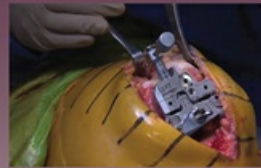
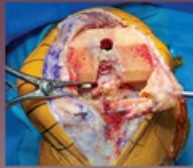




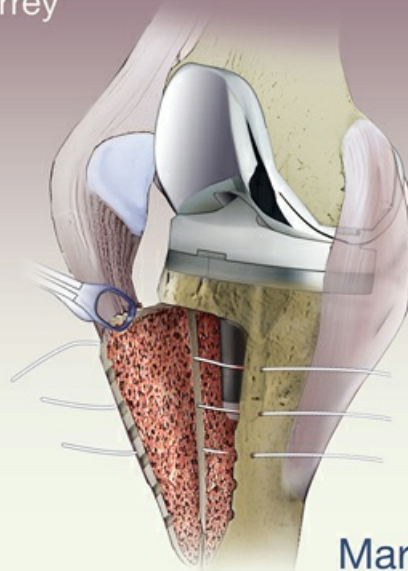
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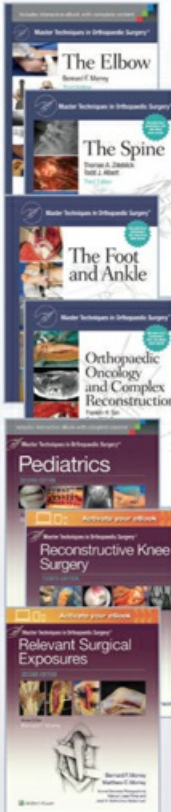
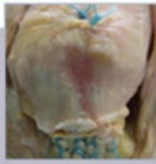


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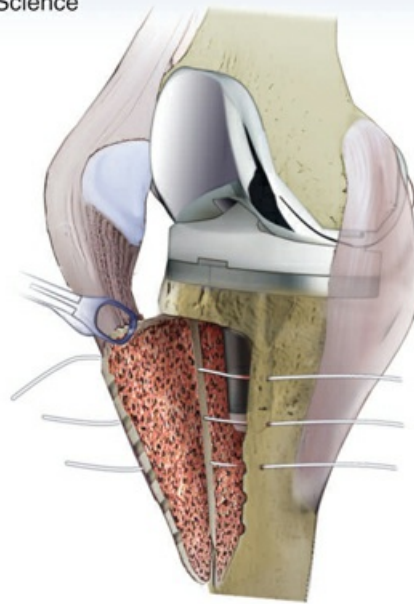
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Acquisitions Editor: Brian Brown
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Marketing Manager: Julie Sikora
Production Project Manager: David Saltzberg
Design Coordinator: Steve Druding
Manufacturing Coordinator: Beth Welsh
Prepress Vendor: S4Carlisle Publishing Services

Fourth edition

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Printed in China

Library of Congress Cataloging-in-Publication Data

Names: Pagnano, Mark W., editor. | Hanssen, Arlen D., editor.
Title: Knee arthroplasty / [edited by] Mark Pagnano, Arlen Hanssen.
Other titles: Knee arthroplasty (Lotke) | Master techniques in orthopaedic surgery.
Description: 4e. | Philadelphia: Wolters Kluwer, [2019] | Series: Master techniques in orthopaedic surgery | Includes bibliographical references and index.
Identifiers: LCCN 2018043031 | eISBN 9781496360649
Subjects: | MESH: Arthroplasty, Replacement, Knee—methods | Knee—surgery | Postoperative Complications—prevention & control | Reoperation—methods
Classification: LCC RD561 | NLM WE 874 | DDC 617.5/82059—dc23 LC record available at <https://lccn.loc.gov/2018043031>

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This book is dedicated to our mentors and colleagues whose commitment to outstanding patient care, education, and research has advanced the field of knee replacement surgery over the past 30 years. It is our sincere hope that the collective knowledge in this volume proves useful to surgeons and is beneficial to patients.

