



RANDOMISED CONTROL STUDY TO ASSESS THE EFFICACY OF INTRAOPERATIVE VANCOMYCIN-DIPPED GRAFTS IN ARTHROSCOPIC ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION IN REDUCING POST-OPERATIVE INFECTIONS RATE.

Orthopaedics

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ABSTRACT

Background: Anterior cruciate ligament (ACL) reconstruction surgery carries the risk of post-operative infection, which can lead to complications such as graft failure and long-term joint issues. This study aimed to evaluate the efficacy of intraoperative vancomycin-dipped grafts in reducing post-operative infection rates in patients undergoing arthroscopic ACL reconstruction. **Methods:** This randomized controlled trial involved 120 patients undergoing ACL reconstruction surgery, with 60 receiving vancomycin-dipped grafts and 60 receiving standard grafts without vancomycin. The clinical outcomes of the two groups were monitored at 2, 4, and 8 weeks, and at 3 months post-surgery. Clinical assessments included measures of pain, swelling, discharge, and hyperemia. **Results:** Patients in the vancomycin-dipped graft group showed significantly lower rates of post-operative complications compared to the standard graft group. None of the patients in the vancomycin group experienced pain, swelling, discharge, or hyperemia at any follow-up interval, while the standard graft group had instances of these complications. Visual Analog Scale (VAS) scores for pain showed significant improvement within both groups over time. **Conclusion:** Intraoperative application of vancomycin-dipped grafts in ACL reconstruction is effective in reducing post-operative infection rates without compromising knee function or biomechanical properties. This approach is recommended for routine use in ACL reconstruction protocols to enhance patient outcomes and minimize complications.

KEYWORDS

ACL Reconstruction, Vancomycin-Dipped Grafts, Post-operative Infection, Knee Stability.

INTRODUCTION

The anterior cruciate ligament (ACL) is a critical structure in the knee joint that helps maintain stability during dynamic movements like running, jumping, and pivoting. Even though the ACL is a strong ligament, injuries can still occur from it, especially in athletes who play high-impact sports or engage in activities that require abrupt direction changes. [1] ACL injuries frequently result from non-contact mechanisms like sudden direction changes, pivoting, and landing after a jump. ACL tears can also result from direct trauma to the knee, such as a collision or strong blow [2] An ACL tear can have serious effects that range from osteoarthritis and long-term joint degeneration to functional impairment and reduced athletic performance. When it comes to treating ACL injuries, patients with partial tears or those who don't perform physically demanding activities may benefit initially from conservative therapy. [3]

Conservative methods usually include bracing the injured knee and using physical therapy to strengthen the surrounding musculature and enhance knee stability. Even though conservative treatment may work well for certain patients, it might not be sufficient to fully restore knee stability or stop unstable episodes from happening again, especially in those with complete ACL tears or high functional demands. [4] Patients with complete ACL tears or those who want to resume high-level sports or activities are frequently advised to have surgery, especially ACL reconstruction surgery. [5] ACL reconstruction is the process of replacing a torn ligament with a graft, usually obtained from donor tissue (allograft) or from the patient's own tissues (autograft). [6] There are two ways to perform the surgical technique: open or arthroscopic. Arthroscopy is the recommended method because it is less invasive and can result in a quicker recovery. [7]

ACL reconstruction is not risk-free, even with improvements in perioperative care and surgical techniques. Postoperative infection is one of the most worrisome side effects of ACL reconstruction surgery. Although infection rates following ACL reconstruction are typically low (0.14 percent to 1.7 percent), [8] they still pose a serious problem for orthopedic practitioners. Most intra-articular post-ACLR knee infections are acute (2 weeks) or subacute (>2 weeks to 2 months). [9] Infections after ACLR are uncommon, but when they do happen, the consequences can be severe and include graft failure, arthrofibrosis, loss of articular cartilage, and even the requirement for graft removal. [10]

In this population, acutely painful and swollen knee joints, limited

range of motion, sudden worsening of knee pain, a rapidly expanding and persistent effusion, sporadic fever, and hyperemia with serous or purulent discharge are the most common signs of an infection. Furthermore, superficial infections can occur early after ACL reconstruction, especially at the tibial tunnel site where wound dehiscence is present. [10, 11]

