

Original Article Orthopaedics

FUNCTIONAL OUTCOME OF ARTHROSCOPIC SINGLE BUNDLE ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION USING QUADRUPLE HAMSTRING GRAFT FIXED WITH ADJUSTABLE LOOP ENDO BUTTON AND BIO INTERFERENCE SCREW AT TERTIARY RURAL CENTRE

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Abstract

Objective: Anterior cruciate ligament (ACL) is the most common ligament to be replaced in the knee joint and ACL reconstruction (ACLR) is one of the most commonly performed surgery in orthopaedics nowadays. This study evaluated short term results of anterior cruciate ligament reconstruction with quadruple hamstring autograft using adjustable loop endobutton for femoral fixation and Bio absorbable interference screw for tibial fixation.

Material and methods: 40 patients were operated for ACL reconstruction using quadruple autologous hamstring graft with adjustable loop endobutton and bio interference screw. Following the surgery the patients undergone standard rehabilitation protocol. The patients were followed up in OPD and their functional outcomes were measured by Lysholm scoring and IKDC scoring at 2 weeks, 8 weeks, 12 weeks, 24 weeks.

Result: A total of 40 patients were evaluated in which there were 36 male patients and 4 female patients with a mean age of 26.75 ± 5.95 and 25.25 ± 7.27 . The mean Lysholm score were 89.62 ± 8.90 at 24 weeks of follow up compared to 79.38 ± 11.32 at preoperative. The mean IKDC score were 85.06 ± 9.35 at 24 weeks of follow up compared to 56.703 ± 12.27 at preoperative.

Conclusion: Arthroscopic ACL reconstruction and graft fixation using adjustable loop endobutton for the femoral end fixation and bioabsorbable

interference screw fixation at the tibial end give an excellent result with minor complications.

Keywords: ACL reconstruction, adjustable loop endobutton, hamstring graft.

Introduction

Anterior knee instability associated with rupture of ACL is a disabling clinical condition. Surgical reconstruction of ACL injuries is required to reduce pain, maintain stability, limit further loss in the joint structure, and function and early return to duty. Untreated torn ACL will result in progressive symptomatic instability leading to recurrent injury, damage to the menisci, articular cartilage, and early osteoarthritis.^{1,2}

Many authors have described various procedures and techniques with autografts like quadriceps, tendon, hamstrings, patellar tendon etc. and allografts of achilles tendon, tibialis anterior and hamstrings.³

Various implants have been described to hold the graft in the femoral and tibial tunnels, like suspensory devices, posts, screws, and suture buttons. We have used endobutton on the femoral side and bio-absorbable screw in the tibial tunnel.⁴

Adjustable loop system like Tightrope is the latest treatment modality of single bundle ACL reconstruction. It has several advantages over routine fixation using endobutton. The adjustable loop length provides greater ease of insertion, allows complete graft fill of the femoral tunnel, obviates the need to calculate the loop length, and allows the same implant to be used regardless of tunnel placement or depth.⁵

In this study we analyzed the clinical and functional results of single bundle ACL reconstruction by quadrupule hamstring graft fixed with adjustable loop endobutton on femoral side and Bio-interference screw on tibial side.

Materials And Methods

Study Population: A prospective interventional study was conducted at BPS Govt Medical College from January 2016 to October 2018 after Institutional Ethics Committee approval. 40 patients were included by simple random sampling in the study after obtaining written informed consent based upon inclusion and exclusion criteria.

Inclusion Criteria

1. Patients in the 20 – 45 year age without preexisting arthritis.
2. Patients with symptomatic unilateral anterior cruciate ligament tear.
3. Patients with clinical or radiological evidence of anterior cruciate ligament tear.

Exclusion Criteria

1. Patients with bilateral anterior cruciate ligament tears.
2. Multi ligamentous injury of knee.
3. Patients with other systemic diseases (diabetes mellitus, hypertension).

