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March 2007

Three-portal technique for anterior cruciate ligament reconstruction: Use of a central medial portal

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47 Introduction

48 Traditional endoscopic anterior cruciate ligament (ACL) reconstruction is 49 performed using two standard portals. The anterolateral portal is used as the viewing 50 portal and the anteromedial portal is used as the working portal. When performing ACL 51 reconstruction however the posterior aspect of the lateral intercondylar notch may be 52 difficult to view entirely through the lateral portal. There have been numerous 53 descriptions for portal locations for knee arthroscopy, but no article has noted optimal 54 locations for specific portals relating to ACL reconstruction.[1-6] In fact, Kurosaka has 55 used a similar multiple portal technique for ACL reconstruction for several years 56 [personal communication, 2002]. 57 Conventionally, the anterolateral portal is positioned above the joint line just lateral to the lateral border of the patella tendon. Likewise, the anteromedial portal can 58 59 be created by direct visualization using a spinal needle but is located slightly above the 60 joint line and just off or nearly 1 cm medial to the medial border of the patella tendon. 61 From our experience these portals limit anatomic placement of both the tibial and femoral 62 tunnels during ACL reconstruction by preventing proper visualization of both the tibial 63 plateau and lateral wall of the intercondylar notch. Our current technique for endoscopic 64 anatomic double bundle ACL reconstruction, a modification from Kurosaka, has been 65 well described and involves the use of three portals [7, 8], which are used 66 interchangeably as viewing and working portals based on the specific task being

67 performed, much like that of arthroscopy of the shoulder.(**Table 1**)

68 **Portal Location**

69 "High" Anterolateral Portal

70 The anterolateral portal is initially used as the viewing portal. It is located just 71 lateral to the patella tendon with the most inferior portion of the portal at the level of the 72 inferior pole of the patella when the knee is flexed to 60 degrees (Figure 1). The portal 73 is created with an 11-scalpel blade taking care to avoid damage to the articular cartilage 74 when penetrating the capsule. This portal avoids penetration into the fat pad and is used 75 for the diagnostic arthroscopy, as it allows complete viewing of the patellafemoral, 76 medial, and lateral compartments of the knee without significant resection of the fat pad. 77 Additionally, the anterolateral portal is used to determine the precise position of the 78 anteromedial (AM) and posterolateral (PL) bundles of the ACL at its insertion on the 79 tibia. These sites are marked in preparation for drilling the two tibial tunnels for ACL 80 reconstruction (table 2). The superior position of the portal allows a wider view of the 81 tibial insertion of the ACL.

82 Anteromedial Portal (Central Portal)

83 The anteromedial or "central" portal is used as a working and a viewing portal. It 84 is placed nearly 1 cm lateral to the medial border of the patella tendon (intratendinous) 85 just inferior from the inferior pole of the patella when the knee is flexed to 60 degrees 86 (Figure 1). Again, the portal is created with an 11-scalpel blade taking care to avoid the 87 articular cartilage of the trochlea. This portal is specifically used for viewing the wall of 88 the lateral intercondylar notch and marking the insertion sites of the AM and PL bundles 89 of the ACL (**Table 2**). While viewing through this portal, the accessory medial portal 90 becomes the working portal. By working in this fashion, no "notchplasty" or

91 "wallplasty" is required because there is no obstruction to viewing the notch, and each
92 bundle is placed in its anatomic insertion while avoiding impingement of the posterior
93 cruciate ligament (PCL). Additionally, the anteromedial portal is used to place the guide
94 (which is set on 45 degrees) for drilling the AM tibial tunnel.

95 Accessory Medial Portal

96 The accessory medial portal is used mainly as the working portal for PL bundle 97 femoral tunnel placement. Nearly 30% of the time it is also used for AM bundle femoral 98 tunnel placement when the transtibial technique does not allow for anatomic AM femoral 99 tunnel drilling. The portal is created using direct visualization with a 18-gauge spinal 100 needle typically just superior to the medial joint line approximately 2 cm medial to the 101 medial border of the patella tendon (Figure 1 & 2). This allows the proper angle to drill 102 the PL (and if necessary the AM) femoral tunnel with avoidance of injury to the cartilage 103 of the medial femoral condyle. It is also used to place the guide (which is set on 55 104 degrees) for the PL bundle tibial tunnel. By placing the guide in different portals for the 105 AM and PL tunnels in the tibia, this allows for a larger bone bridge and the proper angle 106 for tunnel placement (**Table 2**). In addition, the accessory medial portal may be used as 107 a viewing portal to view the femoral insertion of the ACL in the notch.

