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Case Report

Posterior Cruciate Ligament reconstruction augmentation on avulsion PCL: A case series

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ABSTRACT

Introduction: Posterior Cruciate Ligament (PCL) avulsion may mimics PCL rupture with positive posterior drawer test. Treatment of choice to PCL avulsion is vary from open surgery to arthroscopic surgery. PCL reconstruction with augmentation is a rare procedure to be performed in treating PCL avulsion case. This case reported and suggested an augmentation procedure in PCL avulsion case. This study aims is to evaluate the knee functional score using augmented PCL reconstruction on PCL avulsion using peroneus longus tendon.

Presentation of case: We report 3 cases, 1 male and 2 females. The result of physical examination, X-ray examination, and MRI of the knee showed a PCL avulsion. Posterior drawer test showed grade 2 result. We performed an augmented PCL reconstruction on PCL avulsion using peroneus longus tendon. Knee scoring (IKDC, Modified Cincinnati, Tegner-Lysholm) collected pre-operative and 2 years post-operative. The result of knee scoring was significant improved in post-operative compare to before surgery.

Conclusion: Augmented PCL reconstruction can be considered to be an alternative treatment of PCL avulsion because the procedure has excellent post-operative knee scoring result.

1. Introduction

Posterior Cruciate Ligament (PCL) injury is uncommon case. The number is 3%–38% of knee ligament injuries. PCL injury may have different type caused by damage mechanism, either bone avulsion to torn ligament. Avulsion fracture occurs when there is a strong traction on the ligament resulting bone avulsion. PCL avulsion is often underdiagnosed and ten times less common than the Anterior Cruciate Ligament (ACL) avulsion [1–3] (Fig. 1). PCL avulsion may have different mechanism. Direct force to anterior tibia during flexion (dashboard injury), and hyperextension of the knee [4].

PCL avulsion may mimic PCL rupture with positive posterior drawer test. In the first degree and second degree PCL injury (posterior translation 5–10 mm), conservative is the treatment of choice. However, in third degree PCL injury (posterior translation >10 mm), or additional injury to collateral ligament and avulsion, surgery will be the option for treatment [5,6].

Various procedures of fixation exist for PCL avulsion. Fixation with cannulated screws, sutures, and K-wires were known to yield similar results but may have their own disadvantage either done with open or arthroscopy [5].

Open surgery result in a significant decrease in terminal flexion of the knee compared to arthroscopy. Open surgery also requires removal of the installed hardware resulting in three out of 25 patients experiencing irritation [7]. Shino et al. explained two reasons for screw removal after bony union: pain during deep flexion of the knee due screw irritating on PCL substance, and better development of union biologically without screw interference in the

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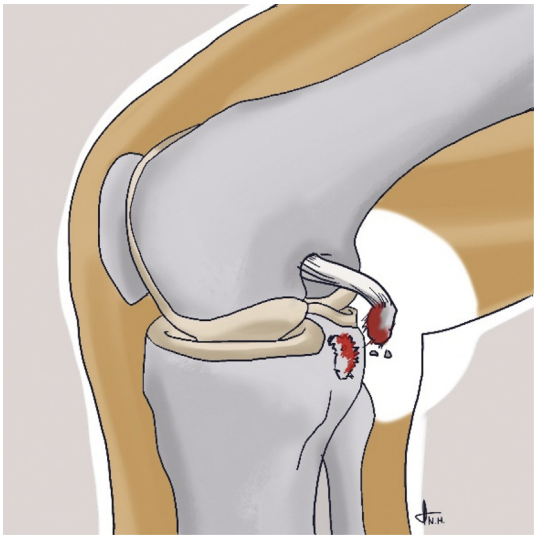

Fig. 1. Schematic picture of PCL avulsion.

fracture [8]. Meanwhile, one patient experiencing irritation under fixation with arthroscopy. Patients were able to perform the same activity as before the injury in 86.2% in open surgery and 96.5% in arthroscopic surgery [7]. We performed PCL reconstruction with augmentation because previous study stated that open surgery might disturbed neurovascular bundle in popliteal region and deteriorated gastrocnemius muscle strength [1,9]. We reported cases of PCL avulsion with posterior translation more than 5 mm, with augmentation procedure of PCL reconstruction using peroneous graft. In this case series of PCL avulsion, we will evaluate the outcome of knee function before and after the reconstruction procedure with augmentation of peroneus longus tendon per arthroscopy.

