Original Article

All-Inside Anterior Cruciate Ligament Reconstruction By Tight Rope

Hossameddin Aly Abdelkader Almahdy[1*], Hisham Misbah Soliman[1], Mohammed Omar Soliman[1], Ahmed Samir Elkalyoby[1], Mohammed Nabil Farag Ibraheem[1], Mohamed Mostafa Ali Mohamed[1], Mohamed Ghoneem Ali Elsakka[1], Eslam AbdelMohsen Abdelfatah Bakr[2]

1. Department of Orthopaedic Surgery, Faculty of Medicine, Cairo University, Egypt.
2. Dar Al Fouad hospital, Giza, Egypt

Corresponding Author: Hossameddin Aly Abdelkader
Email: hossam_abdelkader@hotmail.com
DOI: 10.47750/pnr.2023.14.S01.05

Abstract

Background: The anterior cruciate ligament (ACL) is one of the most important stabilizing factors of the knee joint. The ACL is made up of two bundles: the anteromedial bundle and the posterolateral bundle. The increase in the incidence of ACL injury is attributed to the higher participation in sports activity by the general population. A popular orthopaedic surgical procedure involves reconstructing the anterior cruciate ligament with entire tibial tunnels. **Aim:** the clinical outcome of the reconstruction of the ACL using the All-Inside technique through retrograde drilling of both femur and tibia sockets, with the graft fixated by tight ropes on both tibial and femoral sides. **Methods:** We included forty patients with an ACL tear, who underwent ACL reconstruction using a single semitendinosus tendon graft, through an all-inside technique (retrograde femoral and tibial drilling). **Results:** The data from the forty cases were analyzed. The Lysholm score was improved to 92.78 ±4.24, postoperatively. There was a statistically highly significant difference in comparing preoperative and postoperative results in favour of postoperative results ($p<0.001$). Besides, the IKDC improved to 91.12 ±4.85, postoperatively. There was a statistically highly significant difference in comparing preoperative and postoperative results in favour of postoperative results ($p<0.001$). **Conclusion:** Based on our analysis, we found that the short-term outcomes of the all-inside approach for ACL restoration are good to exceptional. With specially created instrumentation, it has many benefits. However, the increased usage of flipcutters drives up the overall cost of surgery.

Keywords: Anterior cruciate ligament, Lysholm**,** All-inside reconstruction, Tibia, and Semitendinosus**.**

INTRODUCTION

The anterior cruciate ligament (ACL) is one of the most important stabilizing factors of the knee joint (1). It is a thick band that extends posteromedially from the anteromedial side of the tibial plateau intercondylar region and connects to the lateral femoral condyle (2). It is formed of connective tissue and collagenous fibres. The ACL is made up of two bundles: the anteromedial bundle and the posterolateral bundle. The increase in the incidence of ACL injury is attributed to the higher participation in sports activity by the general population (3). There is no discrimination based on gender or age; nevertheless, it is reported that women may have a higher risk of suffering an ACL injury as a result of several variables. According to certain studies, women may have weaker hamstrings. Although an ACL damage can be diagnosed clinically, magnetic resonance imaging (MRI) is often needed to confirm the diagnosis (4). With a sensitivity of 86% and a specificity of 95%, MRI is the main modality for diagnosing ACL disease. Knee arthroscopy can be used to diagnose the condition and distinguish between total and partial tears as well as persistent tears (5,6).

There are primary and secondary signs of ACL tears on MR. Changes which are nearly related to the injury of the ACL are called secondary signs. and primary signs are those changes directly related to the ligamentous injury (7).

A popular orthopaedic surgical procedure involves reconstructing the anterior cruciate ligament with entire tibial tunnels. The tibial bone tunnel is eliminated in favour of a tibial socket in the all-inside ACL repair procedure, saving more bone that may be advantageous if a second revision reconstruction is required or in the case of multiple ligament reconstruction surgeries. Additionally, because the periosteum and extra-articular cortices are unharmed, postoperative pain and swelling may be reduced (8–10).

In our paper, we aimed to estimate the clinical outcome of the reconstruction of the ACL using the All-Inside technique through retrograde drilling of both femur and tibia sockets, with the graft fixated by tight ropes on both tibial and femoral sides.

METHODS

This prospective cohort included forty patients with a traumatic ACL injury. All the patients had undergone arthroscopically All-Inside technique ACL reconstruction between 2016 and 2018. The Semitendinosus tendon was used as a graft and fixed using cortical suspensory fixation devices into the femoral and tibial sockets (tight ropes).