Pre-operative clinical scoring (Lysholm Gillquist score) and Lachmann, Anterior drawer and Pivot shift tests, MRI Knee and X-Rays were performed. After routine investigations for anaesthesia, ACL reconstruction was done. Post operatively, drain was removed after 24 hours and physiotherapy started. Patients were followed up at regular interval for 6 months. Final assessment was done at 6 months by Lysholm Gillquist score, IKDC score and clinical tests..

Statistical Analysis

The data was entered into a Microsoft Excel and analysed using statistical software SPSS .For

continuous outcome mean \pm SD was calculated and for categorical variables, proportion and percentage were calculated. 2 groups were analysed for continuous variable student 't'- test & for categorical outcomes Chi square test was used. >2 groups were analysed for continuous variable ANOVA test & for categorical outcomes Cochran test was used.

P value <0.05 was considered as statistically significant

Surgical Technique

All surgeries were done under spinal anaesthesia. Anteromedial and anterolateral portals were made and diagnostic arthroscopy was performed. Meniscal lesions were dealt and torn ACL was carefully shaved. Semitendinosus graft was harvested and four fold graft was prepared. Femoral tunnel was prepared at centre of footprint through the anteromedial portal with femoral offset and eyelid guidewire with the knee in appropriate flexed position.

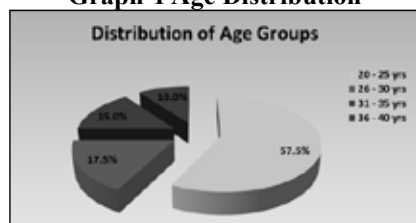
Tibial tunnel was prepared with tibial jig at 55 degrees at centre of tibial footprint. Graft was appropriately marked and placed in the adjustable loop of endobutton and passed through the tibial tunnel. Endobutton was then passed through the femoral tunnel under direct arthroscopic vision and endobutton was flipped over far lateral cortex of femur. Graft was pulled into femoral tunnel upto appropriate mark by pulling the threads attached to the endobutton laterally. Graft was tensioned by 25-30 cycles of knee flexion-extension and was fixed at tibial end by Bioscrew at 15 degrees of knee flexion.

After the surgery the patient was subjected to standard rehabilitation protocol.

Results

Age distribution of patients is shown in graph-1.

Graph-1 Age Distribution

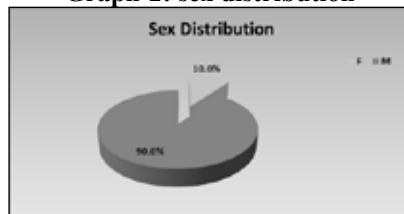


The mean age of males undergoing

surgery was 26.75(+5.95) years and that of females 25.25(+7.27) years.

Majority of the patients in the present study were males 36(90%) and 4(10%) were females as shown in graph-2

Graph-2: sex distribution



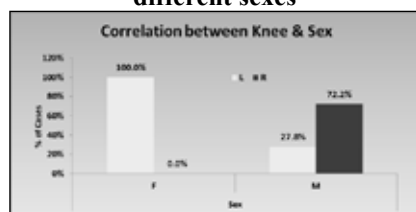
Right side was involved in 26(65%) patients and left in 14(35%) .

Right knee was involved more in males as compared to females. In males right knee was involved in 72.2% cases where as left knee was involved in 27.8% of cases. In females 100% cases showed involvement of left knee as shown in table-1 and graph-3

Table -1: Joint affected in different sexes

Knee	Sex				p value
	F		M		
	Frequency	%	Frequency	%	
L	4	100.0%	10	27.8%	0.011
R	0	0.0%	26	72.2%	
Total	4	100%	36	100%	

Graph-3 Joint involvement in different sexes



The most common cause of injury was sports, accounting for 26 cases (65%) followed by road side accident, which were responsible for 14 cases (35%).

Graph -4: Mode of injury



At 24 weeks, post operatively, Lahmann test was negative in 38 patients and grade 1+ in 2 patients, anterior drawer and pivot tests were negative in all 40 patients.

Functional evaluation was done by Lysholm score. The mean Lysholm score pre operative was 79.38 ± 11.32.

