Chapter 5

Flexion Contracture in Total Knee Arthroplasty

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Many patients requiring total knee arthroplasty will have a moderate flexion contracture that is fully corrected at surgery. However, when preoperative contractures are greater than 20 degrees, the deformity may become fixed and require special surgical consideration. This chapter will discuss these patients.

The deformity is a result of either a bone block and/or soft tissue contractures (Fig. 5.1). The proliferation of osteophytes in degenerative joint disease or prior trauma creates bone blocks that can occur in the anterotibial or posterofemoral condyles. They mechanically abut the intercondylar notch, or tether the posterior capsule, thus preventing full extension. The bone deformity may be slowly progressive and subsequently cause secondary soft tissue contracture of the posterior capsule and collateral ligaments.

Soft tissue contracture occurs in patients with long-standing deformities from a variety of disease states such as inflammatory arthritis, immobility, hemophilia, and neuromuscular disorders. These contractures can be static or progressive and can lead to increasing tightness in the posterior capsule, collateral ligaments, and hamstring muscles. Once the deformity exceeds 50 degrees, the collateral ligaments are inevitably involved.

Flexion of the knee is a response to inflammation, infection, or any condition that leads to joint swelling and increased intra-articular pressures. It has been demonstrated that increasing intra-articular pressure results in the knee assuming a 30- to 45-degree flexion position.[1]

Fixed flexion contractures decrease the patient's ability to walk. Velocity is slowed and energy costs are increased. Perry and associates[2] measured a 50% increase in work by the quadriceps at a given rate of ambulation in the presence of bilateral contractures of 30 degrees. The adjacent joints also assume abnormal posturing and increase the energy requirements with a corresponding reduction in endurance. Persons who have added disability of muscle

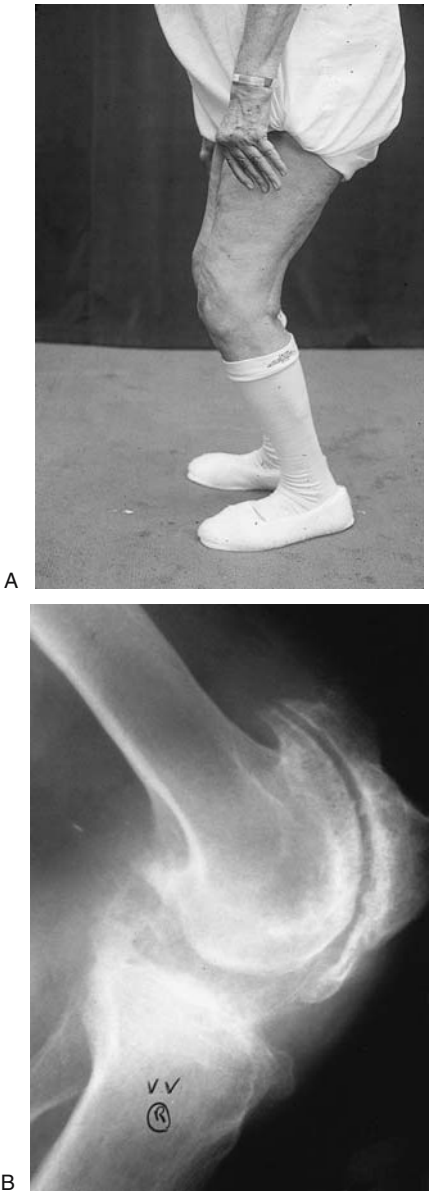

FIGURE 5.1. (A) Patient with rheumatoid arthritis and fixed flexion from soft tissue contracture. (B) X ray of patient with osteoarthritis and severe flexion contracture secondary to bone impingement preventing full extension.

weakness from disease atrophy or paralysis may lose their ability to walk.

Persistent flexion posture eventually leads to tightening of the posterior capsule and portions of the collateral ligaments. Normally these structures help prevent hyperextension and are at full length in extension. With a flexion contracture the collateral ligament and posterior capsule shorten, thereby preventing full extension. It is undetermined if the posterior cruciate ligament contributes to the persistence of flexion contracture, because this ligament lengthens with flexion.

