High Tibial Osteotomy for the Treatment of Unicompartmental Arthritis of the Knee

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High tibial osteotomy has to be considered a valuable option in the surgical management of knee osteoarthritis. Localized wear in the knee corresponds to a malalignment that is either causative of or contributory to the arthritis. For many years, the value of osteotomy to correct malalignment has followed the principle of transferring load to the unaffected compartment of the knee to relieve symptoms and slow disease progression, and has been used extensively, with techniques becoming more refined over time [1]. In addition, despite good long-term results with total knee arthroplasty, there remains a significant concern regarding the longevity of these prostheses, particularly in younger patients. In contrast, osteotomy provides an alternative that preserves the knee joint and, when appropriately performed, should not compromise later arthroplasty if it becomes necessary. The reported results of high tibial osteotomy vary considerably across the literature, but the procedure generally provides good relief of pain and restoration of function in approximately 80% to 90% of patients at 5 years, and 50% to 65% at 10 years [2–7]. In the analysis of these results, most authors have found that success is directly related to achieving optimal alignment [3,6,8]. Accurate preoperative assessment and technical precision are therefore essential to achieving satisfactory outcomes. Many techniques have been described for proximal tibial osteotomies. This article discusses the various options available for alignment correction in the treatment of osteoarthritis using proximal tibial osteotomy and outlines the appropriate indications and technique.

Patient selection

A patient is typically a candidate for high tibial osteotomy when the orthopedic surgeon can clinically detect a varus standing alignment associated with (1) medial compartment arthrosis in a stable knee (classical indication); (2) medial compartment arthrosis with associated ligament deficiency and instability (such as anterior cruciate ligament [ACL], posterior cruciate ligament, posterolateral corner, or combined ligament deficiencies); or (3) painful medial knee compartment with associated medial meniscus deficiency, articular cartilage defects requiring resurfacing, or osteochondritis dissecans lesions.

These conditions often require high tibial osteotomy to unload the affected compartment in either a combined or staged procedure.

Indications in the unicompartmental osteoarthritis of the older active patient

High tibial osteotomy is appropriated for young, active patients who have primary degenerative arthritis involving a single compartment in a malaligned limb. Patient selection is more difficult with older patients. In the United States, osteotomies have substantially decreased in the past 2 decades [9]. Over the age of 60 years, knee replacements are typically offered. Considering the success of arthroplasty in
this age group, osteotomy is frequently proposed as an alternative to joint replacement [10]. The motivation of the patient is crucial. Patients who have high physical demand are usually willing to find a solution that will not dramatically decrease the activity level. Nevertheless, the patient should be aware that the pain relief may not be complete and everlasting. At physical examination, patients should have a complete range of motion, a stable knee, and asymptomatic lateral and patellofemoral compartments. Contraindications that may be considered relative for a younger patient become absolute in older patients. The authors believe that high tibial osteotomy is still a valuable option in medial unicompartmental arthritis in a strongly motivated older patient when osteoarthritis is associated with a varus deformity of the knee.

Preoperative assessment

Clinical assessment

To achieve success with proximal tibial osteotomy, the selection of the appropriate patient is crucial. A thorough clinical assessment requires a detailed history and physical examination followed by appropriate imaging. Specific analysis of this information will help determine whether or not a patient is likely to benefit from osteotomy. Important aspects of a patient’s general history include age, occupation, activity level, and medical and surgical history. Particularly significant are the patient’s expectations of postoperative activity. Questions specific to the knee include previous injury and surgery, and effectiveness of previous treatment. The patient may have noticed an increasing deformity or a static long-term malalignment. Pain history should focus on the site, severity, and aggravating and relieving factors. History of locking, catching, or instability may point to a mechanical source of symptoms, and the specific details of each of these symptoms should be sought to determine if other procedures, such as arthroscopy, may be beneficial as an adjunct to osteotomy.

