Progressive Loss of Knee Extension Post Anterior Cruciate Ligament Reconstruction

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An 18-year-old woman presented with significant and progressive loss of range of motion and pain after re-injuring a reconstructed anterior cruciate ligament (ACL) graft. Magnetic resonance images are shown in Figures 1-4.

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Radiology Case of the Month
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RADIOLOGIC DIAGNOSIS: Localized anterior arthrofibrosis of the knee secondary to anterior cruciate ligament (ACL) reconstruction with resultant impingement of the fibrous nodule in the intercondylar notch upon terminal knee extension (cyclops syndrome).

INTERPRETATION OF IMAGES

Figure 1 and Figure 2 detail loss of the normal ACL graft signal with an associated joint effusion. Figures 3 and 4 depict a localized fibrous nodule anterolateral to the tibial tunnel in the intercondylar space resembling an “eye.”

DISCUSSION

Loss of range of motion after knee ligamentous injury or surgery is a common problem and may occasionally be more debilitating than the instability caused by the original insult. A delay in treatment may lead to permanent loss of motion. As a result, early injury recognition and aggressive intervention is recommended and can usually prevent significant disability and permanent functional impairment. Many etiologies lead to loss of knee extension in post ACL reconstruction patients. Most of these involve formation and deposition of fibrotic tissues in and around the joint. Timing of surgical intervention, surgical technique, presence of infection, postoperative rehabilitation schedule, and treatment regimen all play an important role in determining fibrous proliferation. Possible etiologies resulting in loss of extension post ACL injury or reconstruction include adhesions, capsular contractures, arthrofibrosis, infrapatellar contracture syndrome, synovial osteochondromatosis, and localized anterior arthrofibrosis (cyclops syndrome).

Jackson and Schaefer were the first to describe the cyclops nodule in 1990. They characterized the cyclops lesion as a neoproliferative, hypertrophic, and pedunculated fibrous tissue nodule that develops in the intercondylar notch anterolateral to the tibial tunnel after ACL reconstruction. The lesion protrudes between the tibia and the femur at the anterior margin of the intercondylar notch just anterior to the tibial tunnel. The fibrotic nodule hinders full extension by impinging on the intercondylar notch upon terminal knee extension. Histological examination of cyclops lesions demonstrate a central core of granulation tissue with associated ossified fragments, cartilaginous tissue, and neo-vascularization surrounded by dense fibrous tissue.

The pathogenesis of cyclops lesions has been a debated topic. Jackson and Schaefer first suggested that cyclops lesions arise from a flap of tissue and cartilage anterolateral to the drill hole created during the preparation of the tibial tunnel. Other studies have supported varying etiologies stemming from reparative processes within the ligament, remnants of the ACL stump, repeated micro-trauma to the graft, insufficient anterior notch clearance with associated impingement, anterior tibial tunnel placement, prolonged immobilization of the knee, or a malpositioned graft. A malpositioned graft can undergo micro-trauma from repeated impingement on the notch upon terminal extension. Several studies demonstrate a decrease in the incidence of cyclops syndrome upon modification of the surgical techniques. Some changes include thorough debridement of the tissue anterior and lateral to the tibial tunnel during reconstruction, proper graft positioning, resecting the entire ACL stump, removing debris produced by drilling through the tibial tunnel, and pulling the ACL graft from the femur to the tibia in order to push any possible debris or tissue flap into the tibial tunnel.

The classic clinical presentation of cyclops syndrome consists of postoperative loss of full extension after ACL reconstruction and the presence of an audible click upon terminal extension. Nevertheless not all cyclops lesions are symptomatic. Presentations depend on size and location of the fibrotic nodule. Smaller nodules are generally situated more anteriorly in the knee and can be discovered in asymptomatic patients while larger nodules usually are associated with postoperative loss of full extension and an audible, palpable clunk on terminal extension. Other symptoms often seen in patients with cyclops lesions include a rubbery end point to full extension, painful cracking, stiffness, locking of the knee, residual laxity of the ligament, or discomfort when lying supine or walking.

Magnetic resonance (MR) imaging is a fairly accurate and non-invasive diagnostic tool to evaluate cyclops lesions. Studies have shown a sensitivity of 85%, specificity of 84.6%, and accuracy of 84.8% demonstrating cyclops lesion on MR imaging. Bradley, Bergman, and Dillingham’s study detailed mean axial, sagittal, and coronal dimensions of cyclops lesions that were 12.7 +/- 5.5mm, 11.7 +/- 6.1mm, and 11.6 +/- 5.2mm. In addition, when a lesion measured more than 10mm in at least one dimension, sensitivity, specificity, and accuracy of MR imaging improved to 85%, 100%, and 91% respectively. Cyclops lesions demonstrate intermediate heterogeneous signal intensity on T1, T2, and proton density sequences and are easily distinguishable from the high signal intensity of joint fluid. Furthermore, cyclops lesions are better demonstrated on sagittal images. Because of great soft tissue detail, MR imaging can be best used to evaluate patients with loss of extension post ACL reconstruction.
reconstruction and detect ACL nodules with good accuracy.6

Many factors are important in determining the probability of developing cyclops lesions: type of injury, timing of surgery, rehabilitation schedule, other co-morbidities.1 Severe knee trauma with multiple ligamentous injuries and dislocation injuries lead to a heightened and excessive inflammatory response with disordered healing that predisposes one to fibrotic cyclops lesions.1 Delaying surgical intervention when persistent motion loss, inflammation, and swelling is still present appears to be important in avoiding post-surgical fibrotic changes. Postoperative prolonged immobilization has a detrimental effect on periarticular cartilage, bone, and soft tissue.1 Modern rehabilitation programs stress early motion and weight-bearing resulting in preserving and improving range of motion and leads to better outcomes.1 Infection may also contribute to motion loss as it stimulates inflammatory response that results in synovitis, enzymatic cartilage degradation, and fibrotic scar deposition.

With the advent of arthroscopic assisted ACL reconstruction, tensioning the graft in extension, isometric graft placement, adequate notch plasty, shorter postoperative immobilization, early passive motion, and aggressive rehabilitation the extent of potential arthrofibrosis leading to cyclops nodule formation appears to be decreasing.2 General principles applied to a ACL-injured knee include avoiding reconstruction when the knee lacks full motion, remains swollen, is warm, or does not permit a normal gait. Graft position should be inspected intraoperatively during passive range of motion to avoid notch impingement. Focal lesions such as ACL nodules, malpositioned grafts, or severe arthrofibrosis respond better to arthroscopic treatment. As a general rule limitations of extension usually reside in the notch and posterior capsule while limitations of flexion usually reside in the suprapatellar pouch or peripatellar gutters. If there is evidence of impingement, a notch plasty should be performed. Fibroproliferative ACL nodules should be excised if present. If the cruciate graft or native ligament is malpositioned or excessively scarred, it should be debrided, released, or excised altogether. Arthroscopic treatment results in an excellent outcome with good motion and restoration of function.1

REFERENCES


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