The secondary soft tissue shortening of the capsule and portions of the collateral ligament makes it difficult to achieve ligament balancing during total knee replacement. At surgery we attempt to achieve an equal space between the femur and tibia in both flexion and extension (Fig. 5.2). This is referred to as a balanced flexion-extension gap. In a normal knee we use "measured resections" (i.e., removing equal amounts of bone from the femur and tibia that are to be replaced with prosthetic material). The flexion and extension gaps should be equal after the bony cuts are performed. Patients with long-standing flexion contractures will have a normal flexion gap, but a narrow gap in extension. This leads to persistence of the contracture. This imbalance can be corrected by releasing the soft tissue contracture and/or resecting more distal femur, thereby increasing the extension gap. As more bone is resected from the femur, the joint line is subsequently moved proximally. This creates alterations in the kinematics of the knee and in the contact points of the patella femoral joint. Occasionally it is necessary to take a few more millimeters of distal femur. However, the preferable method to achieve flexion-extension gap balance is to release the soft tissue structures.

In addition to the flexion contractures there is an attenuation in the extensor mechanism and anterior capsule.[3] Although this does not create intraoperative problems, it may contribute to persistent extensor lag and some degree of persistent quadriceps weakness, and may inhibit the patient's ability to maintain full extension during the postoperative period. It is important to recognize this potential for prolonged extensor lag so that the knee can be protected from current deformity.

PREOPERATIVE EVALUATION

All patients should have the usual preoperative evaluations including medical history, functional history, and physical examinations. The standard standing anteroposterior X rays may be misleading

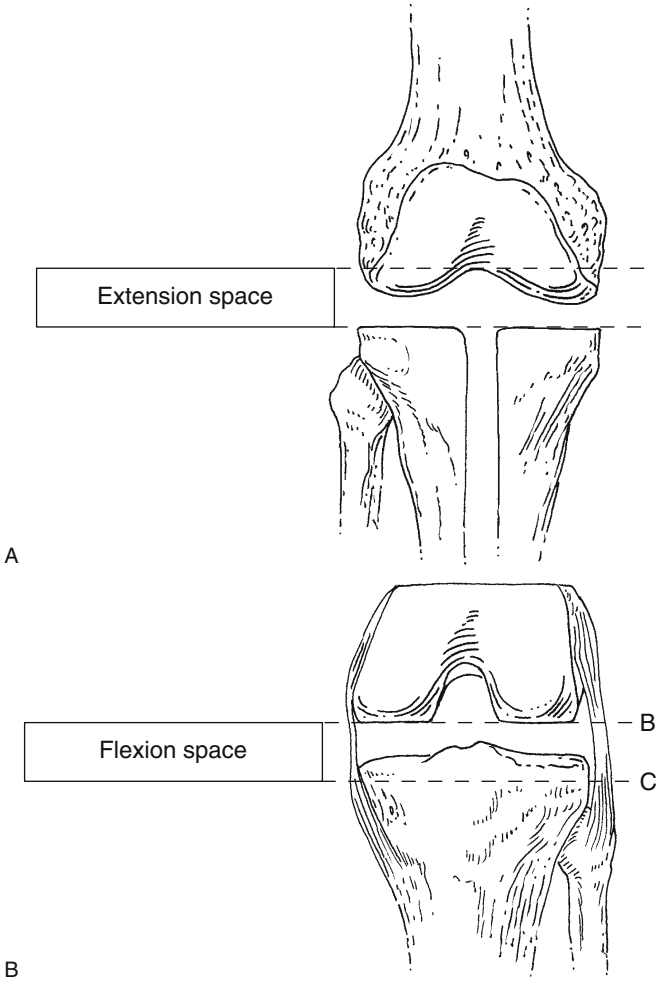

FIGURE 5.2. The space between the femur and tibia should be rectangular and equal in both flexion and extension with fixed flexion deformity. The extension space becomes too tight.

because of the posturing of the knee with a flexion contracture. This contracture will alter the apparent remaining joint space, because the X-ray beams may not be parallel to the joint line, and the joint space will appear to be obliterated (Fig. 5.3). In addition, if there is external rotation of the knees when the X ray is taken, the apparent alignment will be misleading. Therefore, care should