Physical examination should commence with an overall impression of the patient’s health and build. Lower limb alignment should be assessed at each level and the gait should be observed for any abnormalities, particularly a thrust in the direction of the deformity, indicating a significant dynamic component. Presence of deformity in all of three planes should be assessed, particularly rotational deformity because this is more difficult to assess later radiographically. Whether or not a deformity is fixed or correctable should be determined. Patellar tracking and the presence of crepitus are noted. Presence of an effusion is assessed and location of tenderness should be recorded carefully. Range of motion is measured, particularly looking for the presence of a flexion contracture and the amount of flexion comfortably achieved. Ligaments are examined, including sagittal plane laxity and the presence of coronal plane pseudo-laxity, indicating loss of effective joint space. Reproduction of clicking symptoms and pain with McMurray’s test may indicate a meniscal tear. Grinding of medial and lateral compartments through the midflexion range may reproduce symptoms from the diseased compartment, and also roughly mimic the effect of an osteotomy by loading the unaffected compartment. Adjacent joints are examined, and assessment of neurovascular function is essential.

Radiographic assessment

Knee radiographs are an essential component of preoperative assessment. The standard assessment at the authors’ institution includes four short films and one full leg alignment film. The four short films are bilateral anteroposterior weight-bearing radiographs taken at full extension, bilateral posteroanterior weight-bearing radiographs at 45° of flexion, and lateral and skyline films of the affected leg. Full-length alignment films can be single-leg standing, double-leg standing, or supine, and the various advantages of each have been cited by several investigators [11,12]. Whichever is used, it is critical to be aware of the implications of each view. Supine views may underestimate the correction required for the weight-bearing situation, and single-leg films may overestimate correction because of the component of soft tissue laxity not requiring a bony correction. Unfortunately, at this stage there is not a general agreement on the most accurate method of radiographic assessment. It is the authors’ practice to obtain single-leg standing films from hips to ankles and to assess the joint congruency angle as an indication of the component of deformity because of soft tissue laxity. The lateral laxity can then be taken into account when calculating the desired correction [11]. Several measurements are taken from these films to help with preoperative planning. Most important are the axis of weight-bearing, the joint-congruency angle, and the individual articular angles of tibia and femur to assess the site of the deformity. The axis of weight-bearing is a straight line drawn from the center of the hip to the center of the ankle,
showing where the weight passes through the knee joint. Mechanical and anatomic axes of the knee are also measured. The congruency angle between tibial and femoral articular surfaces is recorded, and the angle between these surfaces and the axes of the respective shafts gives an indication of degree of deformity in tibia and femur. Lateral radiographs are assessed for sagittal plane deformity, including measurement of tibial slope.

Calculations of corrections

Several methods have been described for measuring the required correction on preoperative radiographs [11,13,14]. The general principle is to determine the desired postoperative location of the weight-bearing line and thereby calculate the angular correction necessary to achieve this.

Principles of varus knee correction

The varus knee with medial compartment osteoarthritis is certainly the most common scenario for which osteotomy has been used. As Coventry [13] advocated, the results of high tibial osteotomy in this scenario have been best when the anatomical axis is corrected to 8° to 10° of valgus [3]. However, too much overcorrection may yield poor results, particularly in ligamentously lax individuals, in whom minimal bony overcorrection may lead to a significant clinical deformity. Other researchers have examined this in relation to the site of the weight-bearing line, with best results seen when this passes through the lateral plateau at 62% to 66% of the width of the plateau [11]. Preoperative assessment has therefore aimed to achieve this outcome. The traditional method is to measure the preoperative mechanical and anatomic axes and calculate the angular correction necessary to produce 2° to 4° of mechanical or 8° to 10° of anatomic valgus. Dugdale and colleagues [11] and Miniaci and colleagues [14] described more recent methods. These methods determine the angular correction necessary to place the postoperative weight-bearing line at 62% to 66% of the width of the tibial plateau [11]. Preoperative assessment has therefore aimed to achieve this outcome. The traditional method is to measure the preoperative mechanical and anatomic axes and calculate the angular correction necessary to produce 2° to 4° of mechanical or 8° to 10° of anatomic valgus. Dugdale and colleagues [11] and Miniaci and colleagues [14] described more recent methods. These methods determine the angular correction necessary to place the postoperative weight-bearing line at 62% to 66% of the width of the tibial plateau. The current technique used at the authors’ institution is that of Dugdale and colleagues [11], calculating the correction to 62.5% of the tibial plateau width, which equates to 3° to 5° of mechanical valgus. Excess deformity from soft tissue laxity is accounted for by subtracting the increase in congruency angle when compared with the unaffected leg on the double-leg standing film, or a non–weight-bearing film of the affected leg. By measuring the width of the tibia at the level of the proposed osteotomy, the surgeon can convert the angular correction into a wedge size, particularly for opening wedge osteotomies.