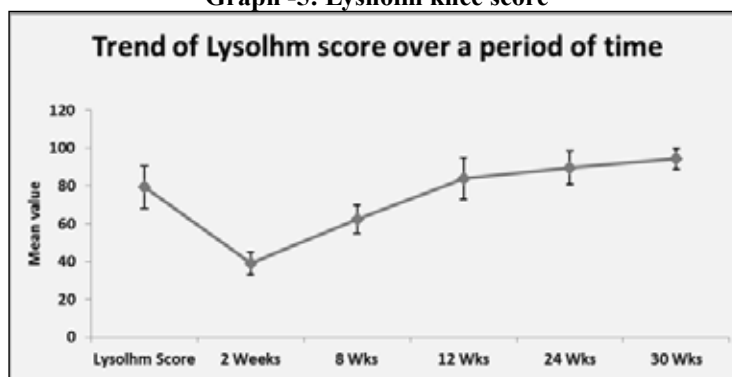
Post operatively, at two weeks the Lysholm score declined to 39.00 ± 5.93 and then it increased to 62.32 ± 7.50 at 8 weeks and then gradually increased to 94.23 ± 5.55 at 30 weeks.

Further, it was observed that there was a significant mean difference in Lysholm score across various time points (p value of <0.001) as shown in table-6 and graph-5.

Table -2: Lysholm knee score

Lysholm score	Mean ± SD	Median	Min - Max
Pre-op	79.38 ± 11.32	82.00	54 - 94
2 Weeks	39.00 ± 5.93	38.00	30 - 56
8 Wks	62.32 ± 7.50	62.50	40 - 74
12 Wks	84.09 ± 11.00	86.00	44 - 95
24 Wks	89.62 ± 8.90	91.50	62 - 97
30 Wks	94.23 ± 5.55	95.00	78 - 100

Graph -5: Lysholm knee score



Post hoc analysis showed that there was a significant mean difference in Lysholm score among the various time points when compared individually. Further it was observed that when the mean difference of Lysholm score was compared between pre operative and other time points there was a fall from pre operative to 2 weeks by 40.045, by 16.818 at 8 weeks. However, it increased by 6.318 at 12 weeks, 11.182

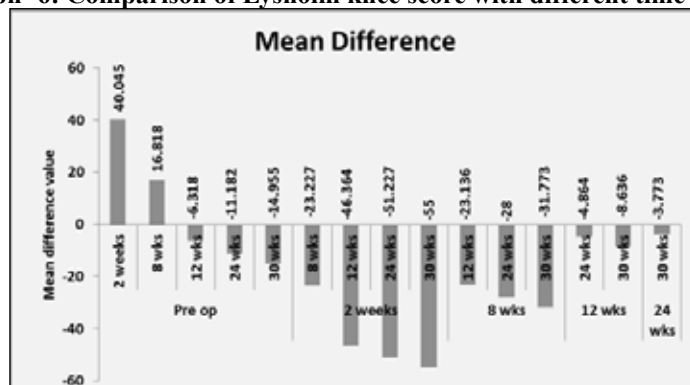
at 24 weeks and 14.955 at 30 weeks. Similarly, when mean difference was compared between 2 weeks and other time points, mean difference increased by 23.227 at 8 weeks, increased by 46.364 at 12 weeks, increased by 51.227 at 24 weeks and increased by 55.000 at 30 weeks. Similarly, when mean difference was compared between 8 weeks and other time points, mean difference increased by 23.136

at 12 weeks, increased by 28.000 at 24 weeks and increased by 31.773 at 30 weeks. Further, when mean difference was compared between 12 weeks and other time points, mean difference increased by 4.864 at 24 weeks and increased by 8.636 at 30 weeks. And the mean difference increased by 3.773 at 30 weeks when compared with 24 weeks as shown in table-3 and graph-6.