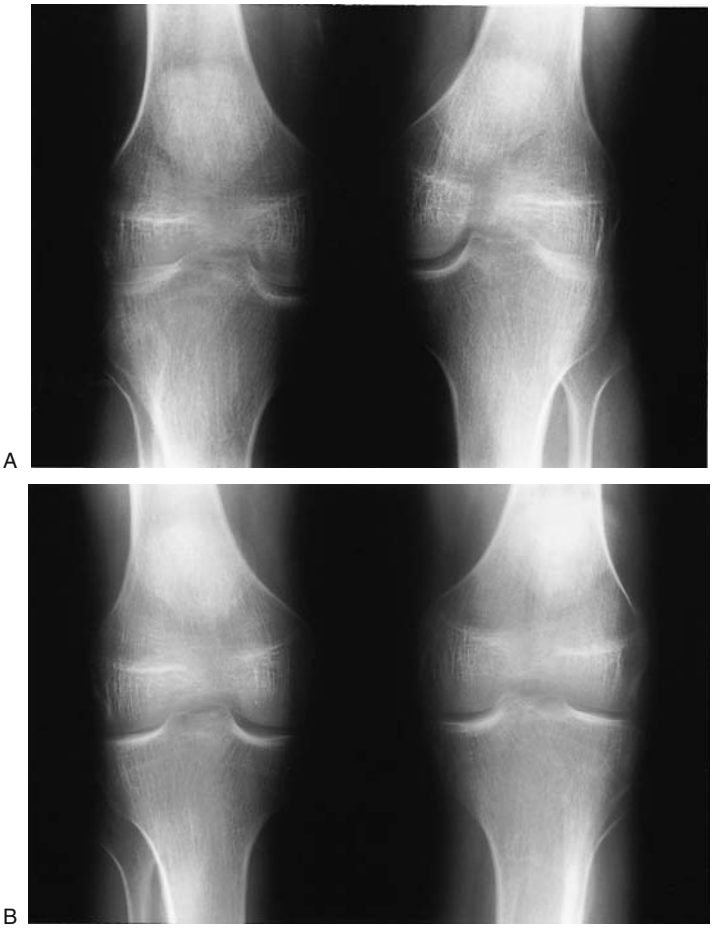

FIGURE 5.3. Patient with fixed flexion deformity. (A) Films taken in antero-posterior view with apparent obliteration of joint space. (B) X ray taken parallel to joint surface showing that good space remains.

be taken to have the X rays taken parallel to the tibial plateau surface and with a true anteroposterior position. In addition to alignment and joint-space aberration there will also be increased magnification from X-ray beam parallax making the templating inaccurate. These variations should be recognized during preoperative planning.

Accurate preoperative anteroposterior X rays are important because a tangential X ray, which shows absence of joint space, is misleading and may suggest that an arthroplasty is required. If joint space remains and the principal abnormality is soft tissue contracture, then this knee could potentially be handled by soft tissue release alone. This would be particularly important in patients who have quiescent juvenile rheumatoid arthritis or immobility contractures with preservation of articular cartilage surface.

Some surgeons have recommended preoperative casting to reduce the contracture. This can potentially make the surgical procedures easier and avoid postoperative skin and nerve complications. If the contracture is of relative recent onset and there is a soft spring to the extension endpoint, indicating potential improvement in extension, then there may be some benefit from repeated preoperative casting to reduce the contracture.

Preoperative casting can be initiated with a knee manipulation under anesthesia and casting in the extended position. The cast must be very carefully applied with padding over the patella, achilles tendon, and posterior thigh. Pressure sores must be assiduously avoided.

In one study by Convrey and associates[4] 46 knees in 23 patients were treated with casts with an average correction of 60%. At follow-up averaging 41 months the patients showed a general tendency for the deformity to recur. However, the original deformity was maintained with a mean loss of only 5 to 11 degrees. The amount of correction that was obtained did not appear to be directly effected by the severity of joint destruction, precast deformity, or ambulatory status. The total degree of flexion was unchanged with the casting technique. The overall functional status was dependent on the deformity. The study acknowledged the difficulty in a retrospective review for multiple uncontrolled variables.