Surgical techniques

Medial opening wedge osteotomy

Medial opening wedge osteotomy has not been as widely reported in the English-speaking literature as the closing wedge technique, but has been extensively used in Europe and is now enjoying increased popularity in North America [15,16]. The theoretical advantages of opening wedge over closing wedge include (1) restoration of anatomy with addition of bone to the diseased medial side; (2) the ability to achieve predictable correction in coronal and sagittal planes; (3) the ability to adjust correction intraoperatively; (4) the requirement for only one bone cut; (5) avoidance of proximal tibiofibular joint disruption and invasion of the lateral compartment; and (6) the relative ease of combining with other procedures such as ACL reconstruction.

The disadvantages of this procedure include the creation of a defect that requires bone graft with attendant harvest morbidity, a theoretical higher risk for nonunion, and a longer period of restricted weight-bearing postoperatively. Medial opening wedge osteotomy has been the preferred technique in the authors’ institution for these reasons.

Graft choices include autograft, allograft, or pre-prepared bone substitutes. Each option has its own advantages and disadvantages, and although iliac crest autograft probably remains the current gold standard, it has recently been the authors’ practice to use femoral head allograft. Using femoral head allograft avoids donor site morbidity and decreases surgical time. This method seems to result in predictable union, but it obviously requires a readily available bone bank facility.

The surgery is performed with the patient supine on the operating table. A radiolucent table is used with a leg extension applied to allow fluoroscopic visualization of hip, knee, and ankle joints for alignment assessment intraoperatively. A tourniquet is placed around the thigh and the involved limb is prepared and draped free. If iliac crest bone autograft is to be used, the ipsilateral crest is also prepared and draped. The surgeon stands with the instruments on the opposite side of the operating table to the
operative leg, allowing direct access to the medial side of the leg. This positioning also allows the fluoroscopy arm to come in from the operative side.