2. Methods

2.1. Methods

The study design is case series with prospective design from January 2017. We enrolled patient with isolated PCL avulsion with grade 2 or more in posterior drawer test. Informed consent was given to patients regarding their consent for reconstruction procedures and study publication. Detailed history, physical examination, X-ray and MRI were performed in each of our patients. This work has been registered and had a unique identifying number: researchregistry4880. Our institutional review board also provide an ethical approval in the form of case report with KE/FK/0095/EC/2019 as the protocol number. This research work has been reported in line with the PROCESS criteria [10].

2.2. Initial operating procedure

Spinal anesthesia was selected. Patient was positioned on the operating table in a supine position. Aseptic and antiseptic was performed. Diagnostic arthroscopy was done to detect PCL avulsion. PCL avulsion was fixed under arthroscopy.

2.3. Arthroscopic technique

A single senior knee surgeon performed all procedures. Patient laid in supine position under regional anesthesia. Tourniquet was applied in the thigh and inflated without elevation and exsanguination. Standard anterolateral, anteromedial and accessory posteromedial portals were used. Diagnostic arthroscopy for PCL rupture was performed. Peroneus longus tendon were harvested for the graft.

Location of skin the incision for peroneus graft was marked at 2–3 cm proximal and 1 cm posterior the lateral malleolus. The incision was deepen through the skin, subcutaneous tissue, and superficial fascia. Peroneus longus and peroneus brevis tendon were identified. Peroneus longus was isolated and the location of tendon division was marked at 2–3 cm above the level of lateral malleolus. Distal part of the peroneus longus tendon was sutured end to side toward peroneus brevis tendon. Peroneus longus tendon was stripped proximally and stopped 4–5 cm below the fibular head to prevent peroneal nerve injury. Peroneus longus was harvested (Fig. 2).

2.4. Tunnel preparation

2.4.1. Femoral tunnel preparation

The femoral footprint and cartilage borders were identified with radiofrequency probe. Posterior cruciate Ligament were preserved throughout the procedure. The femoral PCL guide was positioned at the condyle's articular surface. 2.4-mm guide passing pin was drilled penetrating medial femoral cortex (PCL origin) and the skin. A 4.5-mm cannulated drill was used to create the first full length passing channel. Next, cannulated drill were picked to match the diameter of the harvested graft. The depth of the socket was calculated based on the length of the prepared graft (usually 25-30-mm). The free ends of a no.2 Vicryl suture loop were advanced out of the thigh using the guide passing pin.

2.4.2. Tibial tunnel preparation

Accessory portal was made with needle guide just medial to lateral part of medial femoral condyle (pass through patellar tendon). Posteromedial (PM) portal was made with transillumination guide and needle in line with posterior plateau. The shoulder trochar was put in PM portal. The PCL tibial guide was placed through the Anteromedial (AM) portal at the anatomic position of the PCL insertion just below the avulsion site. The drill sleeve was placed at the medial proximal tibia and make incision about 2 cm.

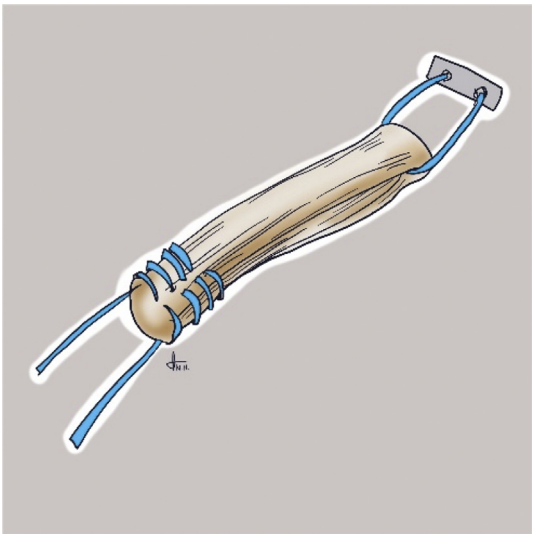

Fig. 2. Harvested Peroneus Longus tendon autograft.

We were drilled a 2.4-mm guide pin into the tibia carefully and not to damage the posterior neurovascular structures using 30° arthroscope in the PM portal. This crucial step was performed under direct arthroscopic visualization with fluoroscopic control to confirm sagittal plane of guide wire placement. The protection curettage was inserted from AM portal and placed over the 2.4 mm guide wire. A cannulated reamer that matches graft diameter was used for the final tibial tunnel preparation. Soft tissue remnants at the posterior exits of tibial tunnel was removed by shaver or radiofrequency probe through the tibial tunnel. By keeping the arthroscope in the PM portal, a looped number 3 nonabsorbable suture was inserted into the tibial tunnel using a suture passer with an eyelet. With an arthroscopic grasper, this suture was retrieved from the AM portal through the intercondylar notch. The suture was tied with the femoral tunnel suture. The suture was pulled through the tibial tunnel. The tie between suture was opened. The second suture was then removed (tibial tunnel suture).