A variety of casting techniques have been described. These have included (1) serial casts with anesthesia; (2) removing a long anterior window from the foot, anterior tibia, and knee, with subsequently placing thicker soft padding behind the heel and calf; (3) hinges with turnbuckle extenders; and (4) traction. Most

of these techniques have been described but not scientifically validated. They may or may not be appropriate for arthroplasty surgery.

There is very little written on casting for flexion contractures prior to joint arthroplasty. The number of patients that may require casting is relatively small, and there are a variety of disease processes with variable amounts of joint destruction. Therefore, it is difficult to make firm recommendations in this regard. However, our own preference is to consider casting for younger patients with recent contractures but not to utilize casting in patients who are older with fixed deformities and significant joint destruction.

SURGICAL TECHNIQUE

Standard total knee arthroplasty is initiated with "measured resection" in which the bone that is resected is the same dimension as the prosthesis. In general, exposure is not a problem as these usually have good flexion. Once the measured resections are completed, osteophytes are carefully removed from all segments of the knee. We carefully remove osteophytes from the posterior femoral condyles and circumferentially around the tibial plateau with a curved osteotome and curette (Fig. 5.4). The knee is then evaluated for the space in flexion compared to the space in extension. There will be a wide variation in the discrepancy depending on the amount of deformity, rigidity of fixation, and age of the patient.

To equilibrate the flexion-extension space, a soft tissue release is carried out in stages, checking the extension gap after each step.[5–7] First, a periosteal elevator is used to elevate the capsule from the posterior femur (Fig. 5.5). Both the anterior and posterior cruciate attachments from the intercondylar notch of the femur are removed (Fig. 5.6) and the soft tissue capsular attachments in the posterior femur are dissected from the posterior femur (Fig. 5.7). The extension gap is again measured, and if more release is required, the dissection is carried more proximal releasing the gastrocnemius muscle origins from the femur. Again the extension gap is evaluated. If more release is required, we carefully dissect the medial and lateral corners approaching the posterior aspects of the medial and lateral collateral ligaments. We avoid resecting the collateral ligament attachments, although some authors completely skeletalize the distal femur. After all of the posterior capsule, gastrocnemius muscular origins, and posterior

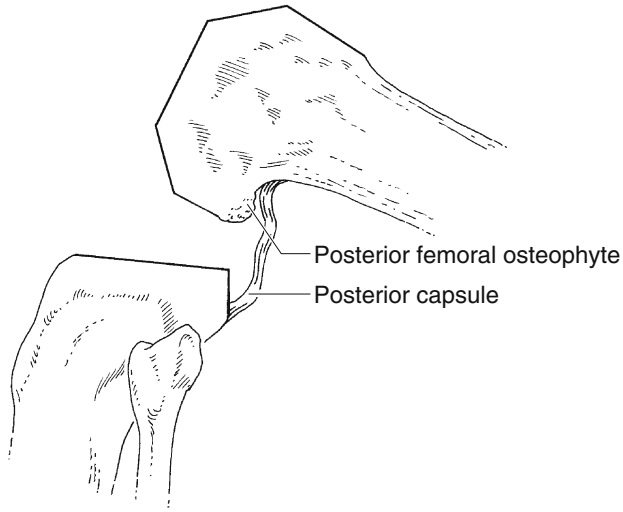

FIGURE 5.4. The osteophytes behind the posterior femoral condyles must be removed in order to prevent persistent flexion contracture from tethering of the posterior capsule.

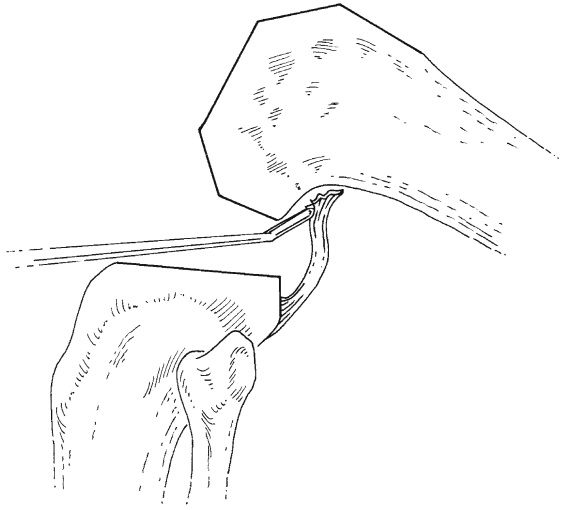

FIGURE 5.5. The posterior capsules become contracted and may require release from the femur.