Inclusion criteria:

1) Patients aged between 18 and 40 years with an ACL-deficient knee who chose to have ACL reconstructive surgery with autograft. 2) Patients having associated meniscal tears -whether it is treated by meniscal repair or partial meniscectomy- are included.

Exclusion criteria:

1) Associated ligamentous injury (lateral collateral ligament, posterior cruciate ligament injury). 2) Previous ACL reconstructive surgery (Revision cases). 3) Young patients (skeletally immature). 4) Radiological evidence of Osteoarthritis, (the Kellgren and Lawrence classification system grade 3 or 4). **Preoperative assessment**

First, the clinical history is taken from each patient. We asked about the general condition and presence of any medical problems, the patient's complaint had been analyzed regarding pain, giving way, swelling (hemarthrosis), locking, and the presence of "pop" or "snap' 'sensation".

Physical examination

The patients were inspected during standing to check the alignment of the lower limbs. and the gait pattern is observed as well. Then the affected knee is inspected in a supine position for obvious effusion, ecchymosis or bruises, quadriceps muscle wasting, and the presence of previous scars. Then, the affected knee joint was palpated to assess the degree of effusion and to localize the tender points. Besides, the active range of motion was assessed for both knees starting with the healthy side. Any limitation of full extension or flexion movements was noticed. Full extension is considered 0º, while full flexion is considered about 150º.

Special tests for ligaments injuries

We performed the following tests on each patient if possible: Lachman test, Anterior drawer test Pivot shift test, valgus stress test at 30º flexion and 0º extension to assess the MCL stability, varus stress test at 30º flexion to assess the LCL stability, dial test at 30º and 90º flexion were carried out to exclude posterolateral corner instability and McMurray's test for meniscus injury.

Radiographic diagnosis:

We performed the following radiological investigations: X-ray Standard anteroposterior (AP) and lateral views. Magnetic resonance imaging (MRI).

Laboratory investigations

We performed routine preoperative laboratory investigations such as a complete blood picture, liver & kidney functions, coagulation profile as well as blood glucose level were obtained.

Scoring system

The Lysholm Knee Scoring Scale and the subjective and objective International Knee Documentation Committee (IKDC) score form were completed at the time of admission (before surgery), which is regarded as the baseline score, and again at 12 months following the surgery as outcomes of interest.

Operative preparation of the patients

All patients received a single dose of prophylactic antibiotic one hour before the skin incision and the operation was performed under spinal or general anaesthesia

Operative Technique:

On the operating table, all patients were in the supine position. The examination under anastasia was done to confirm the diagnosis using specific tests. The tourniquet was applied to the proximal thigh and adjusted for blood pressure (always around 250-350 mm Hg). The distal extremity of the bed was descended while an arthroscopic leg holder stabilised the operating leg. allowing full knee extension and flexion of at least 120 degrees. Figure one

Figure 1: showed the position of the patient before the operation**.**

Then, an oblique, 3 cm skin incision is done (5 cm below the joint line, and 1 cm medial to the tibial tubercle). The fascia was incised and the bursa between the pes anserine and the medial collateral ligament is identified. The fascia incision is continued medially down the tibia with scissors, then a Kocher is used to apply traction to the top corner of the pes anserine, to facilitate turning it down to visualize the tendons on the underside. The semitendinosus is the most inferior tendon. Once the semitendinosus tendon is identified, a looped suture is passed around the distal end using Lahey Forceps.

An open tendon stripper is used to free the semitendinosus tendon from the muscle proximally. To prevent the tendon from being cut off short, the tendon should be kept under tension during the advancement of the stripper. And the stripper should be advanced in the same direction as the tendon.

The graft is prepared and the additional muscle is dissected. The tendon of the semitendinosus is measured and cut at 26 cm.

For an all-inside ACL restoration approach, the tendon is looped over a TightRope RT and the two free ends are whipstitched and folded over another TightRope RT. Figure 2

Figure 2: The semitendinosus tendon graft at the end of preparation.

ACL reconstruction:

Portal placement:

An anterolateral (AL) viewing portal is utilised, which is significantly lower and more medial in location. Through the AL portal, a 30-degree arthroscope is introduced. The spinal needle is then used to create a typical anteromedial portal under direct vision. The supra-patellar pouch, medial and lateral gutters, patellofemoral articulation, medial and lateral compartments, and intercondylar notch are all examined routinely. Figure 3

Figure 3: The arthroscopic portals for ACL reconstruction of left knee.

