The results of the LCS mobile bearing knee arthroplasty meet or exceed the best results reported for fixed bearing total knee replacement. However, while most patients have enjoyed clinical success with these implants, an occasional patient will be referred with pain, swelling and stiffness, which may be severe enough to consider revision surgery. A thorough evaluation will help to determine a specific diagnosis in most cases. However, if a specific diagnosis cannot be determined, the results of revision surgery are likely to be unsatisfactory.

HISTORY

Evaluation of the painful total knee should always start with a complete history. Does the patient have a history of diabetes mellitus or underlying neurovascular disease or any potential sources for infection? Ask the patient to characterize his pain in terms of its location as well as what activities exacerbate the pain and what maneuvers relieve it. It is important to differentiate rest pain from activity related pain. Establish the exact onset of the patient’s symptoms, has he had pain ever since the surgery or was there a period when the knee pain was relieved and then some event after which the symptoms began. Have these symptoms been progressively worsening or are they stable? What specific activities make the pain worse, what relieves the pain and are any medications helpful?
A history of swelling requires having the patient distinguish between the sensation of tightness around the joint and true swelling. Localizing the swelling as well as timing its’ appearance and disappearance is helpful as well as documenting its’ presence and degree by an independent observer.

Any previous problems with the knee should be documented beginning with the index diagnosis, as well as the symptoms in the knee before the most recent surgery. What surgeries preceded the knee arthroplasty, were there any perioperative complications, any history of problems with the wound or with rehabilitation.

Family history should be reviewed in particular regarding history of gout, systemic lupus erythematositis or ankylosing spondylitis. In addition the patient should be questioned about his ability to lead a normal life, his ability to ambulate with crutches, cane or walker as well as the distance or time he is able to walk. Can he ascend or descend stairs, and is this performed normally or one step at a time. Is there any sensation of instability on either ascending or descending stairs? Difficulty arising from a chair should be noted. The patient’s specific complaints before surgery should be reviewed along with his expectations before and after surgery. Employment history is often helpful in placing the patient’s function in perspective as is any history of underlying psychiatric disease or treatment with antidepressants or other psychiatric medications.
Medications including corticosteroids and immunosuppressive agents may have serious side effects and any recent change in the dose of corticosteroids should be noted since a flare of disease activity may take place when these drugs are suddenly discontinued or reduced. Patients with cardiovascular disease who complain of joint pains should be asked whether they are taking Hydralazine or Procainamide since these may induce a Lupus-like syndrome.

Finally determine who the patient feels is responsible for his knee condition. Is this a workman’s comp related case, a personal injury case or medical malpractice and is any medical-legal action pending? A discussion of what physical therapy and rehabilitation measures have been performed post-operatively and over what time course is useful as well.
PHYSICAL EXAMINATION

Physical examination can be exceedingly useful in assessing the painful total knee arthroplasty. Pain about the knee may result in muscle atrophy and weakness. The patient’s gait should be evaluated and over all alignment of the limb in varus or valgus noted. The patient’s ability to arise from a chair should be observed as well as his ability to ascend and descend a step without assistance. The character of the wound should be noted. In particular, observing any evidence of erythema, induration and abnormal warmth. Swelling should be graded and intra-articular effusion differentiated from generalized soft tissue edema by balloting the patella. When evaluating swelling about the knee, swelling in the pre-patellar bursa or popliteal bursa must be distinguished from that in the knee joint proper. Palpation of the areas medial and lateral to the patella can provide information about synovial hypertrophy. Large intra-articular effusions are easily detected by balloting the patella after compressing the suprapatellar bursa to displace the fluid that it contains. Small amounts of fluid in the knee joint can be elicited by stroking the lateral aspect of the joint, thus moving the fluid back into the medial aspect of the knee. The “bulge sign” may then be observed on the medial aspect of the knee. Limitation of motion should be documented and specific range of motion noted in the patient’s chart. Next the knee should be palpated for specific areas of tenderness. Tenderness should be elicited from all three compartments, the patello-femoral, medial and lateral compartments as well as areas overlying the medial and lateral femur and medial and lateral tibia. The function of the extensor mechanism should be assessed and any crepitance or grinding in the patello-femoral joint noted. Strength for extension and flexion of the knee should be documented on a 0 – 5 scale. Patellar tracking should be checked for subluxation or dislocation. Extensor lag or fixed contractures should be measured and documented. Knee stability should be evaluated both in the AP and medial lateral plane. Varus and valgus stability to stress should be assessed in full extension as well as 30° of flexion and 90° of flexion.
In addition to thorough examination of the knee, examination of the back and abdomen are also important to rule out the possibility of referred pain. The back should be evaluated for tenderness or deformity. The abdomen should also be evaluated for areas of irritability or tenderness. Full examination of the hip is required to document range of motion as well as assessing the hip as a source of referred pain to the knee. Flexion contracture of the hip can be demonstrated using the Thomas test by having the patient flex the contralateral thigh to the chest while lying supine. Examination of the hip has been particularly helpful in my experience since several patients have presented complaining of dissatisfaction and pain with a knee replacement only to be found to have severe arthritis in the ipsilateral hip. In these cases addressing the hip problem relieved the knee complaints as well. Evaluation of the foot for malalignment is also useful since significant deformities can cause abnormal stress and pain at the knee.