2.4.3. Graft Passage and fixation

Graft Passage through the tibial tunnel. The difficult part of the procedure was to pass gradually the graft through both the tibial and femoral tunnels. The killer turn angle at the posterior exit of the tibial tunnel was certainly the most perilous step. This was due to the severity of the reflexing angle and the difficulty of controlling the graft progression in the posterior hidden and narrow compartment.

Graft passage through the femoral and tensioning was performed by pulling the sutures and securing the adjustable loop of the button at the tibial side. During final fixation, the knee is retained in 70– of flexion, and an anterior drawer was applied. The final step was to make sure the graft sit on top of the avulsed bone. The avulsed bone was reduced to the tibial fracture site to promote healing (Fig. 3).

2.4.4. Rehabilitation

The knee was immobilized for 4 week with brace in full extension. Ambulation with non-weight bearing protocol was initiated on the second postoperative day. Quadriceps isometric exercise, and straight-leg raising exercise initiated after 2 week. Protected ROM was gradually increased from 0 to 90° flexion starting from the fourth week. After 8 weeks, progressive knee flexion from 90° to full ROM was exercised gradually. Partial weight bearing was permitted after 4 weeks. Full weight bearing with hamstring-strengthening exercises was permitted after 8 weeks and active knee ROM should progress to complete flexion and extension. Patients usually returned to their normal daily activity and were allowed to exercise on a stationary bike or standing on a single leg starting at 5 months postoperatively. Light sports activities began at 6 months. After 12 months, the patients is evaluated with serial hop test (single hop test and triple hop test) and then cleared for sport activities if the result is good.

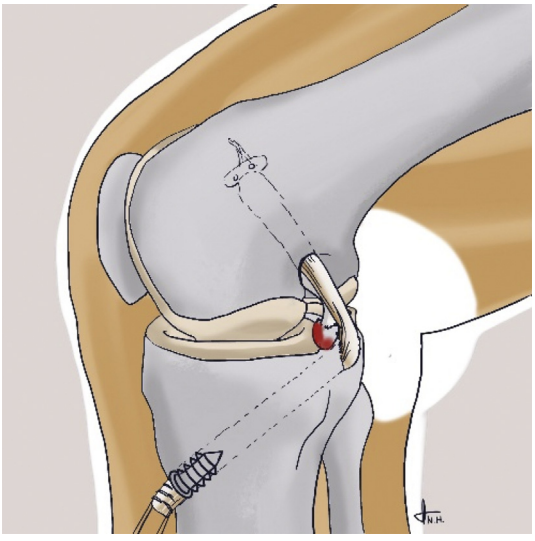

Fig. 3. Schematic picture of augmented PCL reconstruction on PCL avulsion.

2.4.5. Post-operative evaluation

Post-operative functional outcome were recorded six months after surgery with direct patient examination and interview. A single orthopedic surgeon outside the surgical team examined and interviewed all the patients. We collected data of International Knee Documentation Committee (IKDC) [11], Modified Cincinnati [12], and Tegner-Lysholm score [13].

2.5. Case

2.5.1. Case 1

A 21-years-old male working as a private employee came with a complaint of instability of the knee after a motorcycle accident one month before hospital admission. Physical examination, X-ray examination, and MRI of the left knee (Fig. 4 and Fig. 5) showed a PCL avulsion. Posterior drawer test showed grade 2 result. There was no sign of any other knee ligament injury.

2.5.2. Case 2

A 16-years-old female came with discomfort of the right knee and instability during walk. These complaints appeared since she had a motorcycle accident two weeks before hospital admission.

Physical examination and diagnostic tests revealed PCL avulsion on her right knee. Posterior drawer test was grade 2 with 1-cm disparency in the thigh circumference.

2.5.3. Case 3

A 37-years-old female came with discomfort of the right knee and instability during walk. She had a history of traffic accident three months prior to the hospital admission. Posterior drawer test showed a grade 3 result. There was no difference in the diameter of right and left tight circumference. X-ray and MRI revealed PCL avulsion of the right knee.

