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COMPARISON OF OUTCOME OF ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION USING INTERFERENCE SCREW VERSUS ADJUSTABLE BUTTON SYSTEM (ABS) IN TIBIAL GRAFT FIXATION

Original Research

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ABSTRACT

Background: Anterior cruciate ligament (ACL) reconstruction is a widely performed orthopedic procedure, with graft fixation playing a pivotal role in surgical success. Among the various fixation techniques, interference screw and adjustable button system (ABS) are commonly employed, but evidence comparing their outcomes in the local population remains scarce.

Objective: To compare the short-term functional outcomes of ACL reconstruction using interference screw versus adjustable button system (ABS) for tibial graft fixation.

Methods: A randomized controlled trial was conducted at the Department of Orthopedics, Khyber Teaching Hospital, Peshawar, over six months. A total of 276 patients aged 18–50 years with chronic ACL tears were randomly allocated into two groups: Group A (interference screw) and Group B (ABS), with 138 patients each. All patients underwent standard arthroscopic ACL reconstruction using autografts. Functional outcomes were assessed preoperatively and at three months postoperatively using the International Knee Documentation Committee (IKDC) scoring system. Data were analyzed using SPSS v25, and outcomes were compared using Chi-square and t-tests, with $p \leq 0.05$ considered statistically significant.

Results: Group A showed significantly greater improvement in mean IKDC scores (51.9 ± 10.4) compared to Group B (45.5 ± 11.1). Significant improvement (≥50-point increase) was noted in 71% of patients in Group A versus 55% in Group B. Moderate improvement was observed in 19.6% (Group A) and 27.5% (Group B), while 2.2% in Group A and 5.8% in Group B showed no improvement.

Conclusion: Interference screw fixation resulted in superior early functional outcomes compared to ABS in ACL reconstruction. These findings suggest its preferential use for tibial graft fixation where early recovery is desired.

Keywords: Anterior Cruciate Ligament, Arthroscopy, Graft Fixation, IKDC, Interference Screw, Knee Injuries, Orthopedic Surgery, Rehabilitation, Surgical Outcomes, Tibial Fixation.

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INTRODUCTION

Anterior cruciate ligament (ACL) injury is one of the most frequently encountered ligamentous injuries of the knee, particularly among individuals engaged in sports and physically demanding activities. The ACL plays a fundamental role in maintaining knee joint stability by preventing anterior tibial translation and controlling rotational loads. Anatomically, it originates from the anterolateral intercondylar area of the tibia and inserts on the posteromedial aspect of the lateral femoral condyle, consisting of the anteromedial and posterolateral bundles (1,2). Its intricate ultrastructure, composed primarily of collagen fibers and elastic elements, enables it to endure substantial tensile forces and multidirectional stresses during motion (3). Injuries to the ACL commonly result from sports-related trauma, vehicular accidents, or domestic falls, often leading to partial or complete rupture (4). If left untreated, ACL injuries can progress to chronic knee instability, reduced activity levels, secondary meniscal damage, and an increased risk of developing early-onset osteoarthritis (5). Accurate diagnosis typically involves clinical evaluation through tests such as the anterior drawer, Lachman, and pivot shift tests, which are essential in cases of suspected ligamentous injury (6). The decision to pursue surgical reconstruction depends on several patient-specific factors including age, occupational demands, athletic involvement, and associated intra-articular injuries (7).

ACL reconstruction, particularly via arthroscopic techniques using autografts such as hamstring tendons or bone-patellar tendon-bone grafts, remains the gold standard for restoring knee stability. However, the success of these procedures is largely dependent on optimal graft fixation within the bone tunnels, which directly influences the biomechanical stability and healing potential of the graft (8). Graft fixation techniques are broadly classified into aperture fixation (e.g., interference screws) and suspensory fixation (e.g., adjustable or fixed-loop cortical buttons) (9). Interference screws offer direct compression and are considered a traditional method, while adjustable button systems (ABS) have gained popularity due to their versatility and ease of use, particularly in achieving secure fixation across variable tunnel lengths. Recent studies have attempted to evaluate the clinical efficacy of these fixation methods. One investigation involving ABS reported that 55% of patients achieved an International Knee Documentation Committee (IKDC) score greater than 50, with an additional 28% scoring between 41-50 (10). Conversely, outcomes using interference screws showed more favorable results, with 71.3% of patients attaining an IKDC score above 50 and only 3.4% experiencing surgical failure (11,12). Despite these findings, there is a lack of direct comparative evidence assessing the functional outcomes of ACL reconstruction using interference screws versus ABS for tibial graft fixation within the local population. This gap in the literature underscores the need for further research to inform surgical decision-making in this context. Therefore, the objective of this study is to compare the functional outcomes of anterior cruciate ligament reconstruction using interference screws versus adjustable button systems for tibial graft fixation, aiming to identify the superior modality for improving patient recovery and long-term knee function.

