Comparison of Functional Outcome between Bio Absorbable Interference Screw and Endobutton Fixation on Femur in Arthroscopic ACL Reconstruction

Shafqat Wasim,[1] Syed Baqar Jafree,[2] Sher Afgan,[3] Sajjad Hussain,[4] Syed Habib Ullah Shah,[5] Taimoor Nawaz Khan,[6] Muhammad Moaz Bin Khalid[7]

Abstract

Objective: Arthroscopic reconstruction of the anterior cruciate ligament (ACL) is a common surgery with various techniques, including suspensory and aperture fixation. This study aims to compare the clinical outcomes of using bioabsorbable interference screws versus Endobutton fixation in arthroscopic ACL reconstruction in our population, addressing the lack of local research and conflicting international data.

Material and Method: This prospective comparative study was conducted at Orthopedic Department Unit-I of Jinnah Hospital in Lahore, including 60 patients (30 in each group) diagnosed with complete ACL tear. ACL repair was performed using quadrupled hamstring tendon autografts, with femoral fixation using either bioabsorbable interference screws or Endobuttons. Clinical examinations and MRI confirmed ACL tears. Post-surgery, all patients followed a standardized rehabilitation program. Knee stability was evaluated using the Tegner-Lysholm scoring scale six months post-surgery. Data were analyzed using SPSS version 25.0, with a p-value < 0.05 considered significant.

Results: The mean age was 37.10±8.876 years in group A and 37.33±9.234 years in group B. Mean BMI was 28.35±9.741 kg/m² in group A and 29.41±9.485 kg/m² in group B. Mean symptom duration was 3.5±1.5 weeks in group A and 3.7±1.7 weeks in group B. Excellent outcomes were observed in 46.7% of the bioabsorbable screws group and 66.7% of the Endobutton group, with a statistically significant p-value of 0.032.

Conclusion: Endobutton fixation produced superior functional outcomes compared to bioabsorbable screw fixation in arthroscopic ACL reconstruction. Further long-term, large-scale trials are needed to confirm these findings.

Keywords: Anterior Cruciate Ligament (ACL), Arthroscopy, Endobutton Fixation, Bioabsorbable Screws.

How to cite: Wasim S, Jafree SB, Afgan S, Hussain S, Shah SHU, Khan TN, Khalid MMB. Comparison of Functional Outcome between Bio Absorbable Interference Screw and Endobutton Fixation on Femur in Arthroscopic ACL Reconstruction. Esculapio - JSIMS 2024;20(04): 606-611

DOI: *xxxxxxxxxxxxxxxxxxxxxxxxx*

Introduction

Anterior cruciate ligament (ACL) reconstruction is a common and critical procedure for restoring knee stability and function after an ACL injury.[1] With the advent of arthroscopic techniques, the surgical management of ACL injuries has evolved significantly, allowing for minimally invasive approaches that promote faster recovery and reduced post-operative complications.[2,3] The choice of fixation devices for graft attachment remains a subject of ongoing debate among orthopedic surgeons.[4] Among the various fixation methods available, bio-absorbable interference screws and endobutton devices have gained widespread acceptance.[5] Bio-absorbable interference screws are designed to provide secure graft fixation while gradually degrading

1-4,6. Department of Orthopaedic Unit 1,Jinnah Hospital Lahore
5. Department of Orthopaedic Surgery Allama Iqbal Teaching Hospital, DG Khan
7. Post Graduate Resident Orthopaedic Unit 1, SIMS/Services Hospital Lahore

Correspondence:
Dr. Muhammad Moaz Bin Khalid , *Post Graduate Resident, Orthopaedic Unit 1 , SIMS/Services Hospital, Lahore, Pakistan.*
E-mail. muhammadmoazbinkhalid@yahoo.com

Submission Date:	13-08-2024
1st Revision Date:	09-09-2024
Acceptance Date:	15-11-2024

over time, theoretically eliminating the need for hardware removal and reducing long-term complications associated with metallic implants.[6,7] On the other hand, endobutton fixation utilizes a suspensory technique that is purported to provide robust mechanical stability and promote biological healing at the graft-tunnel interface.[8] This research is driven by the lack of local studies and the presence of conflicting results in the existing international literature. By addressing these gaps, the findings of this study will help enhance patient care in our future clinical practice.