**RADIOGRAPHIC ASSESSMENT**

Plain radiographs can determine the type of implant used, the alignment and positioning of the components, and malrotation of the components, as well as gross evidence of polyethylene wear. Anteroposterior, lateral and sunrise views should be taken tangential to the joint. The position of the joint line should be compared to the unoperated opposite knee. Elevation of the joint line of more than 1cm is associated with patello-femoral problems. Metal backed components may show evidence of metal debris if there has been wear through of the polyethylene. Complete or progressively widening radiolucent lines at the cement prosthesis interface or cement bone interface suggest loosening. Similarly a shift in the position of the implants confirms loosening.

Cementless implants are more difficult to assess and tangential views are critical in this regard since 5° of flexion or rotation can obscure a 1mm radiolucency as can 6° or greater angulation of the x-ray beam or more than 2.5cm offset of the beam. Metal backed components obscure the interface with as little as 4° of flexion. Fluoroscopic positioning is useful to obtain true tangential views for the AP and lateral radiographs.
The relative position of the patella to the joint line may be assessed on a lateral view. In addition, the thickness of the patellar reconstruction should approximate the pre-operative thickness of the patella. Tracking may be assessed radiographically by obtaining merchant or sunrise views at 15°, 30°, 45° and 60° of flexion. Stress radiographs can also document medial or lateral instability as well as anterior posterior instability.

When a knee arthroplasty develops pain postoperatively, infection should always be suspected. A complete blood count, erythrocyte sedimentation rate and C reactive protein level are recommended. Aspiration of the joint gives the most direct evidence of infection. Cultures should be sent for routine aerobic and anaerobic cultures as well as fungal and TB. We have occasionally encountered fungal infections as the source of pain after joint reconstruction since the vast majority of patients are treated with prophylactic antibiotics at the time of surgery. We have occasionally repeated aspirations on two or three occasions when the initial aspiration is no growth or if the culture is positive for a suspected skin contaminant.

Technetium diphosphonate bone scans have been particularly useful in assessing the painful knee in our practice because of the difficulty in clearly demonstrating loosening on plain radiographs.(Figure 1) While bone scans have been noted to remain positive for one year after surgery, bone remodeling and local synovitis as well as early osteolysis may contribute to increased activity in a significant number of asymptomatic patients even after one year. If, however, a patient with a symptomatic knee replacement presents with a normal bone scan, the probability of loosening or infection is low. Indium 111 labeled white cell scans are useful in evaluating for infection. If diphosphonate and Indium 111 scans are negative the likelihood of infection is low, as is the likelihood of component loosening. CT scans are helpful in assessing the degree of bone loss behind the femoral component.(Figure 2,3) Aspiration of the joint is critical in ruling out infection. Arthrogram has not been particularly helpful in assessing for component loosening in our experience. A technetium diphosphonate bone scan may also be useful in suggesting other possible locations for referred pain. For instance a patient with a negative scan of the knee may have increased uptake in the ipsilateral hip or low back
suggesting that investigation into these areas might be illuminating. For instance, a patient with increased uptake in the low back might be evaluated with an MRI or CT scan to rule out the presence of involvement of the lumbosacral nerves. Doppler studies may also assess for possible occlusive vascular disease.

CAUSES OF PAIN AFTER TOTAL KNEE ARTHROPLASTY

There are many specific factors which can cause pain after total knee arthroplasty.

POLYETHYLENE WEAR: Currently, the most common type of prosthetic failure is caused by polyethylene wear. (Figure 4) Polyethylene damage can occur without pain. With significant polyethylene wear, synovitis may develop along with an effusion. The synovitis can cause pain and chronic synovitis can cause weakening of the ligaments and instability. Polyethylene wear should therefore be treated aggressively with polyethylene exchange. When malalignment is the cause of premature polyethylene wear, revision of the metal components may be required as well.