A skin marker is used to identify the medial joint line, the tibial tubercle and patellar tendon, and the posteromedial border of the tibia. The leg is elevated and the pneumatic tourniquet inflated. A 5-cm longitudinal incision is created, extending from 1 cm below the medial joint line midway between the medial border of the tibia and the posteromedial border of the tibia. The sartorius fascia is exposed by sharp dissection. The superior border of the sartorius fascia is identified, and the pes is then retracted distally with a blunt retractor, exposing the superficial fibers of the medial collateral ligament. The anterior border of the medial ligament is identified and this is raised with a scalpel and periosteal elevator. A blunt Hohmann retractor is then passed deep to the medial ligament, around the posteromedial corner of the proximal tibia, and along the posterior cortex of the tibia to protect the posterior neurovascular structures. The medial border of the patellar tendon is next identified. A short longitudinal incision is made to allow a second blunt lever to be placed deep to the patellar tendon just proximal to the tubercle and retract it laterally. The medial insertion of the tendon is released for a few millimeters to allow clear identification of the anterosuperior corner of the tubercle. The residual retinaculum and periosteum between these anterior and posterior retractors is then elevated toward the joint line, creating a proximally based flap. Elevation of this flap gives a subperiosteal exposure of the tibia from the tibial tubercle around to its posteromedial corner. A guidewire is then inserted along the line of the proposed osteotomy. Accurate positioning of this guidewire is critical to the success of the operation. The two points of the superomedial corner of the tibial tubercle and the tip of the head of the fibula laterally are identified. The guidewire starting point on the anteromedial tibia is the direct continuation of a straight line between these two points, which usually gives a start point on the medial tibia approximately 3 to 4 cm distal to the medial joint line. Guidewire obliquity can be altered somewhat depending on the size of the tibia and the required size of correction (a more oblique osteotomy will allow for only a small angle of correction). Fixation failure and intra-articular fracture are more likely with increased obliquity of the osteotomy [17]. The guidewire should be placed about 2 mm proximal and parallel to the proposed osteotomy, because the osteotomy is performed on the distal side of the guidewire. The obligatory requirements for wire position include osteotomy placed above the patellar tendon insertion; medial start position distal enough to allow sufficient bone for positioning of the fixation plate on the proximal fragment; osteotomy at least 1 cm distal to the tibial articular surface at its most proximal (lateral) extent; and osteotomy directed toward the upper end of the proximal tibiofibular articulation. The tibial osteotomy is performed immediately distal to the guide pin, the pin protecting against proximal migration of the osteotomy into the joint. The slope of the osteotomy in the sagittal plane is critical and should mimic the proximal tibial joint slope. The tendency to make the osteotomy perpendicular to the long axis of the tibia should be avoided because this will create a thin bony fragment posteriorly because of the natural posterior tibial slope of approximately 10°. The joint line can be palpated through the incision or marked with needles, and the line of the osteotomy should be equidistant from the medial joint line anteriorly and posteriorly to be parallel to the tibial slope. The authors mark the tibia along this line with a cautery device before performing the osteotomy. With the previously placed retractors protecting the soft tissues anteriorly and posteriorly, a small oscillating saw is used to cut the tibial cortex from the tibial tubercle around to the posteromedial corner under direct vision. Thin, flexible osteotomes are then used to advance the osteotomy laterally, systematically working from medial to lateral and anterior to posterior. The osteotomy should be taken to within 1 cm of the lateral tibial cortex, using intermittent fluoroscopy. As much as possible should be completed with the thin osteotomes, and this is completed using solid, broad but thin osteotomes. In the authors’ early experience with this technique, intra-articular fractures were caused by using thicker, traditional osteotomes. A useful technique to ensure completeness of the osteotomy is to place a broad osteotome centrally to open the osteotomy slightly, and then work with a long, thin osteotome along the anterior and posterior cortices. While performing the osteotomy, it is important to regularly check progress with a fluoroscope to ensure the appropriate depth and direction of the cut. Calibrated guide pins and osteotomes are also available and can help keep the requirement for fluoroscopy to a minimum. The mobility of the osteotomy is checked by gentle manipulation of the leg with a valgus force. Ensure the osteotomy opens slightly before proceeding with the wedge osteotomy. If the osteotomy seems incomplete, check again with a narrow flexible osteotome anteriorly and posteriorly. “Stacking osteotomes” can often be useful in encouraging mobility in the osteotomy. The Puddu tapered
osteotome is then engaged into the osteotomy, keeping the direction parallel to the osteotomy. This osteotome is calibrated to allow assessment of the size of the opening achieved in millimeters, and should be advanced slowly (roughly 5 mm/min) to allow gradual opening of the osteotomy. Fluoroscopy should be used to ensure progression of the instrument parallel to the osteotomy. Rapid advancement is likely to produce unwanted extension of the osteotomy proximally or laterally. Alignment should be checked intermittently. Once the calculated preoperative wedge size has been reached, a long alignment rod can be used as described earlier with fluoroscopy. With the rod centered over the hip and ankle joints, it should lie at 62% to 66% of the tibial width, usually at the lateral edge of the lateral tibial spine. The sagittal plane correction should also be assessed by looking carefully at the amount of opening of the osteotomy anteriorly and posteriorly. Because the tibia is a triangular bone-in cross-section with apex anterior, the size of the wedge anteriorly at the tubercle should be less than that at the posteromedial corner to avoid changing the tibial slope. If the gap is anteriorly equal to that at the posteromedial corner, the posterior slope of the tibia will be inadvertently increased. The sagittal alignment is also important, and the orientation of the tibial articular surface in this plane is another critical determinant of outcome. In cases of pure medial compartment osteoarthritis in a stable knee, the normal tibial slope should be preserved using the method described previously and intraoperative fluoroscopy. The sagittal slope can be deliberately altered in instability patterns to decrease tibial translations and assist with knee stability [18]. A decreased posterior tibial slope will decrease anterior tibial translation in the presence of ACL deficiency. This decrease may be important to address in medial compartment arthritis subsequent to chronic ACL deficiency, and in anterior instability patterns with associated varus deformity. Conversely, in the posterior cruciate–deficient knee, increasing the posterior cruciate–deficient slope, increasing the anterior tibial translation can be beneficial by increasing anterior tibial translation.