The impetus for this research stems from the need to optimize surgical techniques and improve patient outcomes in ACL reconstruction. Finding the best fixation technique is essential for a good recovery and restoration to pre-injury activity levels since ACL injuries have a major impact on athletes and active people. By offering a thorough comparison of two popular fixation techniques, this research aims to add to the body of information already in existence and improve the care that patients receiving ACL reconstruction get.

Materials and Methods

This research was carried out at Jinnah Hospital in Lahore's Department of Orthopedics Unit-II, over a period of one calendar year following the acceptance of the study synopsis. The research design was a prospective comparative study, utilizing a non-probability consecutive sampling technique. Sixty patients in all were chosen, and they were split evenly between two groups of thirty. With 80% power and a 95% confidence level, the population size was determined, based on expected outcomes of 51% for bio-absorbable screws and 72% for endo-button fixation. Inclusion criteria for the study were patients of both genders, aged 18 to 55 years, with clinically and radiologically confirmed complete ACL rupture, involving a single knee, and undergoing their first surgery on the affected knee. Exclusion criteria included simultaneous injuries (such as collateral ligament, posterior cruciate ligament, and meniscal injury), grade II or higher osteoarthritis, inflammatory pathology, significant varus/valgus deformity, BMI outside the range of 19-35 kg/m^2, involvement of both knees, and any previous knee surgery.

After ethical approval, 60 patients meeting the inclusion criteria were recruited. Informed consent was obtained, and demographic and clinical data such as age, weight, and gender were collected. Patients were briefed about the procedure and its potential advantages and disadvantages. ACL reconstruction was performed using quadrupled hamstring tendon autografts by the same surgical team, with bio-absorbable interference screws or endobutton fixation for femoral attachment. Clinical examinations and MRIs confirmed complete ACL tears, and patients were evaluated based on knee instability, positive Lachman and anterior drawer tests, and MRI results. Patients were randomized into two groups using the lottery method: group A received bio-absorbable screws, and group B received endo-button fixation. Under general anesthesia, each patient underwent a clinical examination confirming a "positive Lachman test and pivot shift test. Details of injuries", clinical and radiological findings, and "Tegner-Lysholm scores" were recorded on a data sheet. An initial arthroscopy via the anterolateral portal confirmed ACL rupture in all patients. A 4 cm incision was made, 2 cm medial to the tibial tuberosity and 3 cm distal to the joint line, in order to collect the hamstring tendons. The gracilis and semitendinosus tendons were made by quadrupling and whip sewing using fiber wire. A three-portal approach was used to repair the ACL, with bioabsorbable screws being used to secure the graft on the tibia and either endobuttons or bioabsorbable screws being used on the femur.

Postoperative care included a standardized rehabilitation protocol from Oxford University Hospital's ACL Reconstruction physiotherapy guidelines. In the first 1-2 weeks, patients were allowed weight-bearing as tolerated with crutches, aiming to discontinue crutch use within this period. From weeks 2-6, patients progressed to full weight-bearing, achieving full range of motion, half squats, and static cycling. Between 6-12 weeks, follow-up continued, allowing outdoor biking, jogging, and stair climbing.

Patients' knee stability was assessed six months after surgery using the Tegner-Lysholm score system. SPSS version 25.0 was used to record and evaluate the data. While frequencies and percentages were used to represent qualitative data, means and standard deviations were used to communicate quantitative data. Less than 0.05 was the threshold for statistical significance. The Tegner-Lysholm scoring scale was used to classify the research results into four categories: excellent (95-100), good (84-94), fair (65-83), and bad ($\leq$ 64). A score of 100 indicated the absence of any symptoms or handicap.

Results

There were a total of 60 people with a confirmed case of full ACL tear who participated in this research. Individuals were randomly assigned to either Group-A (Bioabsorbable screws) or Group-B (Endobutton fixation). There were 20 (66.7%) males and 10 (33.3%) females in group B, compared to 19 (63.3%) males and 11 (36.7%) females in group A as shown in Table 1. Mean age in group-A patients was 37.10±8.876 year and 37.33±9.234 year in Group-B patients. In group-A, 26.7% were between the ages of 18 and 30, while 56.7% were between the ages of 31 and 45, and 16.7% were between the ages of 46 and 55. Six (20%) in group B were in the 18-30 year old range, eighteen (60%) were in the 31-45 year old range, and six (20%) were in the 46-55 year old range, as illustrated in figure 1. Mean "BMI in group-A patients were 28.35±9.741 kg/m^2 and 29.41±9.485 kg/m^2 in Group-B patients". In 'group-A, 10(33.3%) had normal BMI, while 19(63.3%) and 1(3.3%) were overweight and obese respectively, while in Group-B', 12(40.0%) had normal BMI, while 16(53.3%) and 2(6.7%) were overweight and obese respectively (Table 1)