Table -3: Comparison of Lysholm knee score with different time points

Lysholm score	Lysholm score	Mean Difference	Std. Error	p value	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
Pre op	2 weeks	40.045*	3.121	<0.001	29.717	50.374
	8 wks	16.818*	2.648	<0.001	8.054	25.582
	12 wks	-6.318	2.263	0.164	-13.809	1.173
	24 wks	-11.182*	2.228	0.001	-18.556	-3.808
	30 wks	-14.955*	2.159	<0.001	-22.099	-7.81
2 weeks	8 wks	-23.227*	1.947	<0.001	-29.672	-16.782
	12 wks	-46.364*	2.318	<0.001	-54.037	-38.691
	24 wks	-51.227*	2.044	<0.001	-57.992	-44.463
	30 wks	-55.000*	1.84	<0.001	-61.09	-48.91
8 wks	12 wks	-23.136*	1.679	<0.001	-28.694	-17.579
	24 wks	-28.000*	1.489	<0.001	-32.927	-23.073
	30 wks	-31.773*	1.374	<0.001	-36.319	-27.226
12 wks	24 wks	-4.864*	0.864	<0.001	-7.722	-2.005
	30 wks	-8.636*	1.234	<0.001	-12.719	-4.553
24 wks	30 wks	-3.773*	0.732	0.001	-6.197	-1.348

Graph -6: Comparison of Lysholm knee score with different time points



Interpretation of Lysholm score

Table -4

Score	Outcome	patients
98-100	Excellent	0
93-97	Good to excellent	23 (57.5%)
82-92	Fair to good	14 (35%)
66-81	Fair	2 (5%)
<=65	Poor	1 (2.5%)

Table- shows the Lysholm score interpretation of these patients. 57.5% patients had good to excellent outcome, 35% patients had fair to good outcome,

5 % patient had fair outcome while , 2.5% had poor outcome.

IKDC score

The table and the chart below shows the mean IKDC score across the various time points for the patients under the study. It was observed that the mean IKDC score at pre op was $56.70 \pm$

12.27. At two weeks the IKDC score declined to 33.03 ± 4.22 and then it increased to 64.71 ± 9.91 at 8 weeks and then gradually increased to 88.99 ± 6.50 at 30 weeks. Further, it was observed that there was a significant mean difference in IKDC score across various time points (p value of <0.001) as shown in table-5 .

Table -5: IKDC score

Ikdc Score	Mean \pm SD	Median	Min - Max
Pre op	56.703 ± 12.27	53.95	35.6 - 82.7
2 Weeks	33.033 ± 4.22	32.10	25.2 - 41.3
8 Wks	64.713 ± 9.91	64.30	35.6 - 82.7
12 Wks	75.246 ± 12.71	78.70	35.6 - 91.9
24 Wks	85.06 ± 9.35	86.20	57.4 - 96.5
30 Wks	88.99 ± 6.50	90.80	63.2 - 96.5

Interpretation of IKDC Score

Table-6

IKDC score	Pre operative	Post operative (six months)
A normal outcome	0	12 (30 %)
B near normal outcome	3	25 (62.5%)
C abnormal outcome	17	3 (7.5%)
D severely abnormal outcome	6	0

Two patients developed complications in the post operative period.

One patient developed common peroneal nerve palsy in the post operative period which was managed conservatively. The palsy recovered after 3 months of conservative management. Another patient developed knee stiffness in the post operative period owing to improper follow up and not adhering to physiotherapy protocol. The patient was managed by knee manipulation under general anaesthesia at 3 months post operatively.

