The Extensile Medial Parapatellar Approach to the Distal Femur and Knee: Anatomic Landmarks and Surgical Technique

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Summary: This paper describes an extensile surgical approach to the distal femur, which incorporates the medial parapatellar arthrotomy. This extensile exposure serves as an anterior utility approach to the knee, allowing the surgeon access to all aspects of the anterior knee and near circumferential access to the distal femur. Reported indications for access to this region include: tumor resection, difficult primary arthroplasty and revision arthroplasty of the knee, and intra-articular and extra-articular fractures of the distal femur. Despite adequate working knowledge of the standard medial parapatellar approach to the knee, the extensile approach is seldom required and, as a result, orthopedic trainees and practising orthopedic surgeons may not be familiar with the musculotendonous junctions that occur in the quadriceps tendon. This report describes a novel surgical approach and the relevant anatomy through a series of detailed clinical and fresh cadaveric dissections. A previously undescribed anatomic landmark is demonstrated through photographs and cadaveric variation studies, which may help guide the surgeon in defining crucial planes.

Key Words: medial parapatellar—extensile—approach—knee.

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The extensile medial parapatellar approach to the knee is useful for addressing a variety of pathologies of the distal femur and knee, which include primary and secondary tumor of both bone and joint, as well as the sequelae of musculoskeletal trauma. In this paper, we describe the senior author's (J.T.P.) extensile surgical approach to the distal femur and knee joint, which incorporates the medial parapatellar arthrotomy. This method is currently used in the approach to distal femur resection where tumor endoprosthesis is required, it can, however, also be applied to any operation that requires extensile exposure to the joint. In particular, we describe the technical aspects of identifying the intermuscular plane between vastus medialis (VM) and rectus femoris (RF), leading to exposure of vastus intermedius (VI). This allows for an intermuscular plane to be developed through VI, giving access to the distal femur and knee joint. It has previously been suggested that with the exception of the contour of VM, there are no anatomic landmarks to guide the surgeon to the intermuscular plane between RF and VM.[1] We present a consistent landmark in both clinical and cadaveric approaches to aid the surgeon in demarcating the plane between RF and VM.

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The authors declare that they have nothing to disclose.
For reprint requests, or additional information and guidance on the techniques described in the article, please contact Jarrad Stevens, MBBS, FRACS, FAOrthA, at drjarradstevens@hotmail.com or by mail at Edinburgh, Scotland, UK. You may inquire whether the author(s) will agree to phone conferences and/or visits regarding these techniques.

MATERIALS AND METHODS

Patient consent was obtained for intraoperative photography to illustrate this approach. The senior author demonstrated the extensile approach and sequential photographs were taken. A cadaveric specimen was utilized to highlight in detail further aspects of anatomy and dissection. Twelve cadaveric knees from 6 cadavers were assessed for the presence of the landmark we describe in order to identify the junction between RF and VM. Fresh frozen cadaveric knees were utilized for this study and all were visually inspected to ensure the extensor mechanism of the knee was intact and not disturbed. No scars suggesting previous surgery were observed. The section length was from high thigh to foot. All cadavers had been donated for education and research through the Edinburgh School of Medicine anatomy department. The primary objective was to ascertain the presence or absence of the landmark demarcating RF and VM. All cadaveric knees

FIGURE 1. An incision traversing the anterior midline of the Right knee and distal femur. M indicates medial; P, proximal. full color online

underwent extensile exposure for the purpose of clinician training for complex knee arthroplasty.

TECHNIQUE

The patient is placed supine. A tourniquet is not utilized as it may compress and anchor the quadriceps muscles. An incision traversing the anterior midline of the knee and distal femur is made (Fig. 1); this measures ~20 cm and is biased proximally. The subcutaneous tissues are divided along the line of the skin incision, ensuring hemostasis onto fascia and retinaculum (Fig. 2). A medial skin flap is developed to expose the quadriceps tendon, the medial border of the patella, and the medial border of the patellar tendon.