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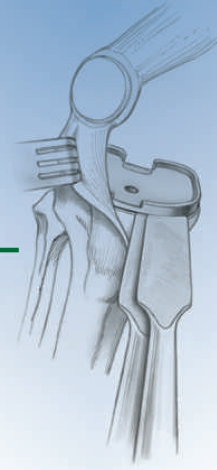
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Series Preface



Since its inception in 1994, the *Master Techniques in Orthopaedic Surgery* series has become the gold standard for both physicians in training and experienced surgeons. Its exceptional success may be traced to the leadership of the original series editor, Roby Thompson, whose clarity of thought and focused vision sought “to provide direct, detailed access to techniques preferred by orthopaedic surgeons who are recognized by their colleagues as ‘masters’ in their specialty,” as he stated in his series preface. It is personally very rewarding to hear testimonials from both residents and practicing orthopaedic surgeons on the value of these volumes to their training and practice.

A key element of the success of the series is its format. The effectiveness of the format is reflected by the fact that it is now being replicated by others. An essential feature is the standardized presentation of information replete with tips and pearls shared by experts with years of experience. Abundant color photographs and drawings guide the reader through the procedures step-by-step.

The second key to the success of the *Master Techniques* series rests in the reputation and experience of our volume editors. The editors are truly dedicated “masters” with a commitment to share their rich experience through these texts. We feel a great debt of gratitude to them and a real responsibility to maintain and enhance the reputation of the *Master Techniques* series that has developed over the years. We are proud of the progress made in formulating the third edition volumes and are particularly pleased with the expanded content of this series. Six new volumes will soon be available covering topics that are exciting and relevant to a broad cross-section of our profession. While we are in the process of carefully expanding *Master Techniques* topics and editors, we are committed to the now-classic format.

The first of the new volumes is *Relevant Surgical Exposures*, which I have had the honor of editing. The second new volume is *Essential Procedures in Pediatrics*. Subsequent new topics to be introduced are *Soft Tissue Reconstruction*, *Management of Peripheral Nerve Dysfunction*, *Advanced Reconstructive Techniques in the Joint*, and finally *Essential Procedures in Sports Medicine*. The full library thus will consist of 16 useful and relevant titles.

I am pleased to have accepted the position of series editor, feeling so strongly about the value of this series to educate the orthopaedic surgeon in the full array of expert surgical procedures. The true worth of this endeavor will continue to be measured by the ever-increasing success and critical acceptance of the series. I remain indebted to Dr. Thompson for his inaugural vision and leadership, as well as to the *Master Techniques* volume editors and numerous contributors who have been true to the series style and vision. As I indicated in the preface to the second edition of *The Hip* volume, the words of William Mayo are especially relevant to characterize the ultimate goal of this endeavor: “The best interest of the patient is the only interest to be considered.” We are confident that the information in the expanded *Master Techniques* offers the surgeon an opportunity to realize the patient-centric view of our surgical practice.

Bernard F. Morrey, MD

Acknowledgments



We offer a sincere thank-you to the master knee surgeons who have contributed their knowledge and shared their expertise in this volume. We recognize the hard work of the publisher and staff including Brian Brown, David Murphy, Jr., and Kayla Smull. We appreciate the support provided to each of us by our families, not just during this project but throughout our careers, and recognize that we could not have accomplished what we have without them.

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INTRODUCTION

Since its inception, total knee arthroplasty has most commonly been performed using some variation of a medial parapatellar approach. Von Langenbeck originally described the dissection of the vastus medialis from the quadriceps tendon extending distally through the medial patella retinaculum and along the patellar ligament, leaving a small cuff of tissue for closure.¹ Insall described a modification of this approach whereby the quadriceps mechanism was opened with an incision in the quadriceps tendon dividing its medial one-third from the lateral two-thirds.² Rather than skirting the medial border of the patella and leaving a cuff of tissue, he brought the incision straight distally, directly over the medial aspect of the patella. His modification was believed to improve quadriceps healing (tendon to tendon) and to be less disruptive to the extensor mechanism. Hofmann and associates advocated a subvastus (or southern) approach to the knee, which divides the vastus medialis at the intermuscular septum leaving the muscle largely untouched.³ The trivector and midvastus approaches evolved as surgeons attempted to capture the advantages of a subvastus surgical approach without compromising full exposure to the knee.^{4,5}

