tendon stripper to achieve maximum length of the tendon grafts (Fig. 2C). Then tendons were cleaned of remaining muscle and fatty tissue and sutured the proximal ends of the tendon grafts by No. 2 ethylbone along their longitudinal axes to aid in subsequent passage of the tendons through the bony tunnels. A moist gauge was temporarily used to cover the tendon grafts before inserted to the patella.

After the tendon grafts are well prepared, the operation was shifted to patella tendon area and the tourniquet starts to work at that time. The residual tissues and scar tissue in the remnants of the patellar tendon were preserved. Adhesions around the patella and parapatellar retinaculum were sequential lysed and patellofemoral joint arthrolysis were done to mobilize the patella distally. The undersurface of quadriceps tendon was released or quadriceplasty was done if the patella is still too tight to be pull down to the femoral intercondylar groove when knee flexed to 90°.

We created two transverse bone tunnels by reamer for inserting tendon graft. Two guide pins were inserted with the guide of anterior cruciate ligament reconstruction before reaming. One tunnels is located between distal third and intermediate zone of the patella and the other one at the level of the tibial tubercle. The sizes of this two tunnels were about 5 – 6 mm in width to allow the tendons to pass through.

While the knee was held in 45° flexion, the free end of the semitendinosus tendon and gracilis tendon were then passed from the medial to the lateral openings of patellar tunnel. A continue stretching force was applied to the tendon grafts and then the knee was slowly flexed to 90° passively. We try to make that this length of the patellar tendon is approximately equal to the length of the patella according to the Insall-Salvati ratio.[19,20] The congruence of knee patella tracking was also checked. The tendon grafts were then fixed with interrupted sutures at medial opening of patellar tunnel, the point of medial distal portion of patella contact with tendon grafts and medial site of the remnants of the patellar tendon (Fig. 3A and 3B). Then the knee was held in 45° flexion again, the free end of the tendon grafts were then passed from the lateral to medial openings of tibial tunnel. Again, a continue stretching force was applied to the tendon grafts and the knee was slowly flexed to 90° passively. The tendon grafts were then fixed with interrupted sutures at lateral opening of patellar tunnel, the point of lateral distal portion of patella contact with tendon grafts, lateal site of the remnants of the patellar tendon and the lateral opening of tibial tunnel. Finally, the tendon grafts were fixed to itself at medial site of tibial tunnel.

After the repair was completed, the knee the knee was protected by a range of motion (ROM) knee brace which was set at 10° flexion. Stretching leg raising exercise of quadriceps with ROM brace started after operation. After 3 weeks, we allowed the patients to walk with a brace adjusted for progressive range of motion. Continuous passive motion (CPM) training started six weeks later after operation. Close train exercise for quadriceps started at the same time. Jogging was allowed after 3 months Functional recovery of the extensor unit of the knee could be expected.

Discussion

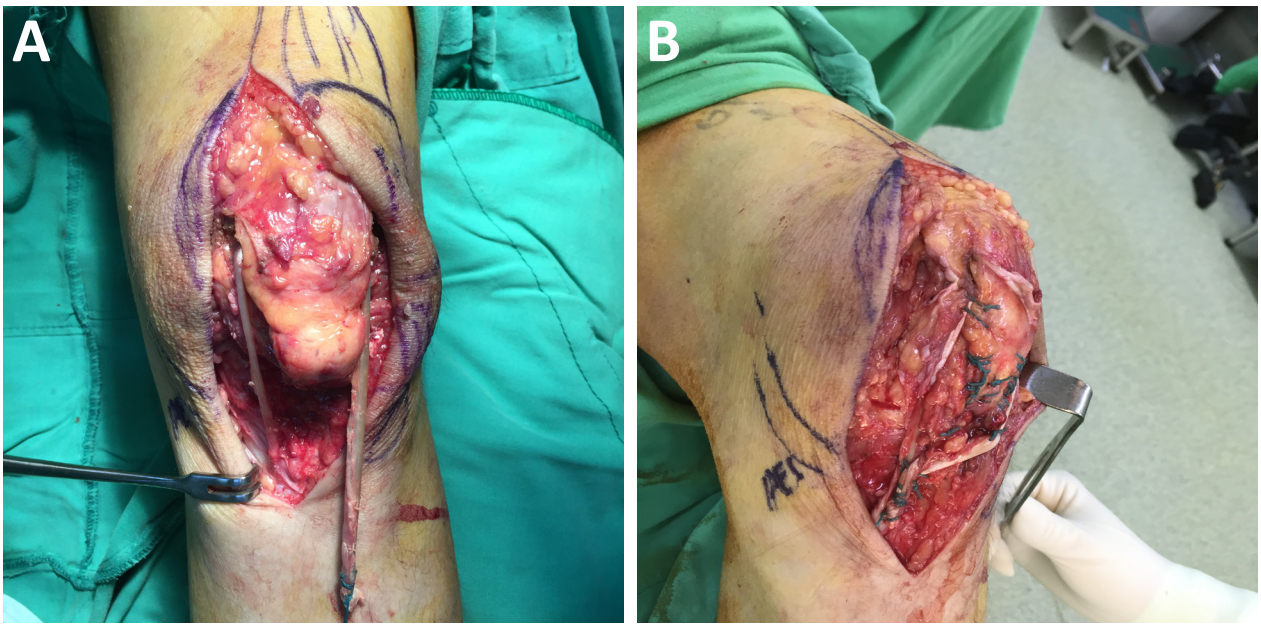

Fig. 3 (A)We used 6 mm reamer for cruciate ligament reconstruction and then passed the tendon through the bone tunnel. (B) After Krackow tendon suture and the reinforcement of gracilis and semi-tendinous tendons with preserved distal insertion, the reconstruction was completed.