The anatomy is demarcated by sweeping the subcunateous fat from the fascia. A lithograph by Walsh depicts the relationships between the quadriceps' muscles and tendon as they converge onto the patella and retinculum (Fig. 3). RF is flanked by the vasti: VM and vastus lateralis with VI deep to it.

The plane for this approach is between VM and RF, followed by VI split and medial parapatellar extensor division. The medial contour of RF depicted in the lithograph gives a visual representation of the intermuscular plane to be developed. There is no internervous plane; the dissection descends between the VM and RF muscles, both of which are supplied by the femoral nerve. The intermuscular plane can be safely used to expose the distal two-third of the femur as the femoral nerve division to these muscles is high in the thigh.[3]

The quadriceps muscle and tendon are easily identified proximal to the knee. The challenge for the surgeon is in defining the muscular junction of RF and VM. The plane between RF and VM is identified by the fat stripe shown in Figure 3. This fat is differentiated from the surrounding tissue by its thickness and linear quality. The fat stripe is key to

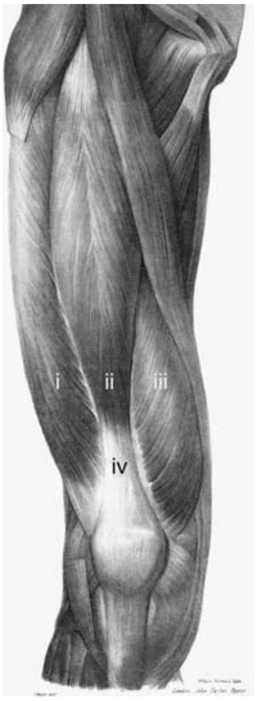

FIGURE 3. Section of lithograph by Walsh[2] entitled Plate xxxii. i = vastus lateralis, ii = rectus femoris, iii = vastus medialis, iv = quadriceps tendon.

identifying the nonadherent junction between these 2 muscles. This is highlighted in the clinical picture in Figure 4 and then enhanced and enlarged in Figure 5. This fat stripe should be

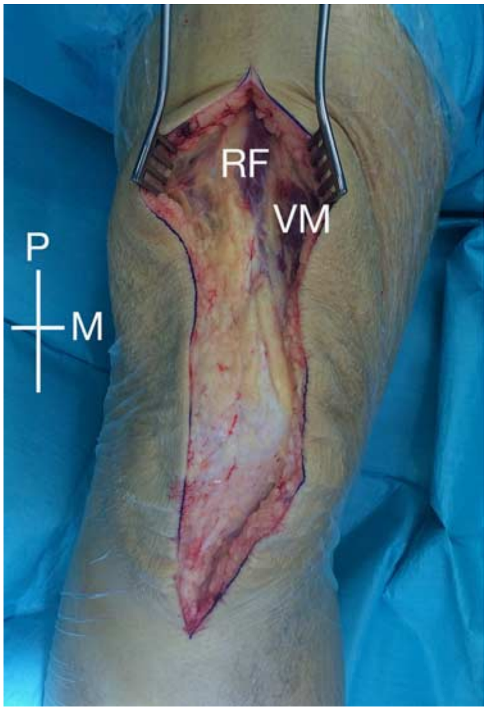

FIGURE 2. The subcutaneous tissues are divided along the line of the skin incision. M indicates medial; P, proximal; RF, rectus femoris; VM, vastus medialis. full color online