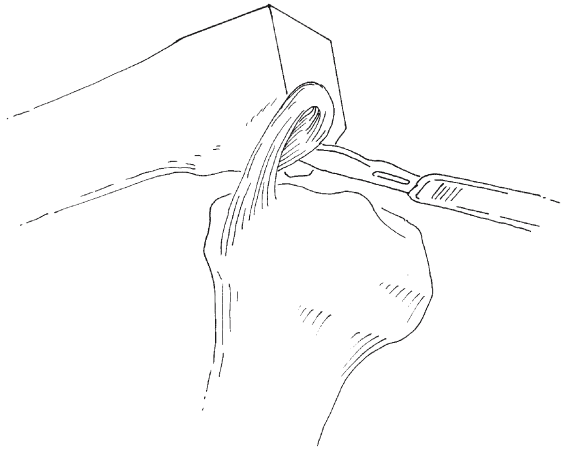

FIGURE 5.6. The cruciate ligaments will usually require releasing with large fixed flexion deformity.

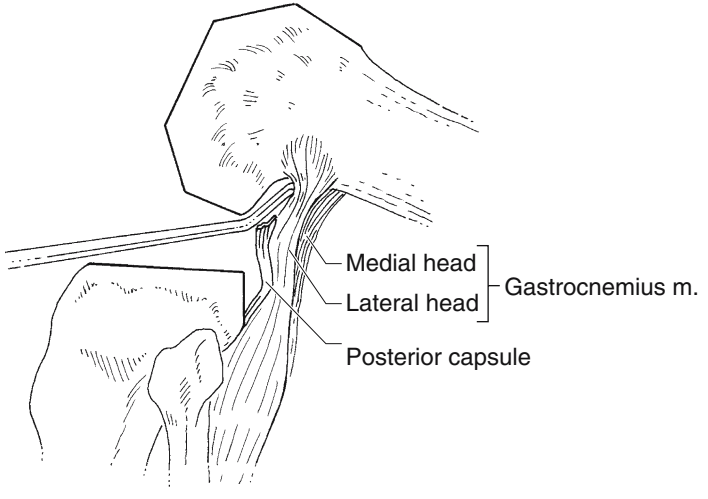

FIGURE 5.7. The gastrocnemius muscle insertion will also require release in severe fixed deformity.

corners have been resected along with the posterior aspects of the collateral ligaments, if the extension gap remains too tight, we will then resect more bone from the distal femur. The additional bone resection of the distal femur is done last because it significantly affects the joint mechanics by migrating the joint line proximally.

The soft tissue dissection of the posterior aspect of the joint and modest proximal migration of the joint line will correct most of the deformity and resolve the flexion-extension gap inequality. If the joint is still too tight in extension and/or too loose in flexion, the choice of a prosthesis with a high central trial spike, such as a total condylar III prosthesis, can be utilized in order to protect the knee from instability and subluxation. The inability to achieve full correction usually occurs in extremely disabled patients who have significant preoperative polyarticular deformity and who will not be achieving normal activity in the postoperative period. Therefore this will not be a major functional compromise.

At the end of surgery we like to have almost all of the deformity corrected. With the lesser flexion contractures we expect the knee to come to full extension. With flexion contractures greater than 70 degrees a few degrees of flexion may remain at surgery.[8] In general, we work to avoid residual flexion contracture at the end of surgery.

POSTOPERATIVE MANAGEMENT

The degree of initial deformity affects the postoperative management. For the lesser deformities in which there is less anterior capsular stretching and quadriceps elongation with reasonable muscle tone, then routine care and management is all that is required. On the other hand, with a large preoperative deformity, the anterior capsular will be stretched, the quadriceps elongated, and there will be a prolonged extensor lag and subsequent tendency to develop recurrent deformity. These patients should be casted in full extension during the postoperative period. The duration of the casting will be determined by the deformity. The greater the deformity, the longer the postoperative cast. The duration of our postoperative casting will range from 3 to 28 days.

