INTRODUCTION
There has been a recent emphasis on minimally invasive and muscle sparing approaches in orthopaedic surgery. The subvastus approach to the knee joint has been described as an alternative to traditional approaches which involve a large arthrotomy with partial division of the quadriceps mechanism. The most common application of the subvastus approach is in total knee arthroplasty. While concerns have been raised regarding intraoperative visualization and proper component positioning, promising results have been recently reported suggesting improved early recovery with equivalent complication rates.

This paper details the step-by-step surgical technique for the medial subvastus approach to the knee. As with any procedure, patient selection is paramount to success and not all patients are appropriate for this approach. However, in patients who meet our criteria, we feel that this approach offers significant benefit to patients over traditional approaches. These include less post-operative pain and easier, quicker rehabilitation in the early post-operative period. The long-term benefits, if any, are unknown.

SURGICAL TECHNIQUE
The senior author performs a medial subvastus approach whenever possible, however some patients are better served with a standard medial parapatellar approach. Suitable candidates for a subvastus approach must have relatively mobile subcutaneous tissues in order to create a “mobile window” for performing the various aspects of the planned procedure. The mobility of the soft tissues can be assessed during a preoperative clinic visit, but the ultimate decision is made on the day of surgery with the patient under anesthesia. Obesity, contractures and deformity are relative contraindications, however, with experience, the indications can be expanded. Revision surgery is usually a contraindication due to scar tissue formation and obliteration of tissue planes.

The patient is positioned supine in the standard fashion. We generally employ a lateral post at the level of the greater trochanter as well as a post to support the foot, such that the knee can be flexed and maintained at 90 degrees of flexion. The skin incision can be made directly midline or slightly medial, depending on the nature of the pathology. The length of the incision is based on the underlying pathology. Generally, it extends from the superior pole of the patella to the inferior aspect of the tibial tubercle (Figure 1). The incision is carried sharply through the subcutaneous tissue down to the retinacular tissue. Full-thickness medial and lateral flaps are then created sharply with careful hemostasis (Figure 2). The

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creation of large, full-thickness flaps is important because this allows the extensor mechanism to be mobilized deep to the subcutaneous tissues.

The distal insertion of the vastus medialis obliquus (VMO) on the patella is exposed (Figure 3). The fascia overlying the VMO is released sharply, taking care not to injure any underlying muscle fibers (Figure 4). The fascia is released posteriorly towards the attachment of the VMO on the medial intermuscular septum. This exposes the entire distal extent of the VMO (Figure 5). Using blunt dissection, a finger can be placed underneath the VMO at its inferior border. The VMO is then retracted proximally and laterally while maintaining its attachment to the patella. A Z- retractor is inserted anterior to the distal femur and deep to the muscle to maintain retraction (Figure 6).
Two #1 Vicryl marking sutures are placed at the level of the VMO attachment to the patella (Figure 7). An oblique capsular incision is then made just distal to the VMO, beginning posteriorly at the level of the intermuscular septum and extending laterally, parallel to the inferior border of the muscle, towards the medial border of the patella. The incision is made between the marking sutures, which then serve as a guide for later repair. At the medial border of the patella, the arthrotomy is extended distally, taking care to leave a cuff of tissue attached to the patella for closure (Figure 8).

The arthrotomy incision is carried distally across the joint line and parallel to the medial border of the patellar tendon. Care is taken to avoid damaging the anterior horn of the medial meniscus if a biologic procedure is being performed. If necessary, the retropatellar bursa and fat pad can be incised to gain additional exposure.

Next, attention is turned to the suprapatellar pouch where the synovial capsular attachments to the undersurface of the quadriceps tendon are released completely from medial to lateral (Figure 9). This is the key maneuver for being able to fully mobilize the extensor mechanism. After completing this, the patella can then be subluxed into the lateral gutter. Creating a large, full-thickness, lateral subcutaneous flap during the initial exposure is necessary in order to create a pocket into which the patella can be subluxed. A 90 degree bent Hohman or Z-retractor is placed in the lateral gutter at the level of the quadriceps tendon insertion to maintain retraction of the patella. Flexing the knee to approximately 90 degrees then provides excellent exposure of the entire joint and the appropriate procedure can be performed (Figure 10). A standard closure is performed at the end of the case (Figure 11). The closure is quite simple as no muscle needs to be repaired.

**DISCUSSION**

The medial subvastus approach was originally described in the German literature by Erkes in 1929. A modified version was re-introduced by Hoffman in 1991. A so-called “mini” subvastus approach has since been described. There are currently multiple reports in the literature describing the results with respect to total knee arthroplasty. Although concerns have been raised regarding appropriate component positioning, many studies demonstrate more rapid recovery, better pain scores, less blood loss and better short term knee range of motion when comparing the subvastus approach to more traditional approaches. Recently, Schroer et. al published their results of 600 primary total knee arthroplasties performed through a subvastus approach. Follow-up was short-term, averaging 28 months. A historical group of 150 total knee arthroplasties performed through a standard medial parapatellar arthroplasty was used as a control. Overall, there were eleven major complications (1.8%) requiring reoperation in the subvastus group and six (4.0%) in the traditional group. The rate of both major and minor complications was found to be independent of surgical technique. The rate of major complications in the subvastus group was found to be associated with surgical experience, as the rate was reduced by 16% for each additional fifty procedures performed. Mean knee flexion at one year averaged 125 degrees in the subvastus group and
114 degrees in the traditional group. Average operative time was initially higher in the subvastus group, but decreased with experience so that it was less than the traditional group in the last 400 subvastus procedures performed. Of note, the authors stated that 99% of total knee arthroplasties performed during the study period were done through a subvastus approach with 91% of patients classified as overweight and 11% as morbidly obese.

We have found the subvastus approach to provide excellent exposure and allow quicker advancement of rehabilitation after knee surgery. As with any procedure, there is a definite learning curve associated with the subvastus approach. The senior author’s technique and indications have evolved with time and experience. Less emphasis is placed on the length of the skin incision and more emphasis placed on careful dissection of large medial and lateral skin flaps and atraumatic mobilization of the muscle. In addition to total knee arthroplasty and medial unicompartmental knee arthroplasty, we have applied the subvastus approach to the treatment of other intra-articular pathologies, primarily chondral defects. Procedures such as autologous chondrocyte implantation and osteoarticular allografts can easily be performed through this approach.

References