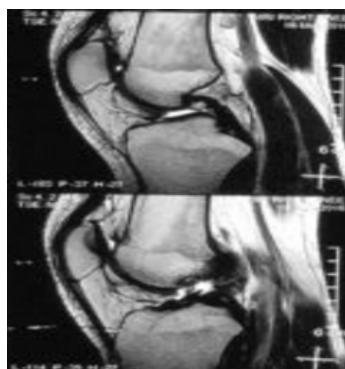


Fig..1 MRI- ACL Tear

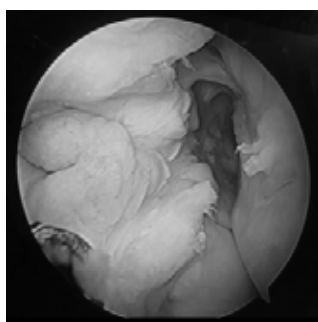


Fig.2- ACL Tear arthroscopic view

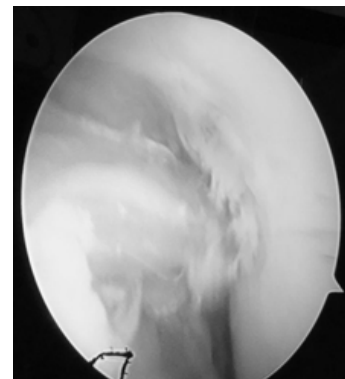


Fig.3 Reconstructed ACL



Fig.4 Post Op X Ray

Discussion

Although there are many potential graft choices from which to choose for ACL reconstruction, hamstring autografts have over the past decade increasingly become more popular. Several studies have shown that multiple-strand hamstring tendon ACL reconstructions have higher strength, stiffness, and cross-sectional area compared with patellar tendon grafts.

Harvest of hamstring tendon autografts also yields fewer donors site morbidity than harvest of patellar bone- tendon- bone grafts and carries no risk of patellar fracture, however remote. New techniques focus on optimizing graft strength and stiffness.

Successful ACL reconstruction using hamstring autograft requires stable initial graft fixation and, ultimately, graft- to- bone healing. Hamstring reconstruction using femoral variable loo endobutton fixation has been shown to have excellent initial mechanical properties,

including pullout strength. Tibial hybrid fixation with bio-interference screws provides excellent soft tissue to bone fixation.

Our observations of the present study have been discussed under the following headings:

1. Age distribution of patients

The mean age of the patients operated for ACL reconstruction in our department at bhagat phool singh government medical college for women was 26.75 ± 5.95 for male patients and 25.25 ± 5.25 for female patients respectively. Majority of the patients (57.5%) belong to 20-25 age group followed by 17.5% in the age group of 26-30 years. 15% patients belong to 31-35 age group and 10% belong to 36-40 years age group respectively. This shows that the ACL injury is highly common among young active individuals.

Sanders TH et al conducted a 21 year population based study on incidence of anterior cruciate ligament tears and reconstruction. They found that Age-specific patterns differed in male and female patients, with a peak in incidence (241.0 per 100,000) between 19 and 25 years in males and a peak in incidence (227.6 per 100,000) between 14 and 18 years in females.⁶

2. Gender distribution among patients

In the present study males outnumbered females by a great measure. There were 36(90%) males and 4(10%) female. More involvement of males in the study can be explained by the fact that they are more involved in sports and outdoor activity and thus are more vulnerable to knee injury.

Olson O et al conducted a Cohort study of 1145 consecutive patients with traumatic knee distorsion who

underwent MRI within median 8 days after injury. They found that anterior cruciate ligament (ACL) rupture was the most common structural injury (52%), followed by meniscal tear (41%) and lateral patella dislocation (LPD, 17%). The annual incidence of ACL injury was 77 (70-85, 95% CI) per 100,000 inhabitants with significant differences between men (91, 80-103) and women (63, 53-73).⁷

3. Mode of trauma

In our study, the most common cause of injury was sports injury accounting for 26(65%) followed by road side accident which were responsible for 14 (35%). The differences in the mode of injury in our study with other studies can be explained as local population is quite involved in contact sports such as kabaddi as compared to other parts of country.

Kobayashi H et al investigated the activity, the injury mechanism, and the dynamic knee alignment at the time of the injury in 1,718 patients diagnosed as having the ACL injuries. They found out that the number of subjects who had the injury during "Competitions" was the largest (846/1718), accounting for 49.2% of all the subjects. The number of subjects who had the injury during "Practice" and "Leisure activities" accounted for 34.8 % and 8.5%, respectively.⁸

4. Joint affected

In the present study, right knee was involved in 26(65%) cases where as left knee was involved in 14(35%) cases. In case of males right knee was involved in 72.2% of cases whereas in females left knee was involved in all cases.