INDICATIONS AND CONTRAINDICATIONS

We prefer a very traditional medial parapatellar arthrotomy for the vast majority of primary total knee arthroplasties at our institution. We have had experience with other approaches to the knee and do not object to their use in select patients. In fact, we consider the use of a lateral parapatellar arthrotomy in severe, fixed valgus deformities and the use of a subvastus approach in cases of retained medial hardware on the distal femur (eg, from a previous distal femoral varus osteotomy). However, it has been our experience that the subvastus and midvastus approaches can be difficult in short, obese, and muscular individuals. These two approaches are also not always conducive to the placement of a navigation array on the distal femur in cases in which we employ computer navigation. We have also found that a lateral approach for severe valgus knees can compromise the ability to seal the arthrotomy from the subcutaneous space just beneath the skin incision.

The medial parapatellar approach can be used in virtually every case regardless of the preoperative deformity and range of motion. It is safe, is extensile, and gives excellent access to the intra-articular and periarticular structures around the knee. This approach can be shortened to allow for a minimally invasive unicompartmental or total knee arthroplasty. It can be extended both proximally and distally to allow for a quadriceps snip or tibial tubercle osteotomy, respectively. There are relatively few contraindications to its use. It allows no exposure posteriorly and is not recommended for anterolateral procedures such as lateral closing wedge high tibial osteotomies or other isolated procedures to the lateral side of the knee.

PREOPERATIVE PREPARATION

The most important aspect of the preoperative planning for total knee arthroplasty is a complete understanding of the patient's anatomy. The blood supply to the skin should be respected at all times, especially when prior incisions are present or multiple incisions are planned. Most of the blood supply to the skin arises from the saphenous artery and the descending geniculate artery on the medial side of the knee.⁶ The vessels perforate the deep fascia, form an anastomosis superficial to the deep fascia, and continue through the subcutaneous fat to supply the epidermis. The skin incision must be selected carefully. Because the fascial perforators arise from the medial side, the most lateral incision giving appropriate exposure should be used. Transverse scars should be crossed perpendicularly because these do not appear to affect the healing of the vertical anterior medial approach. When possible, the anterior incision should incorporate other previous longitudinal incisions about the knee.

The blood supply to the skin should not be confused with the blood supply to the patella.⁶ The patella is separated from the skin by the prepatellar bursa through which few blood vessels pass. The patella has a rich plexus of arteries surrounding it, arising from various sources (Figure 1-1). These branches include the four genicular arteries (superior medial, inferior medial, superior lateral, and inferior lateral) and the anterior tibial recurrent artery. Medial retinacular incisions will disrupt the three medial blood vessels contributing to the anastomosis around the patella. A study using laser Doppler flowmetry of 10 patients undergoing total knee arthroplasty did not demonstrate a significant change in

patellar blood flow with a standard medial parapatellar approach.⁷ If a lateral retinacular release is added, however, one or both of the lateral vessels will be disrupted, potentially compromising patellar blood flow.

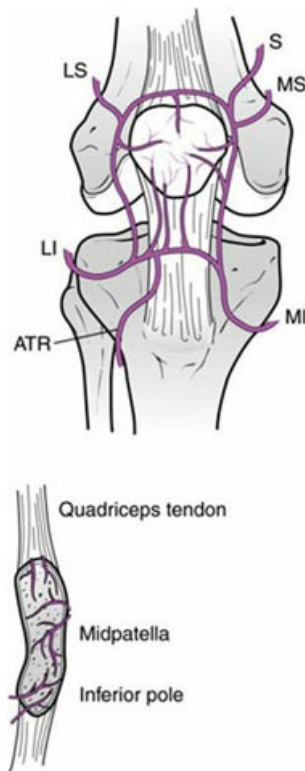


FIGURE 1-1. Schematic diagram outlining the blood supply to the skin and patella. Reprinted with request from Court-Brown CM, Heckman JD, McQueen MM, et al. *Rockwood and Greens Fractures in Adults*. Philadelphia, PA: Wolters Kluwer Health; 2015.