METHODS

This study was conducted as a randomized controlled trial in the Department of Orthopedics at Khyber Teaching Hospital (KTH), Peshawar, following approval from the hospital's ethical review committee. The duration of the study spanned six months from the time of synopsis approval. A total of 276 patients were enrolled, divided equally into two groups of 138 each, based on a calculated sample size using OpenEpi software. The assumptions for sample size estimation included an anticipated proportion of significant improvement of 71.3% with interference screw fixation and 55.0% with the adjustable button system (ABS), a power of 80%, and a 95% confidence level (10,11). Participants included patients aged between 18 to 50 years of both genders who had an anterior cruciate ligament tear, as defined operationally, with a duration of more than six weeks. Diagnosis was based on clinical findings, including a positive Lachman test (more than 2 mm anterior translation compared to the contralateral side) and confirmatory MRI features such as increased T2 signal intensity, fiber discontinuity, abnormal orientation relative to Blumensaat's line, and signs of femoral attachment avulsion. High-grade tears were identified by MRI evidence of complete ligament transection. Patients were excluded if they had posterior cruciate ligament laxity, radiographic evidence of osteoarthritis, or grade 3 or 4 injuries to the medial or lateral collateral ligaments.

Non-probability consecutive sampling was employed. Written informed consent was obtained from all participants or their legal guardians, ensuring confidentiality and voluntary participation without risk. Baseline demographic information including age, gender, and duration of injury was recorded. Eligible patients were randomly allocated using a blocked randomization technique into either the

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interference screw group (Group A) or the ABS group (Group B). In both groups, autografts were harvested and prepared arthroscopically. In Group A, tibial graft fixation was achieved using an interference screw, whereas in Group B, an adjustable button system was utilized for fixation. Surgical procedures followed standard arthroscopic ACL reconstruction protocols. All patients were encouraged to begin partial weight bearing using a long knee brace two weeks postoperatively. Functional recovery was assessed at three months using the International Knee Documentation Committee (IKDC) scoring system. The IKDC score ranges from 0 (no improvement) to 100 (complete recovery). Improvements were categorized as significant (≥50 points increase), moderate (26–49 points), mild (1–25 points), or no improvement (0 or negative change compared to preoperative scores).

Data were collected on a structured proforma and analyzed using IBM SPSS version 25. For continuous variables such as age, BMI, and IKDC scores, normality was assessed using the Shapiro-Wilk test, and results were expressed as means ± standard deviation or medians with interquartile ranges. Frequencies and percentages were reported for categorical variables including gender, residence, education, profession, socioeconomic status, laterality of injury, and outcome categories. Comparisons of functional outcomes between groups were performed using the Chi-square test or Fisher's exact test where appropriate. Stratification was done for potential confounders such as age, gender, duration of symptoms, BMI, and laterality of the affected knee. Post-stratification Chi-square or Fisher's exact tests were applied with a significance threshold set at $P \leq 0.05$.

RESULTS

The study included a total of 276 patients, evenly distributed between two groups: Group A underwent tibial graft fixation using interference screws, and Group B received adjustable button systems (ABS). The mean age in Group A was 29.6 ± 7.8 years, and in Group B it was 30.1 ± 8.1 years. Males predominated in both groups, with a slightly higher proportion in Group A. The average height and weight were comparable between the groups. Urban residents made up a slightly larger portion of each cohort. Educational backgrounds and socioeconomic statuses were similarly distributed across groups, ensuring demographic comparability. The baseline IKDC score was 32.4 ± 9.1 in Group A and 31.7 ± 10.3 in Group B. At three months post-surgery, the final IKDC scores significantly increased in both groups. Group A showed a mean score of 84.3 ± 10.2, while Group B had a mean of 77.2 ± 11.6. The mean improvement (final minus baseline IKDC) was 51.9 ± 10.4 in Group A and 45.5 ± 11.1 in Group B, indicating better average functional recovery in the interference screw group.