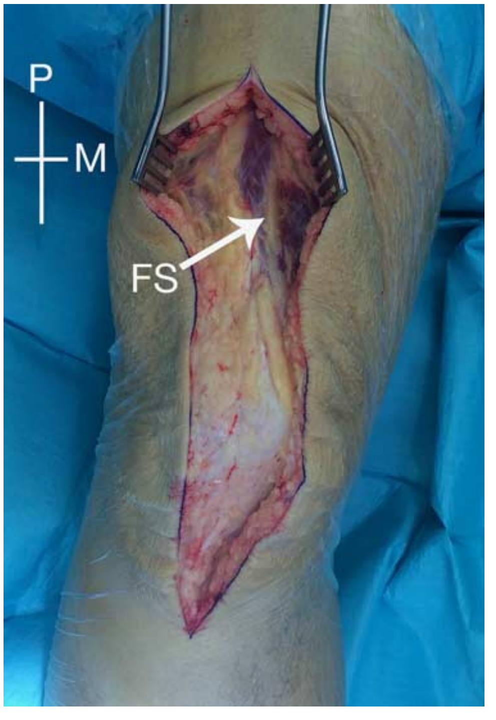

FIGURE 4. The fat stripe (arrow) identifying the non-adherent junction vastus medialis and rectus femoris. FS indicates fat stripe; M, medial; P, proximal. full color online

FIGURE 5. Fat stripe is center of circle. full color online

raised from the medial side and the muscles separated with the use of Norfolk and Norwich self-retaining retractors (Fig. 6). A standard medial parapatellar arthrotomy is now made (Fig. 7).

Most fibers of the VM end in an aponeurosis that blends with the medial side of the suprapatellar tendon or the RF tendon.[4] These fibers are depicted in the cadaveric photograph in Figure 8. A diagram of Figure 8 (Fig. 9) further identifies the anatomy and highlights the undersurface of RF. The 2 deep

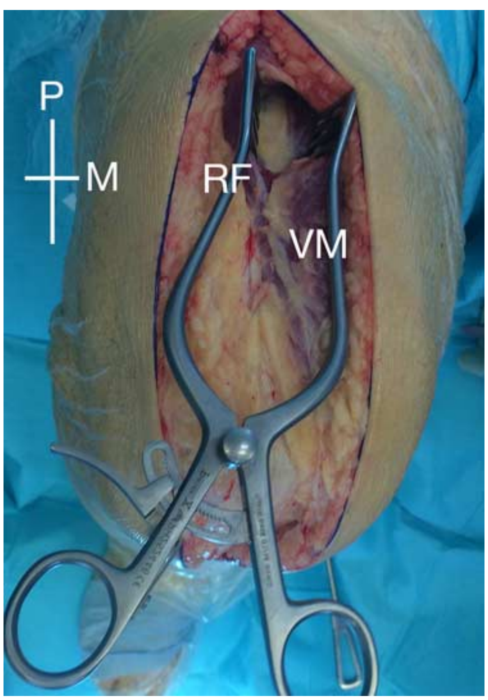

FIGURE 6. Plane between RF and VM. M indicates medial; P, proximal; RF, rectus femoris; VM, vastus medialis. full color online

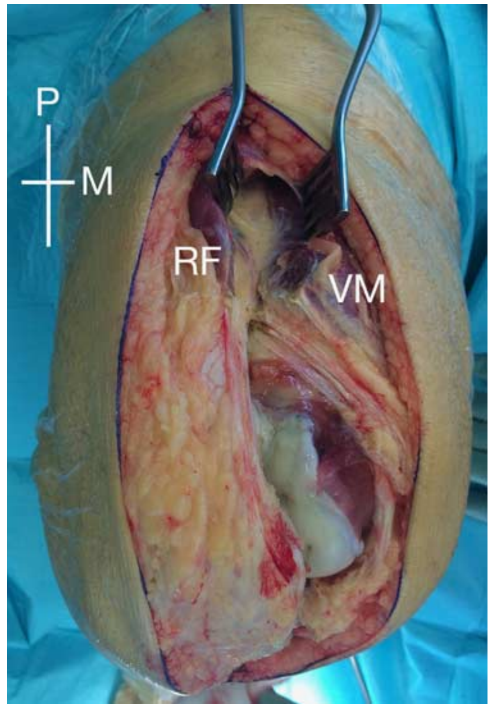

FIGURE 7. Medial parapatellar approach. M indicates medial; P, proximal; RF, rectus femoris; VM, vastus medialis. full color online

dissections are now joined by dividing this aponeurosis. Division of these fibers will expose VI.

Intramuscular division of VI shown in the cadaveric photograph below (Fig. 10) will provide access to the superior capsule and distal femur. The patella now has greater excursion. Following synovectomy, exposure of the distal femur can be appreciated (Fig. 11).

