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Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology 1 (2014) 3–10
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Review article

Lateral reinforcement in anterior cruciate ligament reconstruction

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Received 18 October 2013; accepted 25 November 2013
Available online 24 January 2014

Abstract

Lateral extra-articular procedures were popular in the treatment of anterior cruciate ligament injury in the nineteen seventies and eighties, but fell from favor due to poor results, concerns regarding biomechanics, and concurrent advances in intra-articular reconstruction. Persistent problems with rotational control in modern reconstructive techniques have lead to a resurgence of interest in the concept of lateral reinforcement. In this article, we examine the history of lateral extra-articular procedures, the reasons for renewed interest in the technique, recent research that lends support to lateral procedures and possible indications for selective use.

Keywords: Anterior cruciate ligament; Anterior cruciate ligament reconstruction; Anterolateral ligament

Introduction

Anterior cruciate ligament (ACL) injury is common, with a reported incidence as high as 80/100,000 per year.[1] Surgical treatment aims to restore knee stability and allow return to activity, as well as to prevent secondary injury[2] and the development of osteoarthritis (OA). Modern reconstruction techniques have achieved good results for the majority of patients, however, there remains a group for whom rotational instability remains an issue.[3]

Lateral extra-articular reconstruction procedures were devised to address anterolateral rotational laxity. Widely used during the nineteen seventies and eighties, they were largely abandoned due to concerns regarding poor biomechanics, and the superior results of intra-articular techniques.

Today, the addition of lateral extra-articular reinforcement to intra-articular reconstruction has again been proposed as one possible solution to failure in ACL reconstruction. This raises the important question: have previous concerns with this procedure been adequately addressed?

The rationale for early lateral extra-articular procedures

ACL injury generally produces both translational and rotational abnormalities. Early attempts at surgical intervention, both intra- and extra-articular, attempted to address only anterior tibial translation.[4] In 1979, Slocum and Larson, recognizing the importance of rotational instability in the ACL deficient knee, introduced the concept of rotational laxity, and described a "rotational stability test".[5] Their work focused on anteromedial rotation associated with medial sided injury, and they went on to develop a pes anserinus transfer to hold the tibia in internal rotation.[6]

Evidence for damage to the lateral structures of the knee in ACL injury was described as early as 1879. Prior to the invention of radiographs, Ségond described an avulsion fracture of the proximal tibia during cadaveric experiments to reproduce ACL injury.[7] He hypothesised that this avulsion, from just posterior to the iliotibial tract insertion, was the insertion site of the middle third of the lateral capsular ligament. Norwood published on the incidence of ligamentous injuries associated with acute anterolateral rotatory instability.[8] In 36 knees, he found only four with isolated ACL injury, 26 with ACL and additional lateral injury (to the lateral capsular

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http://dx.doi.org/10.1016/j.asmart.2013.12.002

ligament, the iliotibial tract or both) and six knees with lateral capsular ligament injury alone.

Lateral extra-articular procedures were promoted as having a biomechanical advantage over intra-articular reconstruction in terms of rotational control. This was due to the longer lever arm of a laterally based reconstruction to resist torque. Ellison described the ACL as, "the hub of the wheel", and noted, "it is easier to control rotation of a wheel at its rim than at its hub".[9]

Early extra-articular procedures

Early extra-articular procedures were performed as isolated operations and in combination with intra-articular procedures and generally used iliotibial band as graft material. The most common procedures were the Lemaire, Ellison and Macintosh procedures.

Lemaire procedure

Described in 1967, the Lemaire procedure involved harvesting an 18 cm × 1 cm strip of iliotibial band.[10] Left attached distally at Gerdy's tubercle, the strip was then routed under the lateral collateral ligament (LCL) before passing through a bone tunnel proximal to its insertion. The graft was again passed under the LCL before being secured in a second bony tunnel at Gerdy's tubercle.