Functional outcome analysis showed that 71% (n=98) of patients in Group A achieved significant improvement (≥50-point increase in IKDC), compared to 55% (n=76) in Group B. Moderate improvement (26–49 points) was observed in 27 patients in Group A and 38 patients in Group B. Mild improvement (1–25 points) was reported in 10 patients from Group A and 16 from Group B. Notably, only 3 patients in Group A and 8 in Group B had no improvement or a stationary score at follow-up. Graphical representation of these outcomes confirmed that Group A outperformed Group B in all improvement categories, particularly in achieving significant clinical recovery. Similarly, the line graph of IKDC progression illustrated a steeper improvement trajectory in the interference screw group compared to the adjustable button system group. These results demonstrate a higher proportion of favorable outcomes in patients undergoing ACL reconstruction with interference screw fixation at the tibial end, particularly in terms of marked functional gains within the three-month postoperative period.

Table 1: Baseline Demographics of Study Participants

Variable	Group A (n=138)	Group B (n=138)
Age (years, mean ± SD)	29.6 ± 7.8	30.1 ± 8.1
Gender		
Male	102	98
Female	36	40
Height (cm, mean ± SD)	170.2 ± 6.5	169.8 ± 7.2
Weight (kg, mean ± SD)	70.8 ± 9.2	71.5 ± 10.1
Residence		
Rural	58	61
Urban	80	77

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Variable	Group A (n=138)	Group B (n=138)
Education		
Primary	32	38
Middle	42	44
Higher	61	56
Profession	Mixed	Mixed
Socioeconomic Status		
Lower	48	46
Middle	64	66
Upper	26	26

Table 2: IKDC Scores Pre- and Post-Operatively

IKDC Parameter	Group A (n=138)	Group B (n=138)
Baseline IKDC (mean ± SD)	32.4 ± 9.1	31.7 ± 10.3
Final IKDC (mean ± SD)	84.3 ± 10.2	77.2 ± 11.6
Mean Difference (Final - Baseline)	51.9 ± 10.4	45.5 ± 11.1

Table 3: Functional Outcome Categories Based on IKDC Improvement

Improvement Category	Group A (n=138)	Group B (n=138)
Significant (>50 points)	98 (71%)	76 (55%)
Moderate (26–49 points)	27 (19.6%)	38 (27.5%)
Mild (1–25 points)	10 (7.2%)	16 (11.6%)
No Improvement	3 (2.2%)	8 (5.8%)

Table 4: Laterality and Duration of Injury

Variable	Group A (n=138)	Group B (n=138)
Laterality		
Right	79	82
Left	59	56
Duration of Injury (weeks, mean ± SD)	8.3 ± 1.9	8.6 ± 2.1