3. Discussion

PCL is the strongest ligament located on the knee joint. Preventing posterior translation of the tibia when flexing the knee joint is the main role of PCL. When PCL ruptures, subluxation will occur posteriorly towards the tibia resulting in abnormal pressure on the patellofemoral joint which produces chronic pain and early degeneration in the cartilage [14].

Treatment of PCL avulsion might be done conservatively or surgically [15]. The conservative treatment is immobilization by casting. However, nowadays this method has been left out since it shows poor results with a low functional score and a high incidence of nonunion [16,17].

The surgical approach of PCL avulsion management can be carried out by arthroscopic technique or the ORIF (open reduction and internal fixation) technique. Multiple suture fixation is performed if there are small bone fragments (<10 mm), although this may fail comminuted fracture presents. In a case of medium bone fragments (10–20 mm), the bone can be fixed using wires, while in a case of large bone fragments (>20 mm), cannulated screw is preferred for the fixation [18].

Fig. 4. X-ray of left knee joint. Imaging of avulsion on posterior proximal of tibia was obtained.

Fig. 5. MRI of left knee. Avulsion and PCL avulsie on PCL was found.

The use of conventional screw on thin, small, and comminuted fragments cannot fix the bone firmly, and may causes bone fragmentation. Fixation technique using sutures produces unstable results and does not provide maximum pressure to fix the bone, hence performing early post-operative exercise will be impossible. Combination techniques as using screws and sutures can be performed, yet very complicated and long surgical time [19]. Nevertheless, this must be done with open surgery.

Arthroscopy has a peculiar disadvantage which is the difficulty in fixing and reducing fractures compared to open surgery. Although there has been no consensus regarding the selection of the best technique in dealing with PCL avulsion, performing fixation of the avulsed bone is the common surgical technique in cases of PCL avulsion [5]. Previous quantitative review study stated PCL augmentation compared to reconstruction stated that both procedures were grossly equivalent [20].

This study was explained our treatment to PCL avulsion using augmented PCL reconstruction using peroneus longus tendon. In this study, we reported three patients diagnosed with PCL avulsion. We performed augmentation of PCL reconstruction using peroneus longus tendon graft. We conducted the augmentation in order to strengthen PCL ligament, fixing the site of avulsion by attaching them to tibia using augment graft. The technique of augmentation was based on arthroscopy procedure of PCL reconstruction procedures. Variety of popular grafts such as hamstring and PTB might be used in PCL reconstruction. We used peroneous longus graft because it has been a standard procedure in our center, and we also had published the results [21]. In this case series, we compared the functional score of the knee preoperatively and 6 months postoperatively. The successfulness indicator of the treatment is the higher score in knee scoring after surgery compared to before surgery. We obtained a satisfactory result marked by a significant increase in IKDC, Modified Cincinnati, and Tegner-Lysholm Score. This study performed by single orthopedic surgeon. Study bias can be minimized with this method.

4. Conclusion

Based on the cases we reported, PCL reconstruction augmentation in cases of PCL avulsion is the alternative choice. This is evidenced by the significant improvement in knee functional scores. This study is case series, maybe higher number of subjects is needed to ensure the improvement of knee scoring after surgery.

Ethical approval

The informed consent form was declared that patient data or samples will be used for educational or research purposes. Our institutional review board also provide an ethical approval in the form of case report with KE/FK/0095/EC/2019 as the protocol number.

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Author contribution

Azeta Arief, Deri Mulyadi, Dwikora Novembri Utomo, and Sholahuddin Rhatomy conceived the study. Sholahuddin Rhatomy, Deri Mulyadi and Azeta Arif collected data. Deri Mulyadi, Morteza Bahesdhi Salipi, Riky Setyawan, and Sholahuddin Rhatomy analysed data. Azeta Arif, Deri Mulyadi, Morteza Bahesdhi Salipi, Riky Setyawan, Noha Roshadiansyah Soekarno and Sholahuddin Rhatomy prepared and drafted the manuscript. Azeta Arif, Deri Mulyadi, Dwikora Novembri Utomo, Morteza Bahesdhi Salipi, Riky Setyawan, Noha Roshadiansyah Soekarno and Sholahuddin Rhatomy edited manuscript. Noha Roshadiansyah Soekarno illustrated the figure. Azeta Arief, Deri Mulyadi, Dwikora Novembri Utomo and Sholahuddin Rhatomy reviewed the manuscript.

Conflict of interest statement

No potential conflict of interest relevant to this article was reported.

Guarantor

Sholahuddin Rhatomy, MD.

Research registration number

researchregistry4880

Consent

Written informed consent was obtained from the all of the patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the corresponding author of this journal on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijso.2019.09.003.

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