Ellison procedure

Ellison described his iliotibial band transfer operation in 1979.[11] In this procedure, the iliotibial band was elevated from Gerdy's tubercle with a button of bone. The iliotibial band was then routed under the proximal section of the LCL before being secured just anterior to Gerdy's tubercle with a staple (Fig. 1A). Of note in Ellison's original description is plication of the mid-third capsular ligament.

MacIntosh procedure

The original MacIntosh procedure, described in 1980, was termed the "lateral substitution reconstruction" and used a 20 cm long strip of iliotibial band left attached at Gerdy's tubercle.[12] Similar to the Lemaire procedure, the graft was passed under the LCL. Rather that using bone tunnels, however, the graft was passed through a subperiosteal tunnel behind the origin of the LCL and looped behind the insertion

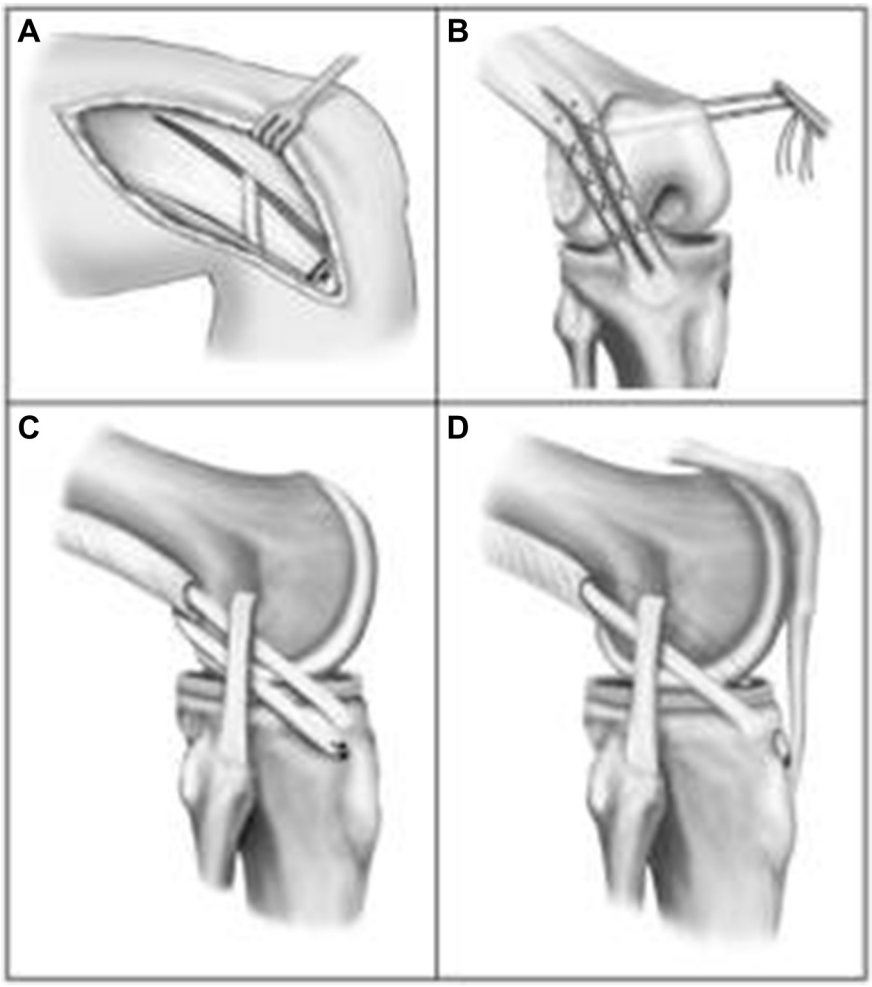

Fig. 1. Early extra-articular techniques. (A) Ellison procedure. (B) Andews mini-reconstruction. (C) MacIntosh 1. (D) MacIntosh 2 "over-the-top". Reproduced with permission from McCulloch PC, Lattermann C, Boland AL, Bach BR Jr. An illustrated history of anterior cruciate ligament surgery. *J Knee Surg.* 2007;20:95–104.