Rupture of the patellar tendon is the relatively uncommon knee injuries[21] causing knee extensor mechanism disable. The rupture of patellar tendon takes place when the estimated force reaches 17.5 times greater than the body weight[1,22-24] and is usually an eccentric overload of the extensor mechanism with the foot fixed on the ground and knee flexion. Several conditions may lead to poor quality of ruptured patellar tendon such as rheumatosis,[25] metabolic abnormalities,[26] hormonal disorders,[27] local steroid injection therapy,[28] after total knee arthroplasty,[6,18,29] and following anterior cruciate ligament reconstruction with a bone-patellar tendon-bone autograft,[30] and knee joint infection. This condition makes primary repair of ruptured patellar tendon less suitable. Hence, the use of autogeneous grafts can compensate poor tissue quality of the ruptured patellar tendons.[31]

Several surgical methods for this challenging problem of repair of neglected ruptured patellar tendon have been previously described. Such as the method of simple re-approximation of the torn ends and direct repair augmented by cerclage wire.[32] Several different substitutes for repairing the torn patellar tendon have been used, such as a contralateral bone-patellar tendon-bone graft[14] with double-wire loop reinforcement, bone-patellar tendon-bone allograft,[26] Achilles tendon allograft,[9] and synthetic materials.[33] But those techniques have a potential risk of bacterial or viral infection, non-conventional transmissible agent transmission and donor site morbidities.

The use of autogenous semitendinosus-gracilis tendon grafts with a Steinman pin for patellar traction has been reported.[34] Other authors[17,35-41] also used autogenous semitendinosus-gracilis tendon grafts to reconstruct the ruptured patellar tendon with different alternative methods. Some authors add the additional circular wire through the patellar and tibial tunnels[17,36,40] to keep satisfactory patellar height and proper patellar tracking. Other authors think that using autogenous semitendinosus-gracilis tendon grafts is enough.[35,37-39] This can avoid the need of secondary surgery to remove the implant or infection related to the metal materials. Our technique did not use any additional material to reinforce the repaired tendon grafts.

The value of the use of a semitendinosus-gracilis tendon graft and the preservation of its distal insertion have been previously described.[17] STG tendons are rich in tendon fibers which can yield a strong graft; the ultimate tensile load of doubled semitendinosus tendon grafts have been reported to reach 2330 N.[42] This autograft can restore the strength and stability of the extensor mechanism with minimal donor site morbidity.[13,43] Besides, the integration between tendon and bone is strengthened and stability is maximized by preserving distal insertion of the tendon and pulling tendons through tunnels in the bone. The blood supply was retained at this point from the original insertion of the STG to promote healing of the tendon, which could provide additional stability of the tendon graft loop. It has also mentioned that the semitendinosus and gracilis tendons are generally shorter (about 21 cm) in Chinese people than in other races.[17] For this reason, we favor reconstruct the tendon grafts in circular type rather than figure of eight shape.

A previous study has reported the technique of placing both tendon grafts in front of the patella in a figure-of-eight fashion to transmit the tension load from the patella directly to the tibial tubercle. The patella is pulled downward and prevented from floating anteriorly by both tendons when the knee bends. Our technique resolve this problem by fixing the tendon graft with interrupted sutures at openings of patellar tunnel, the points of distal portion of patella contact with tendon grafts and sites of the remnants of the patellar tendon. Besides, our technique reconstruct the patellar tendon in the sequence from medial site to lateral site. This sequence could make the patellar have better tracking and avoid patella lateral translation or subluxation.

Despite having numerous advantages, our technique has several limitations. Due to few cases of chronic patellar tendon rupture, we can't compare which technique is better than others. During our practice, we had 5 cases underwent this procedure till now which was not enough for the number of case series. One patient lost follow-up. Two of the four patients had superficial wound infection which was solved after few days of oral antibiotics treatment. This technique need our special equipment of tendon stripper which can be disassembled at the ring blade part. Traditional tendon strippers are one-piece and during the stripping, the distal part of tendon has to be cut first so they can not preserve the tendon insertion. The tendon to bone junction is the most difficult part during tendon fixation. Some authors use screw fixation, while some use pass-suture technique. No matter what kind of fixation, they need tendon to bone growth to offer long-term effectiveness of their fixation. Our technique can save this difficult and time consuming course of tendon to bone growth because we preserved the tendon insertion to bone at the very beginning. So, we introduce our technique to be another choice for surgeons' decision making in dealing with chronic or neglected patellar tendon rupture.

In summary, we present our surgical technique of reconstructing patellar tendon with ipsilateral hamstring tendons with preserved distal insertion. The ipsilateral hamstring tendons with preserved distal insertion is favourable graft choice to reconstruct patellar tendon.

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