A number of approaches, such as careful surgical technique, perioperative antibiotic prophylaxis, and the use of grafts with local antibiotic application, have been suggested to reduce the risk of infection after ACL reconstruction. [12, 13] Applying local antibiotics, like vancomycin, to the graft during arthroscopic ACL reconstruction has drawn interest as a possible way to lower infection rates. [14] Applying vancomycin intraoperatively to the graft creates a localized antimicrobial environment that targets potential pathogens at the surgical site. Vancomycin is a broad-spectrum antibiotic that works well against many gram-positive bacteria. [15]

Results from a single surgeon's ACLR procedure using a vancomycin swab were published in 2012 by Vertullo CJ [16] et al. According to reports, the infection rates were 1% without vancomycin and 0% with it. Subsequent research has demonstrated that, in comparison to standard antibiotic prophylaxis, this strategy significantly lowers sepsis. [17–19]

This investigation compared the incidence of post-operative infection during ACL graft preparation with and without vancomycin in order to thoroughly assess the effectiveness of intraoperative vancomycin-dipped grafts in arthroscopic anterior cruciate ligament (ACL) reconstruction. The study had two main goals: first, it sought to compare the infection rates of patients who received ACL grafts with and without vancomycin, which is a serious concern in orthopedic surgery; second, it evaluated the intraoperative stability of ACL grafts to make sure that infection control practices do not impair the biomechanical properties or integrity of the graft.

METHODS

The present study research was a randomized controlled trial, which was a single blind, comparative, prospective, longitudinal, hospital based study, conducted in the Department of Orthopaedics at a teaching institution in Pune over a 21-month period, aiming to evaluate the efficacy of intraoperative vancomycin-dipped grafts in arthroscopic anterior cruciate ligament (ACL) reconstruction in

reducing postoperative infection rates. A total of 120 patients were enrolled, with 60 receiving vancomycin-dipped ACL grafts and 60 receiving grafts without vancomycin. Patients were selected based on inclusion criteria including confirmed complete ACL tear, confirmed by Magnetic resonance imaging undergoing arthroscopic ACL reconstruction and age over 18 years, while those with concomitant ligament injuries were excluded.

The surgical procedure for arthroscopic anterior cruciate ligament (ACL) reconstruction involved several steps. Initially, small incisions were made around the knee to access the damaged ligament. Through these incisions, an arthroscope was inserted to provide visualization of the interior of the knee joint. Subsequently, the torn ACL was meticulously removed using specialized instruments.

Once the damaged ligament was cleared, a new graft was meticulously prepared. Typically harvested from the patient's own hamstring tendon or patellar tendon, the graft was then inserted into the knee joint, serving as a replacement for the torn ACL. It was securely anchored in place using screws or other fixation devices to ensure stability and proper alignment.

After securing the graft, the incisions were closed, and the patient underwent postoperative monitoring and rehabilitation. Physical therapy was prescribed to aid in restoring strength, range of motion, and stability to the knee joint. Patient assessments were conducted at various intervals post-surgery, focusing on parameters such as swelling, pain, range of motion, and signs of infection.

Statistical analysis of the collected data using SPSS software allowed for a comprehensive comparison of outcomes between the two groups, shedding light on whether vancomycin-dipped grafts indeed offer a tangible advantage in reducing postoperative infection rates.

RESULTS

A total of 120 patients with an ACL tear were included in the present study. A total of 120 ACL reconstructions were performed, with 60 using a vancomycin-dipped graft and the other half (60) not using a vancomycin-dipped graft. The patients' mean age was 30.81 ± 7.97 years; there were more males (90, (75%)) than females (30 (25%)).

The tear was on the right side in 72 (60%) of the 120 patients with an ACL tear, and on the left side in 48 (40%) of the patients. Along with ACL tears, additional diagnoses were evident among 39 patients; the distribution of those patients, along with additional diagnoses, is shown in Table 1 and presented graphically.

Table 1: Additional Diagnosis With Left Or Right ACL Tear

	Left ACL tear	Right ACL tear
Bucket handle medial meniscus tear	1	2
Posterior horn of medial meniscus tear	7	6
Lateral meniscus tear	-	6
Lateral and medial meniscus tear	3	4
Medial meniscus tear	2	2
Body of medial meniscus tear	-	1
Posterior horn of lateral meniscus tear	3	-
Longitudinal tear of medial meniscus	1	-
Anterior horn of lateral meniscus tear	1	-

All 120 patients with an ACL tear underwent arthroscopic ACL reconstruction. In addition to arthroscopic ACL reconstruction, the procedure in Table 2 was done on the patients who had other diagnoses.