108 **Discussion**

109 In shoulder arthroscopy, multiple portals are used to perform specific tasks.

110 Similarly, arthroscopy of the knee and more specifically ACL reconstruction, portal

111 placement is critical to successfully perform the intended procedure. Each of the three

112 portals described above have specific roles during surgery (Figure 3). It is crucial to

113 visualize the ACL footprint on the tibia to determine the precise anatomic location of the

AM and PL bundles of the ACL for tibial tunnel placement (Figure 4). Likewise,

viewing the lateral aspect of the intercondylar notch through the standard lateral portal without a notchplasty to define the anatomic femoral insertion of the ACL can be quite limited (**Figure 5**). This may cause nonanatomic femoral tunnel placement during single or double bundle reconstruction. As a result, we recommend the use of the medial portal as the viewing portal for femoral tunnel drilling and the use of an accessory medial working portal. This prevents the need for removal of any bone from the notch.

121 During anatomic double bundle ACL reconstruction, it is helpful to use a variety 122 of portals throughout the surgery. For marking the anatomic insertions of the ACL on the 123 tibia and tibial tunnel drilling, we recommend using the "high" lateral portal for its 124 greatest visualization of the tibial footprint. Contrary to traditional ACL reconstruction, 125 we advocate using the anteromedial (middle) viewing portal to determine the femoral 126 origin of the AM and PL bundles of the ACL on the femur. In order to do this, the 127 accessory medial portal is used as a working portal for drilling the PL femoral tunnel and 128 if necessary the AM femoral tunnel. Most commonly, the AM femoral tunnel can be 129 placed with the transtibial technique, however if the transtibial technique places the AM 130 tunnel too vertical or non-anatomic, the accessory medial portal is used to drill the AM 131 femoral tunnel.

The most common complication associated with ACL reconstruction is erroneous tunnel placement.[9] The are a variety of causes of this, but poor visualization of the anatomic landmarks is will likely cause inaccurate tunnel placement. We propose the solution to poor intercondylar notch visualization is not notchplasty or wallplasty but rather altering the viewing location and adding an accessory medial working portal. This

- 137 will allow improved visualization of both tibial and femoral anatomic insertions of the
- 138 ACL and may prevent improper tunnel position during ACL reconstruction.

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- 165 Figures

- **Figure 1**: Portal locations marked on skin for ACL reconstruction



- 173
- 174 **Figure 2**: External view of arthroscopic instruments during ACL reconstruction. A)
- 175 Scope in the anterolateral portal and a spinal needle used to identify location of the
- 176 accessory medial portal in a right knee, B) Scope in anteromedial portal and guide-pin
- 177 placed in the accessory medial portal for placement of the posterolateral bundle tunnel in
- the femur of the left knee
- 179





- Figure 3: Arthroscopic view of the intercondylar notch of a right knee from the 183
- anterolateral portal (ALP), anteromedial portal (AMP), and accessory medial portal (MP) 184
- 185

Scope in ALP

Scope in CAMP

Scope in accessory AMP



186 187

188 189

190 Figure 4: Arthroscopic view of the tibial plateau of a right knee through the anterolateral 191 portal after placement of the anteromedial and posterolateral bundle tunnels in the tibia

192



- **Figure 5**: Arthroscopic view of the intercondylar notch of a right knee from the
- anterolateral portal (Å) and the anteromedial portal (B) after placement of the 2 femoral
- 197 tunnels during ACL reconstruction





Table 1: Use of portals in anatomic double bundle ACL reconstruction

1			
Portal	Viewing Advantage	Surgical Purpose	Working Portal
Anterolateral	Anatomic insertion of	Viewing tibia for	Inside-out medial
	ACL on Tibia	tibial tunnel	meniscal repair
		placement	
Anteromedial	Anatomic insertion of	Viewing	Tibial guide
	ACL in Intercondylar	intercondylar	placement for
	Notch	notch for femoral	drilling AM tunnel
		tunnel placement	
Accessory Medial	Anatomic insertion of	Placement of PL	Tibial guide
-	ACL in Intercondylar	and if necessary	placement for
	Notch	AM tunnels in	drilling PL tunnel
		femur	-

Table 2: Specific portal use for anatomic double bundle ACL reconstruction

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Tunnel for ACL	Viewing Portal	Instrument Portal			
Reconstruction					
Tibia – Anteromedial Bundle	Anterolateral	Anteromedial			
Tibia – Posterolateral Bundle	Anterolateral	Accessory Medial			
Femur – Anteromedial Bundle	Anteromedial	Transtibial or Accessory			
		Medial			
Femur – Posterolateral Bundle	Anteromedial	Accessory Medial			