The nerve supply to the skin is similar in distribution to the blood supply. Branches of the saphenous nerve traverse laterally to the anterior aspect of the joint to provide cutaneous sensation. Depending on the patient's anatomy, it is possible to sacrifice the infrapatellar branch of the saphenous nerve with the skin incision, resulting in an area of transient or permanent cutaneous dysesthesia on the skin over the anterolateral proximal tibia. Patients should be made aware of this possibility. The terminal branches of the saphenous nerve innervate the vastus medialis. A concern with any medial exposure of total knee arthroplasty that splits the vastus medialis muscles is that the exposure may damage the distal portion of the muscle. Electromyographic and nerve conduction studies have been performed, however, and have shown no evidence of muscle denervation.^{8,9}

TECHNIQUE

Total knee arthroplasty is performed with the patient in the supine position. The operating table should be level. A protective belt is applied across the upper body to allow tilting of the table as needed. Tilting of the table may be required when total knee arthroplasty is being performed below a fused or ankylosed hip. In those cases, the patient is placed in the Trendelenburg position and the foot of the table is dropped. A tourniquet is applied to the upper thigh after the correct patient and extremity have been identified and marked. The tourniquet should be applied snugly and as far proximally as practical. In the very obese patient, the fat may be pulled distally from beneath the tourniquet, causing it to bulge from the distal edge of the tourniquet. This prevents it from migrating and ensures that the tourniquet is placed as far proximal as practical. We use a commercially available footrest placed at the bulkiest part of the calf to support the knee in flexion during the procedure. Alternatively, a sandbag can be used provided it is taped securely to the bed. We also use a lateral bolster placed at the proximal third of the thigh to prevent external rotation of the hip (Figure 1-2A). We have found this particularly helpful in obese patients. The contralateral leg is well padded, especially under the heel.





FIGURE 1-2. **A**, A tourniquet is placed on the thigh as proximal as possible; a foot rest and lateral bolster are secured into proper position to support with minimal assistance. **B**, The leg suspended and ready for scrubbing and prepping.

There are many ways to prepare and drape a patient for total knee arthroplasty, but we have found that suspending the heel in a leg holder gives excellent access to the knee and allows surgical personnel to be available for other purposes (Figure 1-2B). We shave the hair around the area of the planned incision just before sterile preparation of the leg. The nurses first scrub the leg with an iodine or chlorhexidine solution as the surgical team scrubs. The entire leg is then prepared with an iodine or chlorhexidine solution on the basis of surgeon preference.

The calf is supported with a sterile towel, the foot is removed from the footrest, and the remainder of the leg—including the foot—is prepared. A sterile approach sheet is placed on the operating table. A stockinette is placed over the prepped foot, over the entire leg, and over the tourniquet. A sterile U-shaped drape is placed proximally around the stockinette at the level of the tourniquet. A limb extremity sheet with a rubberized central portion having a hole in it is placed over the stockinette and pulled proximally to the tourniquet level. The foot and ankle are wrapped with an elastocrepe bandage or flannel roll to prevent the stockinette from sliding when manipulating the foot during the procedure. As an alternative, a sterile surgical glove can be placed over the foot. A window is cut in front of the stockinette on the anterior aspect of the knee, and the appropriate landmarks about the knee are palpated and marked with a sterile pen (Figure 1-3A). The incision is then drawn and transverse lines are made to assist with wound alignment at the time of closure. A betadine-impregnated sterile adhesive plastic surgical drape is then applied to encircle the leg around the surgical site (Figure 1-3B).