Table 2: Additional Procedure Performed Along With Arthroscopic ACL Reconstruction

Procedure	N	%
Medical meniscus repair	18	15.0
Lateral and medial meniscus repair	7	5.8
Partial lateral meniscectomy	3	2.5
Lateral meniscus repair	7	5.8
Lateral meniscus balancing	1	0.8
Medial meniscus balancing	3	2.5
Subtotal lateral meniscectomy	1	0.8

The clinical findings were reported at 2, 4, 8 weeks, and 3 months among the patients with and without the use of vancomycin-dipped grafts. At 2 weeks, there was only one patient in the group who was

experiencing both pain and swelling and did not have a vancomycin-dipped graft. While there were no patients reported in the vancomycin-dipped graft group. At 4 weeks, there were 2 patients with swelling, both of whom belonged to the group without using a vancomycin-dipped graft. While there were no patients reported in the vancomycin-dipped graft group. At 8 weeks there were 1 patient each with discharge and hyperemia both belonged to the group without use of vancomycin dipped graft. While there were no patients reported in the vancomycin-dipped graft group. At 3 months there were 2 patients with discharge both belonged to the group without use of vancomycin dipped graft. While there were no patients reported in the vancomycin-dipped graft group. (Table 3)

Table 3: Clinical Assessment Of Patients

	2 Weeks		4 Weeks		8 Weeks		3 Months	
	Yes	No	Yes	No	Yes	No	Yes	No
Pain	0	1	0	0	0	0	0	0
Swelling	0	1	0	2	0	0	0	0
Discharge	0	0	0	0	0	1	0	2
Hyperemia	0	0	0	0	0	1	0	0

The mean values of the VAS score as a measure of pain were calculated in both study groups and compared within and between the groups. The VAS within the groups was significantly ($p < 0.0001$) decreased in both groups at 3 months compared to VAS scores at 2, 4, and 8 weeks. But there was no significant difference noted between the groups for the VAS score at all follow-ups. (Table 4)

Table 4: Comparison Of VAS Score Within And Between The Groups

VAS score	Yes		No		p value
	Mean	SD	Mean	SD	
2 weeks	3.38	0.86	3.53	0.94	0.3636
4 weeks	2.28	0.55	2.22	0.66	0.5896
8 weeks	1.63	0.80	1.48	0.94	0.3485
3 months	0.70	0.67	0.72	0.69	0.8723
	<0.0001		<0.0001		

DISCUSSION

ACL injuries represent a significant burden on patients, healthcare systems, and society, primarily affecting active individuals engaged in high-demand physical activities. The ACL, which sustains fewer than a quarter million injuries annually, is one of the most frequently injured ligaments globally. About 70% of ACL injuries are anticipated to be caused by noncontact mechanisms, with the remaining 30% coming from direct contacts. [20] ACL is crucial for knee joint stability, often leading to functional impairment, decreased quality of life, and an increased risk of osteoarthritis. [3] While conservative management may be appropriate for some cases, surgical reconstruction has become the standard treatment for ACL tears, particularly in patients with high functional demands. [21]

Arthroscopic ACL reconstruction in particular has emerged as a widely accepted and minimally invasive surgical approach. However, potential complications such as post-operative infection can impact recovery and long-term outcomes. Despite being rare, infections do happen after ACL reconstruction; rates ranging from 0.14 percent to 1.7 percent have been documented in the literature. [22]

Following ACL reconstruction, septic arthritis may necessitate multiple reoperations for irrigation and debridement (I&D), protracted oral and intravenous (IV) antibiotic therapy, possible graft removal, and occasionally graft revision. Infection may also lead to worse clinical outcomes, such as decreased function, increased pain, early osteoarthritis, and early graft failure. [23-26] Postoperative infection may be exacerbated by intraoperative graft contamination with skin flora, according to a theory. [23]

The present study aimed to evaluate the efficacy of intraoperative vancomycin-dipped grafts in arthroscopic anterior cruciate ligament (ACL) reconstruction by comparing the post-operative infection rates between patients who received vancomycin-dipped grafts and those who did not. The study involved 120 patients undergoing ACL reconstruction, with 60 patients in each study group. The clinical findings were monitored at 2, 4, 8 weeks, and 3 months post-surgery.