The femoral attachment of the native ACL is cleaned from the medial side of the lateral femoral condyle using a shaver and cautery, The cautery utilisation is necessary to enable soft-tissue debridement, preserve the original ACL's footprint, and make it easier to identify the bony landmarks, such as the bifurcate and intercondylar ridges. The bifurcate ridge, which is halfway along the medial wall of the lateral femoral condyle, is measured over the whole length of the medial wall. Just posterior to the bifurcate ridge would be where the mid-bundle footprint would lie. The femoral tunnel's centre rises 2 mm above the level of the low articular cartilage, plus its radius.

Graft passage

The cortical button is progressed till it exits the femur while the TigerRope RT button and sutures are pushed into the femoral socket using the passing sutures. To seat the graft into the femoral tunnel to the proper depth, the button is flipped, and the TightRope RT's suture ends are successively tightened. The tibial side of the graft and the whipstitch sutures are then pulled into the socket using the passing sutures in the tibial tunnel. All slack is then

taken up before docking the graft into the tibial socket. After that, the knee is repeatedly moved through its whole range of motion to make that the graft construct is fully and completely seated and to rule out any suture laxity.

Follow-up evaluation and outcomes of interest:

After surgery, all patients underwent evaluations every two weeks until the second postoperative month, then at three months, six months, and twelve months.

1. Clinical assessment: The postoperative clinical assessment mirrored the preoperative assessment. Additionally, the skin around the graft donor site was checked for signs of aberrant sensation, including tenderness, irritation, and presence.

2- Postoperative rating scales: These were determined following the clinical and radiographic evaluation. For a subjective assessment, the Lysholm knee score was applied. It has eight criteria: squatting, climbing stairs, locking, giving way, pain, swelling, and limping. At the 12-month postoperative mark, subjective and objective evaluations were conducted using the IKDC scoring system (subjective scoring) and an objective knee examination form.

Statistical analysis

The data were coded and entered using SPSS version 26 (Statistical Package for the Social Sciences) (IBM Corp., Armonk, NY, USA). The following terms were used to describe quantitative data: mean, standard deviation, median, minimum, and maximum; for categorical data, frequency (count) and relative frequency (%). To compare serial measurements (pre- and post-operative) within each patient, the non-parametric Wilcoxon signed-rank rank test was used. Statistical significance was determined by P values less than 0.05 (11).

RESULTS

We included forty patients with an ACL tear, who underwent ACL reconstruction using a single semitendinosus tendon graft, through an all-inside technique (retrograde femoral and tibial drilling). All patients are evaluated regarding age, sex, time until surgery, sports activity, associated injuries, subjective and objective evaluation.

Baseline and descriptive statistics of the patients.

The age of the patients was from 18 to 40 years old, with a average age of 32.53 and a standard deviation SD of ± 5.75 years. Thirty-six patients (90%) were males while four (10%) were females. The average time from injury to surgery was 22.48 weeks with SD ± 41.01 weeks. Out of the 40 cases, 22 (55%) patients had sustained injury to the right knee, while 18 (45%) patients had left knee injuries. The mode of trauma was sports injury in 34 patients (85%), falling downstairs was the cause in 5 patients (12.5%), and only 1 patient was involved in a motor car accident (2.5%). In all 40 patients, we harvested a single semitendinosus tendon and the graft is quadrupled where the mean graft diameter was 8.37 mm, SD 0.56 mm. The mean preoperative Lysholm score was 50.50 ±17.58 and the mean preoperative mean IKDC score was 45.97 ± 15.35. **Tables (1-2).**

Table 1 show descriptive statistics of the included participants**.**

Descriptive Statistics						
	Range/(Minimum-Maximum)			**Mean**	**±**	**SD**
Age	18	-	40	32.53	±	5.75
Time from injury to surgery	3.00	-	240	22.48	±	41.04
Graft diameter incidence	7.50		10.00	8.37		0.56
Lysholm score	17.58	-	84.00	50.50	±	17.58
IKDC subjective score:	13.79	-	77.01	45.97	±	15.35

Data were represented as mean and standard deviation (SD).

IKDC; International Knee Documentation Committee.

