Revision ACL Surgery

Introduction

- Incidence of ACL reconstruction in an active population reported to be 30 per 100,000
- Estimated that there are around 300,000 ACL reconstructions performed per year in the USA
- Reported success rate of primary ACL reconstruction: 75 - 97%
- Therefore, a significant number of patients who undergo ACL reconstruction may have a less than satisfactory outcome

Categories of Failure

There is no strict or universally accepted definition of failure after ACL reconstruction. Patient dissatisfaction following primary ACL reconstruction can be divided into 3 general categories: recurrent instability (graft failure), postoperative complications (infection, loss of motion, patella fracture), and comorbidities related to concomitant pathologic abnormalities (lower extremity malalignment, extensor mechanism dysfunction, donor site pain, meniscus loss, arthritis).

Although graft failure is the most common cause for failed ACL surgery, it is important to remember that other non-graft related problems can lead to an unsatisfactory outcome after ACL surgery.

- Loss of motion
  - Non-anatomic graft placement
  - Impingement
  - Infection
Capsulitis
Cyclops lesion
Concomitant ligament surgery
Immobilization

- Extensor mechanism dysfunction
  - Anterior knee pain
  - Donor site pain
  - Quadriceps muscle weakness
  - Patellar tendinitis
  - Patellar fracture
  - Patellar tendon rupture

- Degenerative Arthritis
  - Initial traumatic event (bone bruise)
  - Meniscectomy
  - Damage secondary to recurrent giving way

**Etiology of ACL Graft Failure**

The etiology of ACL graft failure is varied and often more than one cause exists. In general, the etiology of ACL graft failure can be dividing into 3 categories: (1) surgical technique, (2) trauma, (3) poor graft incorporation and healing (failure of ACL graft to undergo the ligamentization process), and arthrofibrosis and rehabilitation. Early failures (< 3 months) are usually related to loss of fixation and infection. Mid-term failures (3 – 12 months) are often due to errors in surgical technique, aggressive physical therapy and unrecognized loss of secondary restraints. Late failures (> 12 months) are usually related to trauma.
• Etiology of ACL graft failure in published revision studies

Etiology of ACL Graft Failure

- Technical errors in published revision studies

Technical Errors in ACL Surgery

- Etiology of ACL Graft Failure

- Technical Errors in ACL Surgery
Nonanatomic tunnel placement

Technical Errors in ACL Surgery

Nonanatomic Graft Placement

- Rotational Instability
- Excessive graft length changes
- Graft Impingement
- Loss of motion

Failed ACL Reconstruction

Failure to address associated ligamentous laxity or secondary restraints at the time of the primary reconstruction

Graft impingement

Inadequate strength of the primary ACL graft
1. hamstring tendon grafts < 8 mm
2. irradiated allografts

Graft tension
1. undertensioning = patholaxity
2. overtensioning = overconstraint of the joint

Lower extremity malalignment

- Trauma
  Early failure before graft incorporation and completion of rehabilitation (< 6 months)
  1. Overaggressive rehabilitation
  2. Premature return to athletics
  Late failure after resumption of full activities (> 6 months)
  1. Inadequate rehabilitation
  2. Significant reinjury 5 – 7%

- Biological failure (failure of the ACL graft to complete the ligamentization process, resulting in a atonic, disorganized, nonviable ACL graft). Biological failure of the ACL graft should be
suspected in patients who present with symptoms of recurrent instability without a history of trauma and no identifiable error in surgical technique or abnormal biomechanical factors.

**Preoperative Evaluation**

- Must first determine if the cause of the patient's complaints are truly due to a failed ACL graft

- Patient dissatisfaction following primary ACL reconstruction generally falls into the following categories:
  - Recurrent instability
  - Postoperative complications
  - Preexisting comorbidities

- Indications for revision ACL surgery
  - The primary goal of a revision ACL reconstruction is to reconstruct a ruptured or incompetent ACL graft with the goal to stabilize the knee and prevent further meniscal and articular cartilage injuries, while simultaneously maximizing the patient’s function and activity level

- History
  - Cause of primary injury
  - History of reinjuries
  - Symptoms (pain vs instability)
  - Primary graft type
  - Operative technique (one-incision vs two incision)
  - Type of graft fixation
  - Postoperative rehabilitation program used
  - Ability and time patient returned to preinjury level

- Physical examination
  - Lower extremity alignment
  - Gait (varus thrust, hyperextension)
  - Range of motion
  - Extensor mechanism
    1. Donor site pain
    2. Patellofemoral pain
    3. Patellar tendinitis
    4. Infrapatellar contracture
Ligament examination (important to check for associated ligamentous laxity)