Regarding meniscal injuries, Lewis DW [27] et al. reported that 58% of patients undergoing ACL reconstruction had meniscal injuries, with the medial meniscus most frequently involved; they found that the

choice between meniscal resection or repair did not significantly influence the outcomes. We in the present study too reported a higher rate of meniscal injuries, the majority of which included a posterior horn of a medial meniscus tear reported in a total of 13 patients in both groups, followed by lateral and medial meniscus (7), lateral meniscus (6), medial meniscus (4), etc. There were 21 patients in our study with isolated ACL injuries.

As per findings of the recent study autografts for ACL reconstruction are commonly contaminated with skin commensal bacteria during harvest. One-third of the isolates in their study showed resistance to typical perioperative intravenous antibiotics, whereas all isolates were sensitive to vancomycin. Therefore, routine prophylactic decontamination of all autografts before implantation should be recommended, preferably with topical vancomycin. [28]

According to a recent systematic review and meta-analysis, pre-soaking grafts with vancomycin during ACL reconstruction significantly reduces the incidence of postoperative infection and septic arthritis, suggesting that this practice can be a valuable strategy for improving patient outcomes in ACL reconstruction surgery. [14]

All the ACL reconstruction procedures were performed by the same senior orthopedic surgeon using the anteromedial and anterolateral portal technique, along with meniscal repair in the current study. The results suggest a positive impact of vancomycin-dipped grafts on reducing the post-operative infection rate. In particular, the vancomycin-dipped graft group did not experience any instances of pain, swelling, discharge, or hyperemia at any of the follow-up intervals. In contrast, the group without vancomycin-dipped grafts experienced a range of complications, including pain and swelling at 2 weeks, swelling at 4 weeks, discharge and hyperemia at 8 weeks, and discharge at 3 months. These findings suggest that the use of vancomycin-dipped grafts may effectively prevent post-operative complications such as infections. This study assessed knee stability at 3 months using anterior drawer and Lachman tests, finding no significant difference between groups, which challenges previous concerns that vancomycin-dipped grafts could weaken graft architecture.

Among the 2 patients with infection, first patient was 27 years old male patient with isolated right ACL tear had pain and swelling at 2 and 4 weeks respectively, at 4th week and at 3 month follow reported to have discharge from operative site. Post ACL reconstruction MRI indicated presence of fluid in femoral tunnel suggestive of infective and/or inflammatory etiology with mild knee joint effusion. Patient was posted for debridement and removal of Endobutton. No growth was reported on culture. The patient was treated with oral antibiotic. The other patient was having superficial infection with no growth on culture, and managed on OPD basis with regular dressings.

According to Phegan M [19] et al pre-soaking hamstring grafts with topical vancomycin in addition to IV antibiotics significantly reduced the incidence of post-operative infections following ACL reconstruction. Similar findings from Pérez-Prieto D [18] et al were reported.

A systematic review and meta-analysis by Carrozzo A [29] et al revealed similar results particularly for hamstring tendon autografts. This finding supports a strong recommendation for the universal use of vancomycin presoaking in ACL reconstruction. Hu M [14] et al in the analysis of 13 studies encompassing 31,150 participants revealed that those who received vancomycin treatment had notably lower infection rates compared to those who did not receive the treatment.

Shamrock A [30] et al confirmed vancomycin effectively reduces postoperative infection, its application showed no significant impact on long-term outcomes, patient satisfaction, or the risk of graft failure, highlighting its safety and efficacy as an adjunct to ACL reconstruction without compromising surgical success. Although reported intraoperative graft preparation with vancomycin during ACL reconstruction did not influence 2-year patient-reported outcomes or graft failure rates.

Moreover, in present study the Visual Analog Scale (VAS) scores for pain showed significant improvement within both study groups over time, with lower scores at 3 months compared to earlier follow-ups. However, there was no significant difference in the VAS scores between the groups at any time point, suggesting that vancomycin

application did not negatively affect pain management outcomes.

CONCLUSION

The study's findings support the use of intraoperative vancomycin-dipped grafts in ACL reconstruction as an effective means of reducing the risk of post-operative infections while maintaining knee function and stability. These results are consistent with prior research on the benefits of local antibiotic application and provide further evidence to support the routine incorporation of vancomycin-dipped grafts into ACL reconstruction protocols.

As patients who undergo ACL reconstruction with vancomycin-pres soaked grafts experience a lower risk of infection and potentially faster recovery, this approach is recommended for enhancing patient outcomes and minimizing complications.

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