Closure is performed by suturing the fibrous portions of the free edge of VM and RF. The 2 come together as demonstrated in Figure 12.

FIGURE 8. Cadaveric photo depicting aponeurosis, vastus medialis and rectus femoris, and the superficial surface of VI. A indicates aponeurosis vastus medialis and rectus femoris; VI, the superficial surface of vastus intermedius. full color online

FIGURE 9. Line drawing depicting the undersurface of RF, superficial surface of VI, and standard medial parapatellar approach. The remaining aponeurosis is intact. RF indicates rectus femoris; VI, vastus intermedius; VM, vastus medialis. full color online

FIGURE 10. Division of vastus intermedius. full color online

FIGURE 11. Distal femur postsynovectomy. full color online

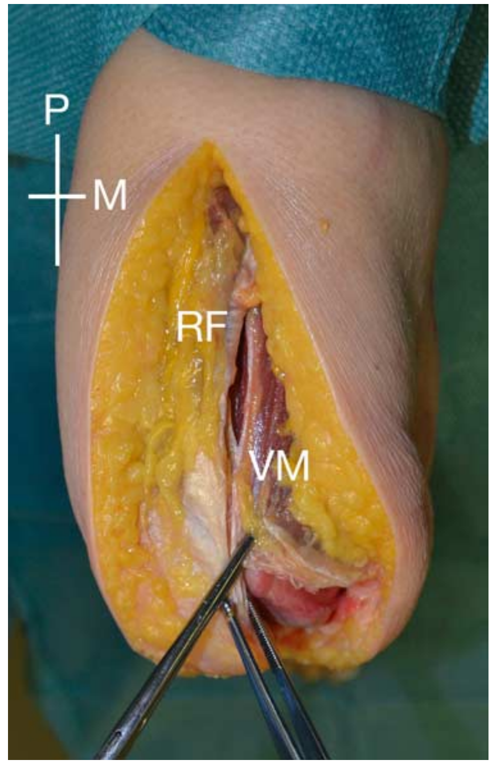

FIGURE 12. Apposition of RF and VM. M indicates medial; P, proximal; RF, rectus femoris; VM, vastus medialis. full color online

RESULTS

Twelve knees from 6 cadavers were assessed for the presence of a fat stripe of linear quality that demarcated the RF and VM muscle. Fresh frozen human cadaveric knees were used in this study, with approval from the university of Edinburgh Anatomy department. Each specimen was screened for a history of abnormal body mass index, lower limb trauma, and surgery. All 12 knees were included in this study. The fat stripe was identified by 2 surgeons in all 12 cadaveric knees.

DISCUSSION

An anterior longitudinal utility approach to the knee through the RF and VM plane, followed by VI split, provides access to the distal femur and knee, which is suitable for endoprosthesis of the distal femur, fracture fixation, and revision knee arthroplasty. We use this approach for all distal femoral replacements and in combination with the medial parapatellar arthrotomy whenever extensile exposure to the knee is indicated. The main benefit of this technique is the ease with which the standard parapatellar arthrotomy can be converted into the extensile approach. Timbrell Fischer[5] is credited with popularizing the medial parapatellar approach to the knee, while Henry[6] introduced the concept of lateral parapatellar arthrotomy with proximal extension between the planes of RF and vastus lateralis, later to be described in detail by Marcy.[7] The extensile lateral parapatellar arthrotomy and the "Swashbuckler" technique have been established to be safe and effective approaches to the knee.[8–10] However, familiarity with the medial parapatellar arthrotomy lends itself to more frequent use and, with the aid of the fat stripe, as demonstrated in this paper, the operating surgeon will be able to confidently demarcate the plane between RF and VM, allowing for elegant reflection of the muscles.

In our experience, return of range of motion and quadriceps strength is reliable when using this approach. We have not found tibial tubercle osteotomy to be necessary with this approach because exposure of the distal femur and excursion of the patella are excellent with this technique. We hope this exposure is useful to surgeons who require access to the distal femur and knee joint.

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