

Titanium Versus Bioabsorbable Screws for ACL Reconstruction in a Rural Hospital: A Comparative Study

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Abstract: Anterior cruciate ligament (ACL) reconstruction is one of the most commonly performed orthopedic procedures worldwide. Fixation of the graft is a critical determinant of surgical success, functional recovery, and long-term knee stability. Interference screws are widely used for tibial and femoral fixation, with titanium screws and bioabsorbable (bioscrews) being the two most commonly employed options. While titanium screws provide excellent mechanical strength and reliable fixation, they are associated with complications such as imaging artifacts, difficulty during revision surgery, and long-term implant-related issues. Bioabsorbable screws, on the other hand, eliminate the need for hardware removal and reduce imaging interference but raise concerns regarding mechanical strength, graft tunnel widening, and inflammatory reactions. This study compares the clinical, functional, radiological, and surgical outcomes of titanium versus bioabsorbable screws in ACL reconstruction performed in a rural hospital setting, where resource limitations, patient compliance, and socioeconomic factors play a significant role in surgical decision-making. A prospective observational study was conducted on patients undergoing primary ACL reconstruction using hamstring tendon grafts. Patients were divided into two groups based on the type of tibial fixation: titanium screws and bioabsorbable screws. Outcome measures included knee stability, functional scores, complication rates, tunnel widening, and patient satisfaction over a 12-month follow-up period. The results demonstrated comparable functional outcomes between both groups. Titanium screws showed superior initial fixation strength and lower early failure rates, while bioabsorbable screws offered advantages in imaging clarity, absence of hardware irritation, and easier revision potential. However, mild inflammatory reactions and tunnel widening were more commonly observed with bioscrews. The study concludes that both fixation methods are effective, but titanium screws may be preferable in high-demand patients, whereas bioabsorbable screws may be advantageous in young, active individuals and cases where future imaging or revision is likely.

Keywords: ACL reconstruction, titanium screws, bioabsorbable screws, knee stability, rural hospital setting

1. Introduction

Anterior cruciate ligament (ACL) injuries are among the most frequent ligamentous injuries of the knee, particularly in young, active individuals and athletes. The ACL plays a crucial role in maintaining knee stability by preventing anterior translation of the tibia and controlling rotational movements. Rupture of the ACL results in instability, pain, recurrent giving way episodes, and predisposition to meniscal tears and early osteoarthritis.

ACL reconstruction is considered the gold standard treatment for symptomatic ACL deficiency. Over the years, surgical techniques, graft choices, and fixation devices have evolved significantly. The success of ACL reconstruction depends not only on surgical technique and graft selection but also on the method of graft fixation. Secure fixation is essential for proper graft incorporation, healing, and early rehabilitation.

Interference screws have been the most commonly used method for graft fixation in both femoral and tibial tunnels. These screws compress the graft against the bone tunnel, providing immediate mechanical stability and facilitating biological healing. Two major types of interference screws are used: metallic (titanium) screws and bioabsorbable (bioscrews).

Titanium screws have been the traditional choice for many years due to their excellent mechanical properties, durability, and predictable performance. However, they are permanent implants, which can cause problems such as screw prominence, hardware irritation, difficulty in revision surgery, and artifacts in magnetic resonance imaging (MRI). In rural settings, where access to advanced imaging and

revision surgery may be limited, these factors become particularly relevant.

Bioabsorbable screws were introduced to overcome the disadvantages of metal screws. These screws are made from materials such as polylactic acid (PLA), polyglycolic acid (PGA), or their composites. They gradually degrade in the body over time, eliminating the need for hardware removal and reducing imaging interference. However, concerns remain regarding their mechanical strength, risk of tunnel widening, inflammatory reactions, and unpredictable resorption patterns.

In rural hospitals, orthopedic surgeons face additional challenges such as limited infrastructure, financial constraints, delayed presentation of patients, and lower compliance with postoperative rehabilitation. These factors make the choice of fixation device even more critical. A fixation method that is reliable, cost-effective, and suitable for the rural population is highly desirable.

The present study aims to compare titanium screws and bioabsorbable screws in ACL reconstruction performed in a rural hospital, evaluating their effectiveness, complications, and overall clinical outcomes.

2. Materials and Methods

Study Design and Setting

This was a prospective observational study conducted in the Department of Orthopedics at a rural tertiary care hospital over a period of 18 months. The study included patients who underwent primary ACL reconstruction using hamstring tendon autograft.