The slope can be adjusted by the type of plate used and its positioning. Plates are available in symmetrical rectangular or tapered shapes. Positioning a symmetrical plate anteromedially will increase the slope; using a tapered plate directly medially should have no effect on slope; and positioning a tapered plate posteromedially should decrease tibial slope. Once the desired correction has been achieved and plate positioning determined, the insertion handle from the Puddu osteotome is removed, leaving the tines in situ. The plate is placed between these tines, which can then be removed. The plate is fixed with two partially threaded 6.5-mm cancellous screws proximally and two 4.5-mm fully threaded screws distally. Fluoroscopic guidance should be used for the proximal screws to avoid penetration into either the joint or the osteotomy. The defect is then grafted using the preferred bone graft as discussed earlier. It has been the authors’ practice in defects of 7.5 mm or less to use only cancellous chips, and in defects of 10 mm or greater to use cancellous chips in the lateral aspect of the defect and two corticocancellous wedges medially: one anterior and one posterior to the plate. Final fluoroscopic assessment ensures adequate position of the osteotomy and hardware and complete filling of the defect with bone graft. The wound is irrigated and a suction drain placed against bone posteromedially. Closure is completed in layers and dry dressing applied to the wounds.

A standard postoperative regimen is followed that is somewhat more restricted than that for the closing wedge procedure. For the first 6 weeks, the knee is placed in a range of motion brace set at 0° to 90°, and the patient is encouraged to achieve this range, particularly full extension. During this period, the patient remains touch weight-bearing using crutches. From week 6 to 12 the brace is discontinued and weight-bearing is progressed gradually to full weight-bearing over the 6-week period. From 3 to 6 months postoperatively, the patient is encouraged to progress activities as tolerated. Short radiographs are taken at 6 and 12 weeks to ensure maintenance of position and healing, and long-leg alignment films are performed at 6 months to assess the correction achieved.

**Lateral closing wedge osteotomy**

The most commonly reported osteotomy for medial compartment osteoarthritis is the lateral closing wedge osteotomy, popularized by Coventry [1] and Insall and colleagues [19]. The goal is correction of alignment as outlined earlier, achieved by removing a laterally based wedge of bone and closing the resultant defect. Many variations of technique have been described for this procedure [1,2,11,19], with the general principle the same in all. Traditionally, an angular calculation is converted to a wedge size based on the tibial width, although newer instrument systems provide angled cutting jigs, obviating this conversion. It is important when calculating a wedge size not to use the traditional rule of 1° equating to 1 mm, because this will lead to an undercorrection in virtually every tibia.

Knee arthroscopy may be required before beginning the osteotomy to treat mechanical symptoms.
This procedure is performed on the basis of a preoperative assessment, suggesting an intra-articular source of mechanical symptoms. The authors do not routinely perform arthroscopy to assess the lateral and patellofemoral compartments, or if symptoms such as pain and swelling are attributable to the arthritis rather than arthroscopically treatable pathologic conditions such as unstable meniscal tears or loose bodies.