Mean duration of symptoms in group-A patients was 3.5±1.5 weeks and 3.7±1.7 weeks in Group-B patients. According to duration of symptoms distribution, 20 (66.7%) had symptoms for ≤ 2 weeks and 10(33.3%) had for >2 weeks in group-A, while in Group-B, 22 (73.3%) had symptoms for ≤2 weeks and 8(26.7%) had for >2 weeks. According to the knee joint involved distribution, 14(46.7%) patients had right knee joint and 16(53.3%) had left knee joint in group-A, while in Group-B, 17(56.7%) patients had right knee joint and 13(43.3%) had left knee joint as shown in Table-1. Mean Tegner-Lysholm score in group-A patients were 86.30±11.582 and 89.87±10.228 in Group-B patients. According to functional outcome, in Bio absorbable screws group, 14(46.7%) had excellent outcome, while 8(26.7%), 5(16.7%) and 3(10.0%) had good, fair and poor outcomes respectively, while in Endobutton fixation group, 20(66.7%) had excellent outcome, while 7(23.3%), 2(6.7%) and 1(3.3%) had good, fair and poor outcomes

Table 2: *Comparison of functional outcome between groups*

Functional outcome	Groups		Total	p-value
	Bioabsorbable screws (A)	Endobutton fixation (B)		
Excellent	14	20	34	0.032
	46.7%	66.7%	56.7%	
Good	8a	7	15	
	26.6%	23.3%	25.0%	
Fair	5	2	7	
	16.7%	6.7%	11.7%	
Poor	3	1	4	
	10.0%	3.3%	6.7%	
Total	30	30	60	
	100.0%	100.0%	100.0%	

Table 1: *Demographic and clinical characteristics among patients undergoing Bioabsorbable screws and Endobutton fixation.*

Demographic	Category	Bioabsorbable Screws (Group-A, n=30)	Endobutton Fixation (Group-B, n=30)	Total (n=60)	p-value
Age	Mean ± SD	37.10 ± 8.876	37.33 ± 9.234		0.89
	18-30 years	8 (26.7%)	6 (20.0%)	14 (23.3%)	
	31-45 years	17 (56.7%)	18 (60.0%)	35 (58.3%)	
	46-55 years	5 (16.7%)	6 (20.0%)	11 (18.3%)	
Gender	Male	19 (63.3%)	20 (66.7%)	39 (65.0%)	0.78
	Female	11 (36.7%)	10 (33.3%)	21 (35.0%)	
Body Mass Index	Normal	10 (33.3%)	12 (40.0%)	22 (36.7%)	0.45
	Overweight	19 (63.3%)	16 (53.3%)	35 (58.3%)	
	Obese	1 (3.3%)	2 (6.7%)	3 (5.0%)	
Knee Joint Laterality	Right Knee	14 (46.7%)	17 (56.7%)	31 (51.7%)	0.52
	Left Knee	16 (53.3%)	13 (43.3%)	29 (48.3%)	
Duration of Symptoms	Mean ± SD	3.5 ± 1.5 weeks	3.7 ± 1.7 weeks		0.72
	≤2 weeks	20 (66.7%)	22 (73.3%)	42 (70.0%)	
	>2 weeks	10 (33.3%)	8 (26.7%)	18 (30.0%)	

respectively with a p-value of 0.032, which is statistically significant (Table 2).