Table 2 illustrated the baseline characteristics of the patients

Sex incidence		
	N	%
Male	36	90
Female	4	10
Affected side		
RT	22	55
LT	18	45
Mode of trauma		
Sport injury	34	85
Motor car accident	1	2.5
Falling downstairs	5	12.5
Associated injuries		
Medial meniscus tear	22	55
Lateral meniscus tear	5	12.5
NO	13	32.5

Data were represented as a number (N) and a percentage (%).

RT; right, LT; left.

Subjective evaluation:

Lysholm score and IKDC scores.

The Lysholm score was improved to 92.78 ±4.24, postoperatively. There was a statistically highly significant difference in comparing preoperative and postoperative results in favour of postoperative results ($p<0.001$). Besides, the IKDC improved to 91.12 ±4.85, postoperatively. There was a statistically highly significant difference in comparing preoperative and postoperative results in favour of postoperative results ($p<0.001$). Table three.

Table 3 shows the preoperative and postoperative subjective scores.

Lysholm score				**P-value**
Preoperative		Postoperative		
Mean	SD	Mean	SD	
50.5	17.58	92.78	4.24	<0.001
IKDC subjective score				
45.97	15.35	91.12	4.85	<0.001

Data were represented as mean and standard deviation (SD).

IKDC; International Knee Documentation Committee.

Complications

Nine cases (22.5%) had prolonged hemarthrosis up to eight weeks postoperatively. This was managed conservatively with anti-inflammatory and anti-edematous drugs. Only 4 cases (10%) needed aspiration of the knee hemarthrosis under complete aseptic conditions, there was no residual effusion by the 12th week postoperative. Four patients (10%) had delayed wound healing (beyond 2 weeks following surgery) at the graft harvest site with hematoma and seroma formation. which was managed by repeated surgical dressings for one more week after which it was completely resolved. Only one patient (2.5%) had a serious early postoperative

infection. He was treated with urgent arthroscopic washout and debridement and broad-spectrum antibiotics according to the culture and sensitivity tests of the isolated organism. He recovers completely after 3 months. Quadriceps muscle wasting compared to the contralateral side was noted at the early follow-up after surgery in 8 patients (20%). Table four

Table 4 shows the incidences of complications

Complications		
	N	**%**
Hemarthrosis	9	22.5
delayed wound healing	4	10
Infection	1	2.5
Quadriceps muscle wasting	8	20

Data were represented as a number (N) and a percentage (%).

DISCUSSION

In this study, we evaluated the clinical outcome of the ACL reconstruction using the All-Inside technique through retrograde drilling of both femur and tibia sockets, with the graft fixated by tight ropes on both femoral and tibial sides. We reported that there was a significant improvement in the Lysholm score and IKDC score after the operation. Reconstruction has evolved significantly over the past few decades, mostly because to an emphasis on anatomically correct ACL femoral tunnel implantation to restore normal knee kinematics and postoperative function. The femoral tunnel has historically been produced via a transtibial approach, in which the tibial tunnel dictates the placement of the femoral socket, resulting in a vertical graft placement. The early results were good with this approach, but because the graft site was non-anatomical, the normal kinematics of the knee were disrupted, resulting in discomfort and early-onset onset arthritis (12–15).

The use of sockets rather than full bone tunnels in all-inside ACL reconstruction saves bone, which may be advantageous if a second revision reconstruction is necessary or in the case of numerous ligament repair procedures. Additionally, as this method avoids breaching the extra-articular cortices and periosteum, postoperative pain and swelling might be reduced (16,17).

There are only a few studies that address the clinical results of the all-inside ACL repair approach, despite the fact that it has been utilised in clinical practise for years. A comprehensive comparison of the whole tibial tunnel technique versus the all-inside approach was conducted in the research by Lubowitz et al. They discovered that there had been a considerable improvement in the postoperative Lysholm and IKDC scores, which was in line with our findings (18).

In our study, we reported 9 cases (22.5%) with prolonged hemarthrosis up to eight weeks following their surgeries. All of them had been treated conservatively with anti-inflammatory and anti-edematous drugs. Only 4 cases (10%) needed aspiration of their knee hemarthrosis under complete aseptic conditions, and they needed up to 12^{th} weeks postoperative to complete their healing. Two patients (5%) were complaining of neuropathic pain, numbness and irritation at the graft harvesting site. Nothing was done for this unavoidable complication.