There is a tendency for the patients to assume the flexion position because of the extensor lag and muscle weakness. Physical therapy must insist that they obtain full extension passively every day in order to prevent fixation and recurrent deformity. It may be several months before patients can achieve full active extension. After discharge the patient should be carefully instructed on how to achieve full passive extension. If patients begin to develop recurrence of their flexion contracture, then a manipulation should be

performed within the first few weeks. Occasionally a second manipulation will be required. However, it is very important not to allow a recurrent deformity to become fixed. The patient should always be able to maintain the degree of correction that was achieved at surgery.

In general, achieving motion in flexion in this group of patients is relatively easy and therefore attention should be carefully focused on the maintenance of full extension.

COMPLICATIONS

Releasing fixed flexion contractures during total knee arthroplasty has significant risks that increase with increasing deformity. The most serious ones include nerve and vascular injury. When recognized the knee should be immediately flexed and allowed to resume part of the preoperative deformity. Clayton reported that 2 of 20 patients with rheumatoid arthritis who had significant preoperative flexion contractures developed a peroneal nerve palsy.[5] Other soft tissue problems include poor wound healing, recurrent deformity, ligament instability, and residual laxity in flexion.

The possibility of posterior subluxation from instability in flexion is a mechanical problem that should be recognized intraoperatively and corrected with appropriate bone resections or prosthetic choice. If the imbalance persists, then a total condylar III style prosthesis should be selected to prevent subluxation.

RESULTS

Firestone and colleagues[9] evaluated their results of total knee arthroplasty in 51 knees that had flexion contractures greater than 20 degrees. A posterior cruciate-retaining device was used. The residual flexion contracture measured 3.1 degrees at the completion of the arthroplasty, 10.1 degrees at 3 months, and 7 degrees at 2 years. At 55 months postoperatively the average flexion contracture for the osteoarthritic group had improved from 25.5 degrees to 3.6 degrees, whereas the rheumatoid arthritis group improved from 28.7 degrees to 8.6 degrees. The average Knee Society Score for the osteoarthritic group was 89 as compared to 81 for the rheumatoid group. Knees that were left with greater residual flexion contracture at the completion of the arthroplasty were found to have greater residual flexion contractures at the latest review.

Some authors feel that it is not necessary to fully correct the flexion contracture at the time of surgery. McPhearson and associates[8] studied 29 patients who had relatively mild preoperative contractures, less than 30 degrees, but were not fully corrected to

neutral following their total knee arthroplasty. They noted that the mean value of flexion contracture in the immediate postoperative period went from 10 degrees immediately postoperatively to 1 degree at 24 months. It may appear that complete intraoperative correction may not be necessary for small contractures up to 30 degrees.

Similar findings were noted by Tanzer and Miller.[10] Their study included 35 knees with less than 30 degrees of preoperative flexion contracture. All the patients had residual immediate postoperative contractures of 15 degrees. Eventually they went to an average of 2.9 degrees at their last follow-up. They felt that mild fixed flexion contractures do not have to be fully corrected at the time of arthroplasty and that intraoperative removal of excessive bone from the distal femur is not indicated. It should be emphasized that the reports are for mild contractures and probably not applicable to large contractures.

SUMMARY

The problems related to preoperative flexion contractures of the knee for total joint arthroplasty increase with increasing degree of deformity. In general, the lesser deformities will correct with less surgical dissection through removal of osteophytes and the release of the posterior capsule. The deformities that are extensive and fixed will require wide soft tissue releases posteriorly and collaterally, as well as some proximalization of the joint line with increased resection of the distal femur. Postoperatively the patient should be protected so they do not develop recurrent deformities. This can be accomplished with casting and manipulations if necessary. The most serious complications involve stretching the neurovascular structures and must be very carefully evaluated in the postoperative period.

Preoperatively, the patients with flexion contractures are so disabled with immobility states and significant restrictions in walking ability that, after surgery and full extension is achieved with a successful arthroplasty, they are amongst our most grateful patients.

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