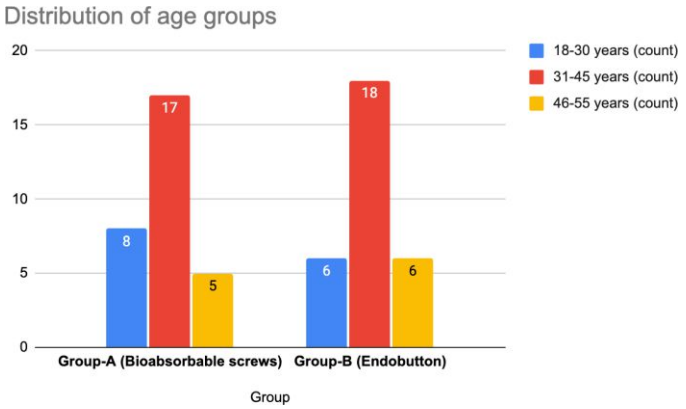

Figure 1: *Comparison of age distribution between groups*

Discussion

The study aimed to compare the outcomes of ACL reconstruction using bioabsorbable screws versus Endobutton fixation in terms of patient demographics, knee function, and overall satisfaction. This comparison is crucial, given the varying reports in the literature regarding the efficacy and complications associated with different fixation methods. Our study included 60 participants, randomly assigned to either the bioabsorbable screws group (Group A) or the endobutton fixation group (Group B); on the femoral side of the ACL graft. The mean ages were almost identical 37.10±8.876 years in Group A and 37.33±9.234 years in Group B, consistent with the typical age range for ACL injuries observed in previous studies[9]. The distribution of body mass index (BMI) was also similar, with both groups having a majority of overweight individuals, which aligns with findings that suggest a higher prevalence of ACL injuries in overweight populations[10,11].

Functional outcomes were assessed using the Tegner-Lysholm score, where Group B showed a slightly higher mean score of 89.87±10.23 compared to Group A 86.30 ±11.58, a difference that was statistically significant (p=0.032). In our study, 66.7% of patients in the Endobutton fixation group reported excellent outcomes, compared to 46.7% in the bioabsorbable screws group. These results are consistent with studies that found higher functional scores associated with endobutton fixation[12]. Our findings echo the conclusions of earlier studies, which reported that different fixation methods can influence the mechanical stability and long-term outcomes of ACL reconstructions. The higher functional outcomes in the Endobutton group may support the notion that suspensory fixation devices may offer superior mechanical stability compared to aperture fixation with bioabsorbable screws. A meta-analysis has shown decreased postoperative complications with suspensory fixation devices, while maximum with metallic interference screws followed by bioabsorbable interference screws and cross-pin fixation techniques. These results might emphasize or slightly overweight the advantage of using suspensory technique methods consistent with our study, but at the same time, this technique has shown relatively decreased functional outcomes as compared to other methods of fixation. The scarce number of studies on this method of fixation might not allow us to conclude that suspensory fixation devices like endobutton might be the best option for ACL reconstruction. The higher failure rate with screws can be attributed to damaged grafts by their threads and further biological and chemical interaction with biodegradable materials used in bioabsorbable screws.[13]

It is important to note that bioabsorbable screws while showing slightly lower functional outcomes in the short term, present fewer complications related to foreign body retention and the potential need for hardware removal. This long-term benefit may offset the marginally lower short-term functional outcomes. In clinical practice, the choice between bioabsorbable screws and endobutton fixation should consider both the short-term functional outcomes and the long-term complications associated with each method[14]. The current study's results suggest that while endobutton fixation might provide better immediate postoperative stability and function, bioabsorbable screws offer an alternative with fewer long-term complications. Long-term studies have shown that suspensory fixation using endobutton on the femur side is related to better functional outcomes over a follow-up of 2-year period 1. Hence studies for longer periods are needed to get an insight more comprehensively. A study including 53 participants with a mean age of 27.3 + 7.2 years who underwent ACL reconstruction using endobutton as a fixation method of graft at the femoral side showed significant improvement in IKDC scores (International Knee Documentation Committee Score) at 1-year follow-up supports the use of endobutton fixation technique.[15] This creates a need for assessment using unified scoring system. Whether the results are the same on the tibial side using endobutton needs further evaluation.

In our study, 34 (56.7%) patients had excellent functional outcomes, followed by good outcomes in 15 (25.0%),

fair outcomes in 7 (11.7%), and poor outcomes in 4 (6.7%) of the patients. The mean Lysholm score in group A patients was 86.30±11.582 and 89.87±10.228 in group B patients. These results are in line with other studies, which reported that a majority of patients achieved high functional scores after ACL reconstruction[16]. One study using a hamstring graft with an outside-in technique showed a mean Lysholm score at 1 year, 5 years, and 15 years follow-up of 96.16 ± 4.50, 95.82 ± 26.94, and 95.80 ± 4.91 respectively which seems promising.
as are the results of our study. This study used a Swing Bridge as a suspension device (Citieffe) on the femoral side.[17] As it comes to graft fixation, interference screws are often thought to have superior fixing strength as compared to other tools like buttons or staples. According to one research, suspension devices were utilized for 79% of hamstring femoral fixation procedures in the UK, whereas interference screws were used for 18% of cases. The Endobutton (48%) was the most often utilized suspension device, followed by Transfix (26%) and Rigid Fix (19%).[18]