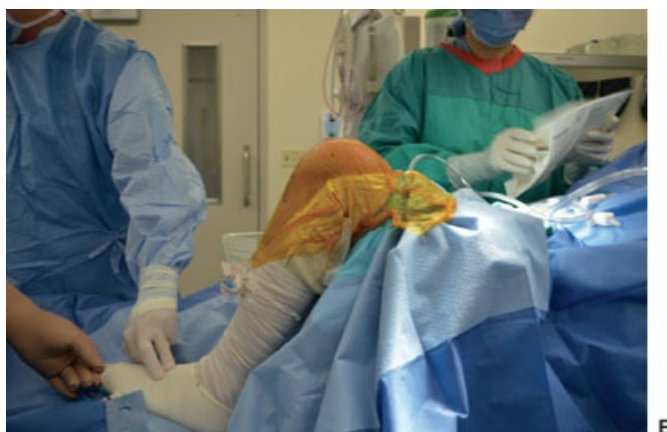
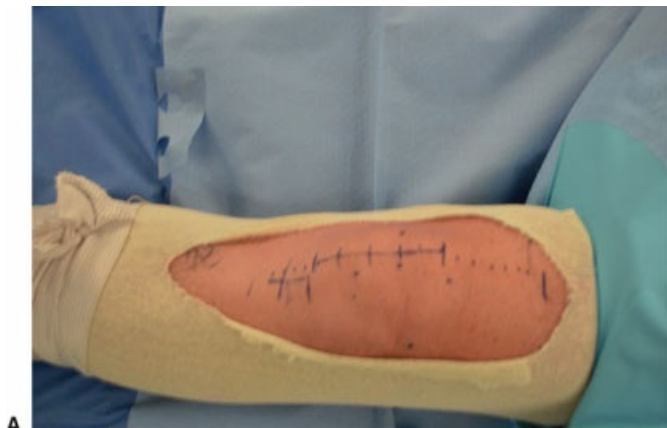


FIGURE 1-3. **A**, The foot and ankle are wrapped with an elastocrepe bandage, and a limb extremity sheet with a rubberized central portion is placed over the stockinette and pulled proximally to the tourniquet. A window is cut in the stockinette anteriorly and the incision is drawn. In this case, a small parapatellar incision is marked in preparation for a medial unicompartmental knee arthroplasty. As seen in the picture, dots are drawn proximally and distally in the event that a total knee arthroplasty is deemed more appropriate intraoperatively. **B**, In another patient, a betadine-impregnated sterile adhesive plastic surgical drape encircles the leg.

A tourniquet is used for all total knee arthroplasties, except in patients with known peripheral vascular disease and absent pulses as

confirmed by Doppler examination. These patients also have a consultation with a vascular surgeon preoperatively. Relative contraindications to the use of a tourniquet include obese patients with a short thigh (in which a tourniquet is often ineffective) or patients with known substantial peripheral neuropathy. The tourniquet is usually inflated to 300 mm Hg so as to have the tourniquet at least 100 mm Hg above the systolic blood pressure. The pressure can be elevated as high as 350 mm Hg in hypertensive or obese patients. The leg is usually elevated for 30 seconds before inflation of the tourniquet. Prophylactic antibiotics are given within 20 minutes of tourniquet inflation.

It is important to check that enough skin area is exposed for the entire incision before marking the skin incision. The initial exposure is done with the knee in flexion. Generally, we use a standard straight, vertical skin incision approximately 10 to 15 cm long. It is centered over the shaft of the femur, in its midportion over the patella, and distally just medial to the tibial tubercle. We believe that the skin knife should be used for skin incision only, as skin bacteria may be transferred deep to the wound if the same knife is used for deep dissection.¹⁰ Using a new blade, the dissection is taken to the anterior border of the quadriceps tendon, patella, and medial border of the patellar tendon. It is important to avoid elevating large skin flaps and creating dead space. The subcutaneous dissection is concentrated on the medial side to allow for a medial parapatellar arthrotomy. Elevation laterally over the dorsal surface of the patella is kept to a minimum. In the severely obese patient, however, lateral dissection may be more extensive and necessary to create a subcutaneous pocket in which the patella may sit, allowing it to evert.