SOFT TISSUE IMPINGEMENT: Soft tissue impingement may cause pain if the femoral or tibial implants overhang the edge of the bone. This problem is diagnosed by palpating directly over the area of involvement. This problem may also be diagnosed radiographically, and bone scan will often localize the involved area. Treatment usually requires exchange for smaller components. (Figure 5)

COMPONENT LOOSENING: Loosening may be caused by malalignment, prosthetic wear or instability. (Figure 6) Infection may also cause loosening. If there is any question, an aspiration should be performed. Radiographic evidence of component loosening includes migration of the implants, complete radiolucent lines greater than 2 mm in width, and a change in alignment of the extremity with subsidence of the implant. Loose cementless implants may shed the beads used as an ingrowth surface. Loose components should be revised promptly to avoid further bone loss or ligament damage. (Figure 7)
PATELLAR COMPLICATIONS: Lateral subluxation of the patella is common after total knee arthroplasty. This may lead to dissociation from the metal backed patellar component. A significant effusion may develop if there is polyethylene wear. On physical examination, a grating sensation is noted and often a click on ballotment of the metal backed patella. Radiographically, the polyethylene component may be displaced. In metal backed patellar components, metallic debris may be present. Aspiration may show polyethylene fragments on centrifugation or the fluid may be discolored secondary to metallosis. Patellar loosening or dissociation usually requires patellar realignment including lateral retinacular release and may require revision of the femoral and tibial components to improve external rotation of these components.

INFECTION: Infection is characterized by pain that is constant, rather than only with activity. The knee may present with an effusion, as well as erythema and drainage from the knee wound. Often, however, the onset is more insidious with no obvious drainage or erythema. Physical exam may show tenderness to palpation and irritability on bending the knee. Radiographs may show loosening and lysis of the bone or more often no obvious changes. Erythrocyte sedimentation rate, complete blood count with differential, and C-reactive protein may or may not be altered. Technetium$^{99}$ diphosphonate bone scan and Indium$^{111}$ labeled WBC scans may also be positive. Diagnosis is made most reliably with aspiration for culture and sensitivity. Treatment is surgical irrigation and debridement, usually including component removal, with staged reimplantation after parenteral antibiotics.

REFLEX SYMPATHETIC DYSTROPHY: Reflex sympathetic dystrophy should be considered when pain is out of proportion to the objective findings on examination. The pain is present from the immediate postoperative period, and is associated with a very slow postoperative recovery. Flexion is usually limited and the skin may be hypersensitive and may be warmer than the unoperated knee. Reflex sympathetic dystrophy may be diagnosed with lumbar sympathetic blockade, which relieves the pain
confirming the diagnosis. Treatment is multidisciplinary and needs to be early and aggressive to improve the prognosis. Occupational and physical therapy help decrease pain and prevent stiffness. Antiedema measures include elevation and massage. Contrast baths improve blood flow and desensitize the patients. The leg should be placed in warm water for one minute, then alternate with cold water for ten minutes.

Phenoxybenzamine may inhibit the adrenergic effects seen in patients suffering from complex regional pain syndrome (the modern term for RSD). The usual starting dose is 10mg./day orally. This may be increased by 10mg./day every two days until pain is relieved. The initial dose should be maintained for at least five days before increase. Treatment usually lasts six weeks. Side effects include postural hypotension and phenoxybenzamine is contraindicated in several cardiac and asthmatic conditions.

Guanethidine may be used in a single oral dose for eight weeks. Side effects include mental depression, loss of appetite, impotence, and orthostatic hypotension.

Propranolol has been used to treat complex regional pain syndrome (CRPS), with less orthostatic hypotension but is contraindicated in patients with cardiac arrythmias or asthma.

Clonidine used as a transdermal patch may diminish hyperesthesia in patients who have had a positive response to sympathetic blockade.

Nifedapine, a calcium channel blocker relaxes peripheral smooth muscle and improves circulation. The starting dose is 10mg.TID and may be increased weekly to a maximum of 30mg.TID. Side effects include headache.

While non-steroidal anti-inflammatories are often ineffective, high dose prednisone may decrease edema and pain. Because of the risks of complications the dose should be quickly tapered.