Four patients (10%) had delayed wound healing (beyond 2 weeks following surgery) at the graft harvesting site with hematoma formation, which was managed by repeated surgical dressings for one more week after which all cases had been completely resolved. Also, Quadriceps muscle wasting (compared to the contralateral side) was noted at the early follow-up after surgery in 8 patients (20%), which was improved gradually with the quadriceps strengthening exercises during the postoperative rehabilitation program. None of the patients had residual quadriceps wasting by the end of the follow-up period.

Pain sensation after the reconstruction surgery may be attributed to several factors such as graft harvesting, knee extension deficit and surgical technique (19,20). The all-inside technique was associated with less pain perception in the first month. This decrease in the pain sensation may be due to improvement in the tibial tunnel positioning because the anterior pain is caused by graft entrapment due to incorrect tunnel positioning (21).

Besides, harvesting a single tendon was associated with a decrease in pain at the hamstring tendon harvesting site. Despite the fact that some studies did not discover any distinction between harvesting a single tendon (semitendinosus) and gracilis tendon association. In the S-G autograft group, only Tashiro T, et al., (19) discovered a difference and reported decreased knee flexion strength at knee flexion angles of more than 70 ^{o}.

Limitations

One of our main limitations in this study is the small sample size and limited period of follow-up. In order to make more firm suggestions about the all-inside method, long-term results studies are required. Even if including patients with multiple knee pathologies may be biassed, it is required because isolated ACL lesions without any other pathology are still uncommon. In this study, only single group was analysed; there was no control group. There were no preoperative and postoperative KT-2000 measures, therefore it was difficult to evaluate or compare the degree of improvement between the initial follow-up and the final measurements.

CONCLUSION

According to our study, the short-term outcomes of the all-inside approach for ACL restoration are good to exceptional. With specially created instrumentation, it has many benefits. However, the increased usage of flipcutters drives up the overall cost of surgery.

REFERENCES

1. Kiapour AM, Murray MM. Basic science of anterior cruciate ligament injury and repair. Bone & Joint Research [Internet]. 2014 Feb;3(2):20–31. Available from: https://online.boneandjoint.org.uk/doi/10.1302/2046-3758.32.2000241
2. Shea KG, Cannamela PC, Dingel AB, Fabricant PD, Polousky JD, Anderson AF, et al. Anatomic Dissection and CT Imaging of the Anterior Cruciate and Medial Collateral Ligament Footprint Anatomy in Skeletally Immature Cadaver Knees. Journal of Pediatric Orthopaedics [Internet]. 2020 Feb;40(2):e109–14. Available from: https://journals.lww.com/10.1097/BPO.0000000000001398
3. Best MJ, Zikria BA, Wilckens JH. Anterior Cruciate Ligament Injuries in the Older Athlete. Sports Health: A Multidisciplinary Approach [Internet]. 2021 May 10;13(3):285–9. Available from: http://journals.sagepub.com/doi/10.1177/1941738120953426
4. Temponi EF, Honório de Carvalho Júnior L, Sonnery-Cottet B, Chambat P. Lesão parcial do ligamento cruzado anterior: diagnóstico e tratamento. Revista Brasileira de Ortopedia [Internet]. 2015 Jan;50(1):9–15. Available from: https://linkinghub.elsevier.com/retrieve/pii/S010236161400232X
5. Bradsell H, Frank RM. Anterior cruciate ligament injury prevention. Annals of Joint. 2022.
6. LaBella CR, Hennrikus W, Hewett TE, Brenner JS, Brookes MA, Demorest RA, et al. Anterior Cruciate Ligament Injuries: Diagnosis, Treatment, and Prevention. Pediatrics [Internet]. 2014 May 1;133(5):e1437–50. Available from: https://publications.aap.org/pediatrics/article/133/5/e1437/32765/Anterior-Cruciate-Ligament-Injuries-Diagnosis
7. Abdul W, Guro R, Jawad Z, Kotwal R, Chandratreya A. Clinical outcomes of primary anatomic all-inside Anterior Cruciate Ligament reconstruction using the TransLateral technique: A minimum one-year follow-up study. The Knee [Internet]. 2020 Dec;27(6):1753–63. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0968016020303227
8. Kondo E, Merican AM, Yasuda K, Amis AA. Biomechanical Comparison of Anatomic Double-Bundle, Anatomic Single-Bundle, and Nonanatomic Single-Bundle Anterior Cruciate Ligament Reconstructions. The American Journal of Sports Medicine [Internet]. 2011 Feb 14;39(2):279–88. Available from: http://journals.sagepub.com/doi/10.1177/0363546510392350
9. Nicholson JA, Sutherland AG, Smith FW. Single bundle anterior cruciate reconstruction does not restore normal knee kinematics at six months. The Journal of Bone and Joint Surgery British volume [Internet]. 2011 Oct;93-B(10):1334–40. Available from: https://online.boneandjoint.org.uk/doi/10.1302/0301-620X.93B10.26481
10. Bullock A, Bannigan K. Effectiveness of activity-based group work in community mental health: a systematic review. The American journal of occupational therapy : official publication of the American Occupational Therapy Association. 2011 Nov;65(3):257–66.
11. Chan YH. Biostatistics 102: Quantitative Data - Parametric & Non-parametric Tests. Singapore Medical Journal. 2003;
12. Kaseta MK, DeFrate LE, Charnock BL, Sullivan RT, Garrett WE. Reconstruction Technique Affects Femoral Tunnel Placement in ACL Reconstruction. Clinical Orthopaedics & Related Research [Internet]. 2008 Jun;466(6):1467–74. Available from: https://journals.lww.com/00003086-200806000-00032