Brophy R et al conducted a retrospective observational study on

Subjects who had sustained an ACL injury due to direct participation in soccer. There were 93 patients in the study with 41 males and 52 female patients. They found that for non-contact injuries, roughly half of the injuries occurred in the preferred kicking leg (30) and the contralateral leg (28). However, by gender, there was a significant difference in the distribution of non-contact injury, as 74.1% of males (20/27) were injured on the dominant kicking leg compared with 32% (10/31) of females ($p < 0.002$).⁹

5. Assessment of functional recovery of the patients using Lysholm knee score at preoperative and at different time periods in postoperative phase.

In our study, functional outcome of ACL reconstruction was assessed by Lysholm knee score and IKDC score. The mean Lysholm score was 79.38 ± 11.32 which declined to 39.00 ± 5.93 at two weeks post operatively. Furthermore the Lysholm knee score increased to 62.32 ± 7.50 at eight weeks postoperatively which shows improvement in knee function owing to successful physiotherapy and rehabilitation. The score further increased to 84.09 ± 11.00 at twelve weeks post operatively, 89.62 ± 8.90 at twenty four weeks, 94.23 ± 5.55 at thirty weeks postoperatively.

Octav Russu et al conducted a prospective study in Thirty-two patients and were operated using the TransLateral technique for ACL reconstruction. In this technique the graft is inserted and fixed with a TightRope Arthrex on the femoral side and a bioresorbable screw on the tibial part. The Lysholm score improved from a mean of 56.3 ± 4.9 at the preoperative time to 72.6 ± 9.8 at

six months follow up and to 93.9 ± 5.6 at 12 months of follow up.¹⁰

Rai et al conducted a prospective study of 300 patients of arthroscopic guided ACL reconstruction using quadrupled hamstring tendon graft (QHTG) and femoral side graft fixation using ACL TightRope. The mean \pm SD Lysholm score at 3, 6, 12, 18, and 36 months was 86.11 ± 9.21 , 87.86 ± 12.40 , 91.67 ± 7.32 , 98.19 ± 3.53 , and 98.25 ± 2.17 , respectively.¹¹

6. Assessment of functional recovery of the patients using IKDC score at preoperative and at different time periods in postoperative phase.

In our study, the mean IKDC score was 56.38 ± 12.27 which declined to 33.033 ± 4.22 at two weeks post operatively. Furthermore the IKDC score increased to 64.713 ± 9.91 at eight weeks postoperatively which shows improvement in knee function owing to successful physiotherapy and rehabilitation. The score further increased to 75.246 ± 12.71 at twelve weeks post operatively, 91.14 ± 11.50 at twenty four weeks, 95.327 ± 7.98 at thirty weeks postoperatively.

Shervegar S et al did a retrospective observational study in which a total of 50 patients underwent arthroscopic anterior cruciate ligament reconstruction with hamstring tendons using femoral Rigid fix cross-pin and interference screw tibial fixation. Patients were followed up from minimum of 6 months to 4 year seven months. The Mean IKDC subjective score post reconstruction was 75.6 with a standard deviation of 17.36.¹²

Devgan A et al did a study on 48 competitive athletes who had undergone arthroscopic ACL reconstruction with Endobutton (Smith & Nephew, Mass, USA) fixation on

the femoral side and a biodegradable screw with tendon staple on the tibial side. At 5 year follow up the mean subjective IKDC score was 82.8 (SD = 14.8). 84.6% of patients had normal or nearly normal objective IKDC grade (A or B), while the remaining 15.4% had IKDC grade C (abnormal).¹³

Rahul singh et al conducted a prospective study of 44 patients who underwent autologous hamstring graft ACL reconstruction using femoral Rigid-fix and tibial Bio-intrafix devices. The mean IKDC scores in the preoperative and follow up period at 1 year were 66.62 ± 5.36 to 92.36 ± 5.30 respectively; the improvement was statistically significant with P value < 0.001 .¹⁴

Limitation of our study was short duration of follow-up.