If symptoms are not relieved promptly by oral medications combined with physical and occupational therapy, a trial of lumbar sympathetic blocks in the lower extremity may provide pain relief. If pain relief is achieved blocks may be repeated to a maximum of twelve blocks. Patients with legal, psychiatric, or disability issues frequently fail to maintain improvement.

When only temporary pain relief occurs after sympathetic blockade, surgical sympathectomy may be considered. Alternative treatments include calcitonin which
alters osteoclast activity and decreases pain. Side effects include nausea, stomach upset and headaches. Electrical stimulation has had varying levels of success in treating RSD. Acupuncture may release endorphins in the central nervous system to relieve pain refractory to other treatments. Amputation may ultimately be required to control persistent infection and painful physical contact but has been unreliable in providing pain relief.

In summary a multidisciplinary approach with early aggressive management offers the best prognosis in management of complex regional pain syndrome (CPRS) or RSD.

**FLEXION CONTRACTURE**: A fixed flexion deformity can result from posterior osteophytes being incompletely removed at the time of initial surgery. Failure to resect sufficient distal femur at the time of the surgery thus shifting of the joint line distally can result in a fixed flexion deformity. Flexion contracture preoperatively is frequently associated with postoperative fixed flexion deformity. All patients should be treated with aggressive physical therapy postoperatively and recalcitrant cases may benefit from bracing or even casting in the postoperative period.

**INADEQUATE FLEXION**: Normal walking requires 67 degrees of flexion, Stair climbing requires 83 degrees, descending stairs requires 90 degrees. Sitting comfortably requires 93 degrees of flexion, bending to tie shoes 106 degrees, and lifting an object from the floor 117 degrees of flexion. If the flexion gap is left too tight, this may interfere with flexion of the knee. A femoral component that is too large will limit flexion as will cutting the tibia with an anterior tilt. Contracture of the posterior cruciate ligament will also cause the knee to be tight in flexion. If the joint line is moved proximally, the posterior cruciate ligament may be too tight in flexion. If the patella is left too thick, flexion may be impaired. These technical errors may require surgical correction if physical therapy fails to achieve adequate flexion. Unfortunately, results after surgery have been less than ideal in our experience.

**INSTABILITY**: Patients may complain that the knee gives way when they walk on uneven ground. Ascending or descending stairs may also cause a sensation of instability.
Physical examination will confirm laxity on varus, valgus, anterior, or posterior stress. The overall limb alignment should also be assessed, and the diagnosis may be confirmed objectively with stress radiographs. Bracing for six weeks may allow adequate soft tissue healing to stabilize the knee. If this is ineffective, revision to more stable implants is indicated with rebalancing of the ligaments (see chapter 12.3).

CONCLUSION: We have learned that a thorough and systematic approach to evaluating the painful total knee reveals a proper diagnosis and treatment in most cases. For the most part, implant loosening, prosthetic infection, and chronic ligamentous instability require operative intervention. However, we can also recommend that if a conclusive diagnosis is not apparent, these conditions are not static and will worsen with time. On the other hand, if these serious conditions are not the problem, then waiting a period of time may be curative as the patient will get better. All reconstructive knee surgeons must deal on occasion with the stiff painful knee. Though reflex sympathetic dystrophy and other rare causes may be at fault, often it is simply the patient and the surgeon’s misfortune. This is the time when the surgeon must follow his Hippocratic teachings. Firstly he must not resort to ill-conceived operations that may make the patient worse. Secondly, he must not resort to surgery because this what he knows how to do and he wants to get paid for it. But most importantly, he must stay at his patient’s side and offer support and benefit even if it is no better than counseling and refilling chronic pain medication. Telling the patient, “there is nothing more that I can offer, you must go somewhere else”, is an abrogation of the physician’s ethical obligation!
Bibliography


Legend

Figure 1. Technetium Scintigraphy reveals increased uptake about the implant of the left knee consistent with implant loosening or infection.

Figure 2. Radiograph demonstrates osteolytic lesion of medial femoral condyle.

Figure 3. CT Scan demonstrates large lytic lesion in this fixed bearing PFC posterior cruciate retaining implant.

Figure 4. Polyethylene failure of this oxidized rotating platform insert.

Figure 5. Polyethylene impingement from the sharp lip of this custom posterior stabilized rotating platform tibial insert.

Figure 6. a.) Anterior/posterior radiograph will demonstrate implant loosening; b.) Rotating platform “spinout”.

Figure 7. Lateral patellar subluxation with this LCS rotating platform TKA.

Figure 8. Patellar metal backed failure of polyethylene.