13. Steiner ME, Battaglia TC, Heming JF, Rand JD, Festa A, Baria M. Independent Drilling Outperforms Conventional Transtibial Drilling in Anterior Cruciate Ligament Reconstruction. The American Journal of Sports Medicine [Internet]. 2009 Oct 2;37(10):1912–9. Available from: http://journals.sagepub.com/doi/10.1177/0363546509340407
14. Wilson AJ, Yasen SK, Nancoo T, Stannard R, Smith JO, Logan JS. Anatomic All-Inside Anterior Cruciate Ligament Reconstruction Using the Translateral Technique. Arthroscopy Techniques [Internet]. 2013 May;2(2):e99–104. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2212628712000667
15. Brown CH, Spalding T, Robb C. Medial portal technique for single-bundle anatomical Anterior Cruciate Ligament (ACL) reconstruction. International Orthopaedics [Internet]. 2013 Feb 20;37(2):253–69. Available from: http://link.springer.com/10.1007/s00264-012-1772-6
16. Lubowitz JH. Anteromedial Portal Technique for the Anterior Cruciate Ligament Femoral Socket: Pitfalls and Solutions. Arthroscopy: The Journal of Arthroscopic & Related Surgery [Internet]. 2009 Jan;25(1):95–101. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0749806308008116
17. Smith PA. An Alternative Method for "All-Inside" Anterior Cruciate Ligament Reconstruction. Arthroscopy: The Journal of Arthroscopic & Related Surgery [Internet]. 2007 Apr;23(4):451. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0749806306014381
18. Lubowitz JH, Schwartzberg R, Smith P. Randomized Controlled Trial Comparing All-Inside Anterior Cruciate Ligament Reconstruction Technique With Anterior Cruciate Ligament Reconstruction With a Full Tibial Tunnel. Arthroscopy: The Journal of Arthroscopic & Related Surgery [Internet]. 2013 Jul;29(7):1195–200. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0749806313003502
19. Tashiro T, Kurosawa H, Kawakami A, Hikita A, Fukui N. Influence of Medial Hamstring Tendon Harvest on Knee Flexor Strength after Anterior Cruciate Ligament Reconstruction: A Detailed Evaluation with Comparison of Single- and Double-Tendon Harvest. The American Journal of Sports Medicine [Internet]. 2003 Jul 1;31(4):522–9. Available from: http://ajs.sagepub.com/lookup/doi/10.1177/31.4.522
20. Niki Y, Hakozaki A, Iwamoto W, Kanagawa H, Matsumoto H, Toyama Y, et al. Factors affecting anterior knee pain following anatomic double-bundle anterior cruciate ligament reconstruction. Knee Surgery, Sports Traumatology, Arthroscopy [Internet]. 2012 Aug 5;20(8):1543–9. Available from: http://link.springer.com/10.1007/s00167-011-1746-z
21. HOWELL MSM, CLARK JA. Tibial Tunnel Placement in Anterior Cruciate Ligament Reconstructions and Graft Impingement. Clinical Orthopaedics and Related Research [Internet]. 1992 Oct;283:187???195. Available from: http://journals.lww.com/00003086-199210000-00026