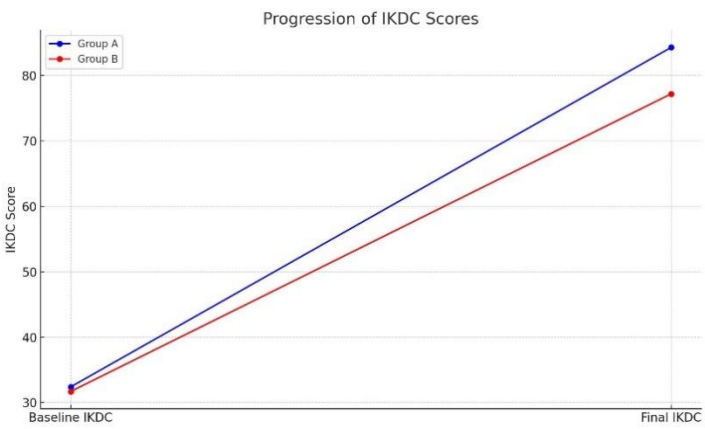


Figure 1 Progression of IKDC Scores

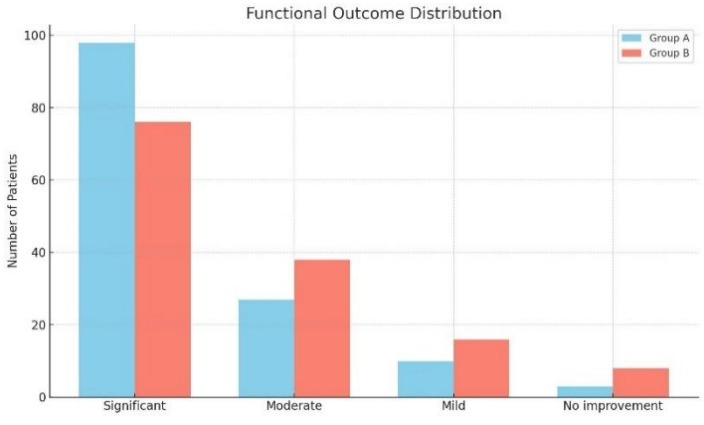


Figure 2 Functional Outcome Distribution

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DISCUSSION

The findings of this randomized controlled trial provide compelling evidence favoring the use of interference screw fixation over adjustable button systems (ABS) for tibial graft fixation in anterior cruciate ligament (ACL) reconstruction. Patients in the interference screw group demonstrated superior functional outcomes at three months, as measured by the International Knee Documentation Committee (IKDC) scores, with a greater proportion achieving significant improvement (≥50-point increase) compared to those in the ABS group. This superiority aligns with several published studies and offers clinically relevant insight into optimizing surgical techniques in ACL reconstruction. These results are consistent with prior literature demonstrating enhanced early functional outcomes and biomechanical stability associated with interference screw fixation. In a study, both titanium adjustable loop buttons and PLDLA-bTCP interference screws showed good postoperative IKDC and Lysholm scores, yet interference screw users reported higher knee stability postoperatively (13,14). Similarly, a study found excellent IKDC and Tegner scores in patients who underwent ACL reconstruction with a combination of suture button and interference screw, emphasizing the favorable outcomes associated with interference screw application (15).

However, despite these encouraging outcomes, interference screws have not been without critique. Multiple studies have raised concerns about postoperative tunnel widening associated with their use. A study reported significant tunnel enlargement in femoral and tibial sites when PEEK interference screws were used, potentially affecting long-term graft integrity and complicating revision procedures (16). Similarly, a study demonstrated increased tibial tunnel volume and diameter in the interference screw group compared to cortical button fixation, though functional outcomes were not significantly different at two-year follow-up (17). On the other hand, ABS devices offer certain biomechanical and technical advantages. A recent study showed that tibial ABS provided greater ultimate failure load compared to interference screws, though they had lower stiffness—suggesting better load accommodation but potentially less initial stability (18,19). Additionally, suspensory fixation techniques have been associated with less tunnel widening over time, a key factor in graft longevity and potential revision surgery planning, as demonstrated by a study in their five-year longitudinal analysis (20).

The current study's strengths include its randomized design, adequate sample size, and the use of validated outcome metrics. However, limitations must be acknowledged. The follow-up period of three months, although sufficient to capture early functional outcomes, may not reflect long-term graft integrity, tunnel behavior, or late complications such as re-rupture. The study also did not stratify results by graft type, tunnel length, or associated meniscal procedures, which could potentially confound outcomes. Furthermore, the exclusive focus on the tibial fixation method without examining femoral fixation techniques limits the generalizability of the conclusions to the entire reconstructive process. Future research should aim to include longer-term follow-ups, radiographic evaluation of tunnel integrity, and comparative studies evaluating hybrid fixation techniques combining both screws and buttons. A multicenter design with diverse patient demographics would enhance external validity. Moreover, including patient-reported satisfaction and return-to-sport metrics would provide a more holistic view of functional recovery. In conclusion, interference screw fixation resulted in better short-term functional outcomes compared to ABS for tibial graft fixation in ACL reconstruction, reaffirming its continued utility in surgical practice. However, the biomechanical advantages of ABS and its potential for reduced tunnel morbidity suggest a role for individualized surgical decision-making based on patient-specific factors and long-term goals.

CONCLUSION

This study concluded that tibial graft fixation using interference screws in ACL reconstruction resulted in superior short-term functional outcomes compared to adjustable button systems, as evidenced by higher IKDC score improvements. These findings support the continued use of interference screws as a preferred fixation method in clinical settings, particularly when early functional recovery is a key priority.

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AUTHOR CONTRIBUTION

Author	Contribution
Wajid Ullah	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Syed Dil Bagh Ali Shah	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Zeb*	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Zeeshan Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Imtiaz ur Rehman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Aftab Ali	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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