Previous incisions

- Radiographic examination. Preoperative imaging should be assessed for 3 major issues regarding the primary ACL reconstruction: (1) the presence of hardware that will interfere with the revision procedure, (2) tunnel position, and (3) tunnel expansion.
  - AP view (femoral tunnel angle)
  - True lateral view in maximum hyperextension (tibial tunnel placement)
  - Merchant’s view both knee
  - Standing AP and PA 45° flexion views AP view both knees (joint space narrowing)
  - Standing long films of both lower extremities (lower extremity alignment)
  - CT scan (bone tunnel placement, tunnel enlargement)
  - MRI scan (evaluation of the ACL graft, articular cartilage, collateral ligaments)
  - CT scan (helpful to evaluate bone tunnel enlargement)
  - Bone scan (OA, infection)

Preoperative Planning

- Patient must be given realistic expectation of the outcome of revision surgery
- Revision surgery favorable in terms of restoring stability
- Revision surgery unpredictable in terms of returning patient to preinjury activity levels
- Revision surgery cannot relieve pain secondary to extensor mechanism dysfunction or pain secondary to articular cartilage injury

- Success of revision surgery influenced by:
  1. Etiology of the primary failure
  2. Preoperative laxity of the knee (secondary restraints)
  3. Status of the menisci, articular cartilage, and secondary restraints

- Important preoperative factors:
  1. Range of motion
  2. Placement of previous incisions
  3. Type of graft used in the primary reconstruction
  4. Type and location of fixation hardware
  5. Size and location of bone tunnels
  6. Presence of associated ligamentous laxities

- Staged procedure performed when there is:
  1. Loss of motion (must address loss of motion prior to revision surgery)
  2. Bone tunnel enlargement (bone grafting)
3. Potential for overlapping bone tunnels (bone grafting)

**Graft selection**  
Controversial! Autograft tissue has a higher success rate but has the issue of donor site morbidity. In cases of tunnel enlargement, it is often desirable to use a replacement graft with a large cross-sectional area (quadriceps tendon autograft) as this allows the bone tunnels to be filled. Allograft tissue has the advantages of unlimited tissue and bone block size. However, allograft tissue has the associated risks of disease transmission, possible alteration of initial tensile properties due to the effects of secondary sterilization, and a higher failure rate.

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<th>What Graft for Revision ACL Surgery: Autografts</th>
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<tr>
<td><strong>Advantages</strong></td>
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<tr>
<td>• Faster and more complete biological incorporation</td>
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<td>• No added costs</td>
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<td>• No risks of disease transmission</td>
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<td>• Better objective stability results and lower failure rate compared to allografts</td>
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<td><strong>Advantages</strong></td>
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<td>• Wide variety of tissue options</td>
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<td>• No limitation of soft tissue or bone block size</td>
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<td>• No donor site morbidity</td>
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<td>• Decreased operative time (no autograft harvest required)</td>
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Technical considerations in ACL revision surgery

- Use a skin incision that will allow simultaneous graft harvest, drilling of the tibial tunnel and tibial graft fixation
- Hardware removal, don’t underestimate have appropriate instrumentation available
- Leave secure hardware in place if it does not interfere with drilling new bone tunnels
- Bone tunnels most technically challenging part of the procedure

Preoperative Bone Tunnel Assessment

- Graft fixation (the surgeon must be knowledgeable and proficient with all fixation options for bone and soft tissue grafts)

- Associated surgical procedures:
  1. Posterolateral reconstruction
  2. MCL/POL reconstruction
  3. Meniscal repair/replacement (MM allograft can help restore AP translation)
  4. Articular cartilage surgery
  5. Osteotomy (malalignment)

Role of extra-articular reconstruction

- Extra-articular reconstruction has a longer lever arm which is more effective at controlling tibial rotation
- Extra-articular reconstruction has been shown to reduce the forces on an intra-articular ACL graft
- Both of these characteristics are advantageous in revision ACL surgery
• Extra-articular reconstruction has been shown to lower the failure rate and increase the percentage of patients with a negative pivot shift test

Rehabilitation

• Avoid accelerated rehabilitation

• Rehab program dictated by graft size/length, bone quality, and type of fixation and associated surgery

• Soft tissue grafts with suspensory fixation require more and longer postoperative protection

• Minimum 9 month return to sports
References


4. Bach BR, Provender, MT (eds): ACL surgery: How to get it right the first time and what to do if it fails. Slack Incorporated, 2010