The quadriceps tendon is then identified. A Cobb elevator is a useful instrument to remove any tissue adherent to the quadriceps tendon. The medial and lateral edges of the arthrotomy at the level of the superior pole of the patella are marked with a sterile marking pen to facilitate an anatomic closure at the end of the procedure (Figure 1-4A). There are many variations to the traditional medial parapatellar arthrotomy, including the midvastus and subvastus approaches (Figure 1-4B). We incise the quadriceps tendon in line with its fibers, about 0.5 cm from the vastus medialis. The arthrotomy is extended in a curvilinear fashion distally along the medial edge of the patella and gently back along the medial border of the patellar tendon (Figure 1-5). A soft-tissue cuff is preserved at the superior pole of the patella and at the tibial tubercle to facilitate closure. The arthrotomy incision is made with a large scalpel blade through the medial retinaculum, capsule, and synovium.

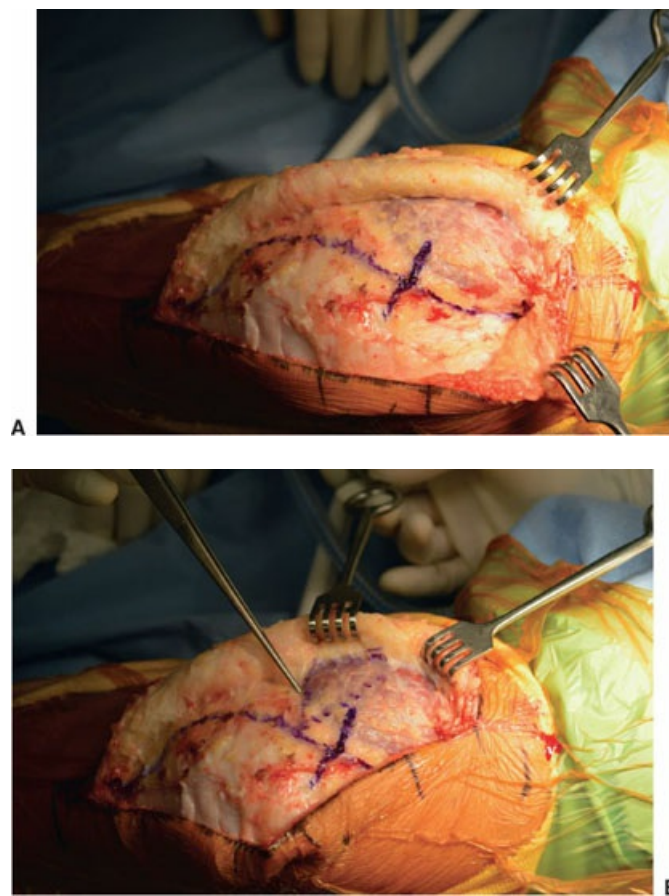


FIGURE 1-4. **A,** The medial and lateral edges of the arthrotomy at the superior pole of the patella are marked with a sterile pen to facilitate anatomic closure. **B,** The subvastus (pointed out), midvastus (dotted line), and traditional medial parapatellar arthrotomy are marked.

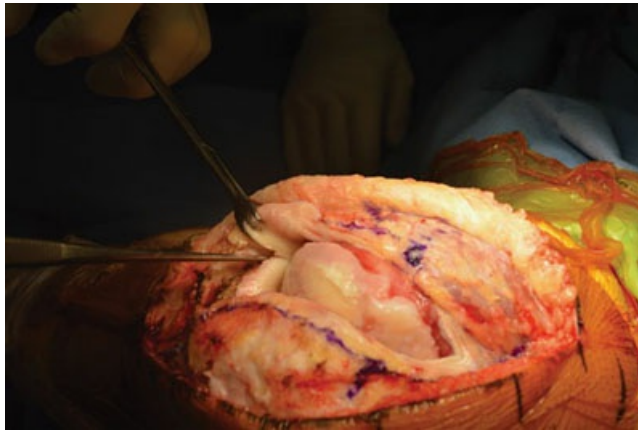


FIGURE 1-5. The quadriceps tendon is incised in line with its fibers, about 0.5 cm from the vastus medialis, and extended in a curvilinear fashion distally along the medial edge of the patella.