Conclusion

Autologous ipsilateral quadrupled hamstring tendon graft is a good graft choice in arthroscopic ACL reconstruction and graft fixation using adjustable loop endobutton for the femoral end fixation and bioabsorbable interference screw fixation at the tibial end give an excellent result with minor complications. This implant has adjustable length loops that can be tightened intraoperatively. This property of adjustable loop endobutton makes it a better and a robust fixation device. ACL rehabilitation protocol concentrating on regaining hamstring power is essential to the success of ACL reconstruction surgery.

References

1. McGinty JB. Arthroscopic surgery in sports injuries. *Orthop Clin North Am* 1980;11:787-99.
2. Arnold JA, Coker TP, Heaton LM, Park JP, Harris WD. Natural history of anterior cruciate tears.

- Am J Sports Med 1979;7:305-13.
3. Meighan AA, Keating JF, Will E. Outcome after reconstruction of the anterior cruciate ligament in athletic patients. A comparison of early versus delayed surgery. *J Bone Joint Surg Br.* 2003;85:5214.
4. Brown CH, Sklar JH. Endoscopic anterior cruciate ligament reconstruction using quadrupled hamstring tendons and endobutton femoral fixation. *Techniques in Orthopaedics.* 1998;13(3):298.
5. Barrow AE, Pilia M, Guda T, Kadrmaz WR, Burns TC. Femoral suspension devices for anterior cruciate ligament reconstruction. Do adjustable loop lengthen? *Am J Sports Med.* 2014; 42(2):343-49.
6. Sander TL, Maradit Kremers H, Bryan AJ, Larson DR, Dahm DL, Levy BA et al. Incidence of Anterior Cruciate Ligament Tears and Reconstruction: A 21 Year Population Based Study. *Am J Sports Med* 2016;44:6
7. Olsson O, Isacson A, Englund M, Frobell R.B. Epidemiology of intra- and peri-articular structural injuries in traumatic knee joint hemarthrosis: data from 1145 consecutive knees with subacute MRI. *JOCA* 2016;24(6):1890-1897
8. Kobayashi H, Kanamura T, Koshida S, Miyashita K, Okado T, et al Mechanisms of the anterior cruciate ligament injury in sports activities: A twenty-year clinical research of 1,700 athletes. *Journal of Sports Science and Medicine* 2010;9:669-675
9. Brophy R, Silvers HJ, Gonzales T, Mandelbaum BR. Gender influences: the role of leg dominance in ACL injury among soccer players. *Br J Sports Med*

- 2010;44(10):694-7.
10. Russu O, Feier AM, Bataga T, Todoran M, Ciorcila E et al. Anatomic All-Inside Anterior Cruciate Ligament Reconstruction Using the TransLateral Technique. *Journal of Interdisciplinary Medicine* 2017;2(S3):17-21.
11. Rai SK, Varma R, Wani SS. Study of outcome of 300 cases of arthroscopic anterior cruciate ligament reconstruction with quadrupled hamstrings tendon graft using anterior cruciate ligament tightrope for femoral fixation. *J Musculoskelet Surg Res* 2018;2:26-30.
12. Shervegar S, Nagaraj P, Grover A, Niranthara G DJ, Ravooof A. Functional Outcome Following Arthroscopic ACL Reconstruction with Rigid Fix: A Retrospective Observational Study. *Arch Bone Jt Surg*. 2015;3(4):264-268.
13. Devgan A, Magu NK, Siwach RC, Rohilla R, Sangwan SS. Functional outcome in athletes at five years of arthroscopic anterior cruciate ligament reconstruction. *ISRN Orthop* 2011 Jul 3;2011:570329.
14. Singh R, Triathy SK, Naik MA, Sujir, Rao SK. ACL reconstruction using femoral Rigid-fix and tibial Bio-intrafix devices. *JCOT* 2017;8(3):254-8