On the other end of the graft, interference screws were used most frequently for tibial fixation (57%), followed by intrafix screws (30%), clinical outcomes and stability were reported to be unaffected by the type of graft attachment device used.[18,19,20] The Endobutton, a commonly used and cost-effective button, was noted to have some drawbacks, including an increased risk of drill tunnel expansion and associated complications due to the "bungee effect" and windshield wiper action caused by micromotion of graft within the tunnel. These issues can lead to significant failure loads and tunnel expansion due to graft-related micromotions into the bone tunnel and anterior joint laxity.[21]

Limitations and Future Research: The study's sample size was relatively small, and the follow-up period was limited to the short-term postoperative phase. Future research should include larger, more diverse populations and extended follow-up periods to fully capture the long-term benefits and potential complications of each fixation method. Additionally, studies should consider the impact of different rehabilitation protocols on functional outcomes.

Conclusion

Our study comparing the functional outcomes of bioabsorbable screws fixation and endobutton fixation in arthroscopic ACL repair revealed superior results with endobutton fixation, as evidenced by the Tegner-Lysholm knee score. However, further long-term research involving larger-scale trials with a greater number of patients is warranted to validate these findings.

Conflict of Interest *None*

Funding Source *None*

References

1. Kumar NN, Halbhavi MR, Gouthamraj H, Kumar TS, Shivanna HY, Sahana VK. A Long-term Comparison of Outcome of Arthroscopic Anterior Cruciate Ligament Reconstruction Using Bioabsorbable Interference Screw and Endobutton on Femur. Journal of Orthopaedic Case Reports. 2024 May;14(5):166. doi: 10. 13107/ jocr. 2024.v14.i05.4472.
2. Mishra AK, Girish S. A prospective study of functional outcome of ACL reconstruction with quadrupled semitendinosus tendon autograft using Endobutton and bioabsorbable interference screw. International Journal of Orthopaedics. 2018;4(3):47-55. doi: 10.22271/ ortho. 2018.v4.i3b.11.
3. Daniel SJ. A case control study to compare distal femur tunnel widening between suspensory fixation and suspensory fixation augmented with bioabsorbable screw for anterior cruciate ligament reconstruction with hamstring graft [dissertation]. Christian Medical College, Vellore. Available from: https://azpdf.net/document/ zwvwwv4l-widening-suspensory-fixation-suspensory-augmented-bioabsorbable-reconstruction-hamstring.html.
4. Jajee N, Dhanraj P, Sriram S, Chakravarthy R. Comparision of functional outcome of arthroscopic anterior cruciate ligament reconstruction using quadrupled semitendinosus and gracilis graft fixed with bioabsorbable interference screw against titanium interference screw. International Journal of Orthopaedics. 2021; 7(1): 838-42. doi: 10.22271/ortho.2021.v7.i1m.2578.
5. Prajapati P, Bansal V, Tiwari A, Bagga M, Mahawar S. A randomised controlled study for the comparison of functional outcome of femoral tunnel fixation devices, aperture fixation by screw vs suspensory fixation by endo-button in arthroscopic anterior cruciate ligament reconstruction. Indian Journal of Orthopaedics. 2023; 9(2):61-5. doi: 10.18231/j.ijos.2023.015.
6. Manikandan P. Outcome analysis of arthroscopic reconstruction of anterior cruciate ligament in adults [dissertation]. Thanjavur Medical College, Thanjavur.
7. Rajadurai S, Adhiyaman S, Kirubakaran G, Selvaraj R. Functional evaluation of anterior cruciate ligament reconstruction with anatomical single bundle technique using quadrupled hamstring tendon. International Journal of Orthopaedics Traumatology & Surgical Sciences. 2020 Feb 15;6(1):63-70. doi: 10.47618/ IJOTSS/ v6i1. 13.