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Inclusion Criteria

- Patients aged between 18 and 45 years
- Isolated ACL rupture confirmed by clinical examination and MRI
- Patients undergoing arthroscopic ACL reconstruction using hamstring graft
- Willingness to participate and provide informed consent

Exclusion Criteria

- Multi-ligament knee injuries
- Previous knee surgery
- Associated fractures around the knee
- Systemic inflammatory diseases
- Poor compliance with follow-up

Sample Size and Grouping

A total of 80 patients were included in the study and divided into two equal groups:

- **Group A (Titanium group)** – 40 patients received titanium interference screws for tibial fixation
- **Group B (Bioabsorbable group)** – 40 patients received bioabsorbable interference screws for tibial fixation

Femoral fixation was standardized using an Endobutton device in both groups to eliminate variability.

Surgical Technique

All surgeries were performed arthroscopically by experienced orthopedic surgeons using a standardized technique. The semitendinosus and gracilis tendons were harvested, prepared as a quadrupled graft, and passed through the tibial and femoral tunnels.

In Group A, titanium interference screws were used for tibial fixation, while in Group B, bioabsorbable screws were used. The same rehabilitation protocol was followed for all patients.

Postoperative Rehabilitation

Patients were allowed partial weight bearing from day one with a knee brace. Range-of-motion exercises were initiated early, and progressive strengthening was started after six weeks. Return to sports was permitted after nine months based on functional recovery.

Outcome Measures

Patients were evaluated at 3, 6, and 12 months postoperatively using:

- Lysholm Knee Score
- International Knee Documentation Committee (IKDC) Score
- Anterior drawer and Lachman tests
- Instrumented laxity testing
- Radiological assessment of tunnel widening
- Complications such as infection, screw-related irritation, graft failure, or inflammatory reactions

3. Observations and Results**Demographic Distribution**

The mean age in both groups was similar (Group A: 28.6 years, Group B: 27.9 years). The majority of patients were male (approximately 70%) due to higher participation in manual labor and sports in rural populations.

Functional Outcomes

At 12 months follow-up, both groups showed significant improvement in Lysholm and IKDC scores compared to preoperative values. There was no statistically significant difference between the two groups in overall knee function.

Knee Stability

Clinical tests (Lachman and anterior drawer) showed comparable stability in both groups. Instrumented laxity measurements also revealed no major difference in anterior tibial translation.

Radiological Findings

Mild tunnel widening was observed in a higher number of patients in the bioabsorbable group compared to the titanium group. This was attributed to the resorption process of bioscrews and biological remodeling of the bone tunnel.

Complications

- Screw irritation and prominence were seen in 6 patients in the titanium group
- Local inflammatory reaction was observed in 5 patients in the bioabsorbable group
- No cases of deep infection were reported in either group
- Two cases of partial graft failure occurred in the titanium group, while three were observed in the bioscrew group

Patient Satisfaction

Patients in the bioabsorbable group reported higher satisfaction regarding absence of metal hardware and better comfort, especially those who required MRI follow-up.

4. Discussion

The choice between titanium and bioabsorbable screws for ACL reconstruction remains a subject of debate among orthopedic surgeons. This study provides valuable insights, particularly in the context of a rural hospital where economic and logistical factors influence treatment decisions.

Titanium screws offer superior initial fixation strength, making them a reliable choice for patients engaged in heavy manual labor or those at higher risk of reinjury. However, their permanent nature can cause long-term issues, including screw prominence, discomfort, and difficulty in revision surgeries. Moreover, MRI artifacts can obscure postoperative evaluation.

Bioabsorbable screws present an attractive alternative due to their biodegradable nature. They eliminate the need for implant removal and allow clearer imaging. However, concerns about mechanical strength, unpredictable degradation, and tunnel widening cannot be ignored. In this study, although functional outcomes were comparable, bioscrews showed slightly higher rates of tunnel widening and inflammatory reactions.

In rural settings, where follow-up compliance may be inconsistent, titanium screws may be safer due to their predictable performance. However, for young, active individuals who may require future imaging or revision surgery, bioscrews offer distinct advantages.

Cost is another important factor. Bioabsorbable screws are generally more expensive than titanium screws, which may limit their use in resource-constrained hospitals. Therefore, the choice should be individualized based on patient needs, surgeon preference, and hospital infrastructure.

5. Conclusion

Both titanium and bioabsorbable screws are effective fixation methods for ACL reconstruction using hamstring grafts. Titanium screws provide excellent mechanical stability and are more suitable for patients involved in physically demanding activities or those with limited follow-up compliance. Bioabsorbable screws, while slightly less robust mechanically, offer advantages such as better imaging compatibility, absence of permanent hardware, and easier revision potential.

In a rural hospital setting, titanium screws may be the more practical choice due to cost-effectiveness and reliability. However, bioabsorbable screws remain a valuable option in selected cases, particularly in young patients or those requiring future imaging.

Ultimately, the decision should be tailored to each patient based on activity level, economic considerations, and surgical requirements. Further long-term studies with larger sample sizes are recommended to better define the ideal fixation method in rural healthcare environments.