At the joint line, it is important to cut the anterior horn of the medial meniscus. The exception is when a patellofemoral arthroplasty is performed, when it is critical to leave the medial meniscus intact. The remainder of the exposure can be done in flexion or extension on the basis of surgeon preference. Our preference is to bring the leg into a figure-four position and apply a thyroid grasper to the medial soft-tissue sleeve (Figure 1-6). This aids in the exposure of the medial side of the joint by subperiosteal dissection of the medial collateral ligament. The medial collateral ligament is dissected in a continuous flap using electrocautery with vertical strokes for a variable distance depending on the type and degree of preoperative deformity. We have found a small Cobb elevator or osteotome useful in this stage of the exposure. It is imperative not to overrelease medially in more severe valgus deformities in which the medial collateral may already be stretched or attenuated. We prefer a stepwise release of the medial structures, beginning with removal of the osteophytes on the medial tibial plateau and medial femoral condyle with a rongeur (Figure 1-6). In most cases, it is necessary to expose the posterior medial corner to allow for proper external rotation, anterior translation, and tibial exposure.

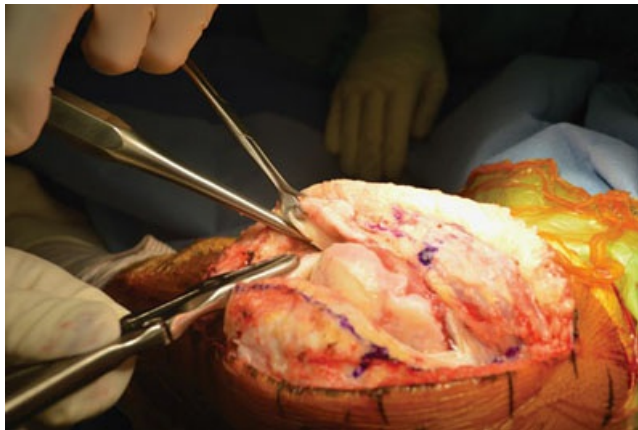


FIGURE 1-6. The leg is gently brought into a figure-four position and subperiosteal dissection of the medial collateral ligament is facilitated by application of a thyroid grasper to the medial soft-tissue sleeve and the use of a small Cobb elevator. A rongeur is used to remove prominent osteophytes on the medial tibial plateau and medial femoral condyle.

After exposing the medial side, we work in a systematic fashion (clockwise for left knees and counterclockwise for right knees) to release extra-articular adhesions from the medial gutter, suprapatellar pouch, and lateral side of the knee. We routinely reflect the anterior synovium on the femur to expose the supracondylar region of the femur to ensure proper and precise sizing of the femoral implant and to avoid notching the anterior cortex. The extensor mechanism is tensioned with a laterally placed right-angle knee retractor and the lateral gutter cleared with the knee in extension (Figure 1-7). Any osteophytes on the lateral femur are removed at this juncture. Dissection is carried across the anterior aspect of the lateral tibial plateau. A right-angle retractor is placed into the bursa posterior to the patellar fat pad, exposing the entire anterior lateral aspect of the knee. The fat pad is detached from the lateral meniscus, and the anterior horn of the lateral meniscus is incised vertically. In some knees, the lateral meniscus can be detached along the lateral margin of the tibial plateau into the meniscal popliteal hiatus. These maneuvers allow the patella to be readily mobilized for eversion. The ligamentum mucosa, if present, should also be sectioned.