8. Awasthi S, Mahapatra S, Aggarwal P, Tripathy SS, Yadav RR, Verma C. Analysis of fixation modalities in arthroscopic anterior cruciate ligament reconstruction. International Journal of Orthopaedics. 2017; 3(4): 102-5. doi: 10.22271/ortho.2017.v3.i4b.16.
9. Gautam V, Nagpal A, Girotra P. Transportal single bundle ACL reconstruction with quadruple hamstring graft using suspensory femoral and hybrid tibial fixation: A prospective study. International Journal of Orthopaedics. 2020;6(1):1089-98. doi:10.22271/ortho.2020. v6. i1n.3020.
10. Alsayed HN, Alkhateeb MA, Aldossary AA, Mohsen K, Houbani YM, Alrashidi YA. Risk of anterior cruciate ligament injury in population with elevated body mass index. Med Glas (Zenica). 2023;20(1):83-7. doi: 10. 17392/1517-22.
11. Bojicic KM, Beaulieu ML, Imaizumi Krieger DY, Ashton-Miller JA, Wojtys EM. Association between lateral posterior tibial slope, body mass index, and ACL injury risk. Orthopaedic journal of sports medicine. 2017 Feb 13;5(2):2325967116688664. doi: 10. 1177/2325967116688664.
12. Bodla VM, Achanala SK. A comparison of functional outcome between interference screw and endobutton fixation on femur in arthroscopic anterior cruciate ligament reconstruction. MRIMS J Health Sci. 2019 Jan 1; 7(1):16-20.
13. Speziali A, Delcogliano M, Tei M, Placella G, Bartoli M, Menghi A, Cerulli G. Fixation techniques for the anterior cruciate ligament reconstruction: early follow-up. A systematic review of level I and II therapeutic studies. Musculoskeletal surgery. 2014 Dec;98:179-87. doi: 10. 1007/s12306-014-0338-8.
14. Höher J, Livesay GA, Ma CB, Withrow JD, Fu FH, Woo SL. Hamstring graft motion in the femoral bone tunnel when using titanium button/polyester tape fixation. Knee Surgery, Sports Traumatology, Arthroscopy. 1999 Jul;7(4):215-9. doi: 10.1007/s001670050151.
15. Hashmi AR, Afgan S, Hamid A, Aslam A, Chishty JA, Shams A, Khalid MM, Ibrahim M. ACL Reconstruction with Peroneus Longus Autograft Using Endobutton & Bioabsorbable Interference Screw and Brace Free Rehabilitation. doi: 10.51273/esc24.251320110.
16. Bhavsar NM, Shah VP, Patel NM, Patel PR, Chhayani S. Results of anatomical ACL Reconstruction. International Journal of Orthopaedics. 2019;5(1):491-6. doi: 10.22271/ortho.2019.v5.i1i.86.
17. Bernholt DL, DePhillipo NN, Crawford MD, Aman ZS, Grantham WJ, LaPrade RF. Incidence of displaced posterolateral tibial plateau and lateral femoral condyle impaction fractures in the setting of primary anterior cruciate ligament tear. The American journal of sports medicine. 2020 Mar;48(3):545-53. doi: 10.1177/ 036 3546519895239.
18. Vaishya R, Agarwal AK, Ingole S, Vijay V. Current trends in anterior cruciate ligament reconstruction: a review. Cureus. 2015 Nov;7(11). doi: 10.7759/ cureus. 378.
19. Mahnik A, Mahnik S, Dimnjakovic D, Curic S, Smoljanovic T, Bojanic I. Current practice variations in the management of anterior cruciate ligament injuries in Croatia. World journal of orthopedics. 2013 Oct 10; 4(4): 3 09. doi: 10.5312/wjo.v4.i4.309.
20. Kim HS, Seon JK, Jo AR. Current trends in anterior cruciate ligament reconstruction. Knee Surgery & Related Research. 2013 Dec;25(4):165. doi: 10.5792/ksrr. 2013. 25.4.165.
21. Choi NH, Son KM, Yoo SY, Victoroff BN. Femoral tunnel widening after hamstring anterior cruciate ligament reconstruction with bioabsorbable transfix. The American journal of sports medicine. 2012 Feb;40(2):383-7. doi: 10.1177/0363546511425883.

Authors Contribution

SW,SBJ,SA,SH, TNK,MMBK, S: Conceptualization of Project

SW,SBJ,SA,SH, TNK,MMBK: Data Collection

SW,SBJ,SA,SH, TNK,MMBK: Literature Search

SW,SBJ,SA,SH, TNK,MMBK: Statistical Analysis

SW,SBJ,SA,SH, TNK,MMBK: Drafting, Revision

SW,SBJ,SA,SH, TNK,MMBK: Writing of Manuscript