The authors use the L-shaped skin incision, with the vertical limb along the lateral edge of the tibial tubercle and the horizontal limb parallel and 1 cm distal to the lateral joint line, taken posteriorly to the anterior aspect of the fibular head. Dissection is performed to expose the fascia of the anterior compartment, which is incised along the anterolateral crest of the tibia, leaving a 5-mm cuff for later closure. A Cobb elevator is used to elevate the muscle from the anterolateral surface of the tibia, and the iliotibial tract is elevated from Gerdy’s tubercle proximally, inserting a stay suture for retraction and later closure. The common peroneal nerve is not routinely exposed but is palpated and protected throughout the procedure. Treatment of the proximal tibiofibular joint also has many described techniques, including joint excision or disruption, fibular osteotomy, or excision of the fibular head. The authors prefer to disrupt the joint but preserve the fibular head. The proximal tibiofibular joint is exposed, the anterior capsule incised, and a curved osteotome is directed posteromedially to disrupt this articulation and mobilize the fibula so as not to impede later correction. A Z-shaped retractor is placed through this joint along the posterior aspect of the tibia to protect posterior soft tissues. It is critical that this retractor be placed directly against bone along the posterior cortex to protect the neurovascular structures [20,21]. The lateral edge of the patellar tendon is identified, and a second Z retractor placed underneath it to protect it during the osteotomy. In this way, the proximal tibia is exposed from tibial tubercle to the posterolateral cortex and is therefore prepared for the osteotomy. In removing a laterally based wedge, either an angular cutting guide can be used or a specific-size wedge can be removed. The authors’ preferred technique is to remove the outer cortex and large portion of the wedge with saw cuts, then remove the medial half using a combination of curettes, rongeurs, and osteotomes before closing the osteotomy. Otherwise, there is a significant risk for intra-articular fracture. In performing these cuts, it is important to check the position of anterior and posterior retractors to ensure soft tissue protection and to cut the anterior and posterior cortices fully, to within 1 cm of the medial cortex. The fluoroscope can be used to assist with assessment of completeness of wedge removal. Once closed, position and alignment are checked with the fluoroscope and fixation then completed. Fixation is usually completed with two stepped staples or alternatively an Association for the Study of Internal Fixation (ASIF) L- or T-shaped plate. Wound closure is then completed as described earlier. A drain is placed against bone and closure is completed in layers. Fascial closure is interrupted and should attempt to cover the plate as much as is possible without undue tension.

Postoperative management involves use of a hinged brace for 6 weeks, with partial weight-bearing using crutches during this time. Radiographs are taken at the 6-week mark, and if early healing of the osteotomy is evident, the brace is discontinued and the patient progressed to weight-bearing as tolerated. A second radiograph is performed at the 3-month mark. If the osteotomy is united, activity level can be increased as tolerated. A long-leg alignment film is taken at the 6-month mark to assess the accuracy of the correction.

Dome osteotomy

The dome osteotomy was originally popularized by Maquet [22] and has been advocated by some authors for correction of large deformities [22–24]. The main advantage of this procedure is that it allows essentially unrestricted correction in contrast to the more commonly used techniques. The position of the tibial tubercle in relation to the joint line is unaffected, and Maquet actually advocated anterior displacement of the tubercle through the osteotomy. Use of an external fixator allows postoperative adjustment of alignment, which may be an advantage especially in larger corrections, although the risk for possible pin tract infection and the cumbersome nature of the treatment for patients is a potential disadvantage.

Achieving a gradual correction with an external fixator

Use of an external fixator to achieve a gradual correction has several potential advantages over a single-stage correction, with many authors reporting good results with this technique [16,25–27]. First, large corrections may be technically impossible with standard closing or opening wedge techniques, either because of excessive bone removal compromising
fixation and creating deformity in the closed wedge technique or excessive soft tissue tension in the opening wedge technique. External fixators also allow constant manipulation of the alignment during the healing process to optimize alignment [16]. This constant manipulation is an especially attractive feature for larger deformities in which major bony deformity combined with soft tissue laxity can make prediction of a single-stage correction difficult. Circular external fixators also allow easy manipulation of angular and translational correction in all three planes as necessary [25].

These advantages are balanced by the significant drawbacks of possible pin site infection [26–28], which if not successfully treated can lead to deeper infection and compromise later surgery, particularly arthroplasty. The treatment is also a significant ordeal for the patient, who needs to be compliant with treatment and prepared for alterations in lifestyle during the treatment period. Selection of the most appropriate patient for this technique is probably the most important factor in the success of the procedure.

It has recently been the authors’ practice to use a circular hybrid external fixator for the correction of deformities that are technically beyond the standard medial opening wedge procedure. In addition, in these larger deformities it is not possible to accurately predict the appropriate single-stage correction. The specific device the authors use is a hybrid ring fixator that has six obliquely oriented struts initially set to match the patient’s deformity, and then gradually adjusted to bring the rings parallel. Computer software (Taylor Spatial Frame; Smith and Nephew, Memphis, Tennessee) allows input of deformity parameters from preoperative radiographs and subsequently calculates initial strut settings and a correction rate set by the surgeon based on specific soft tissue structures at risk. These calculations allow preoperative construction of the frame. It is essential to schedule a preoperative appointment with the patient to show and size the frame and to explain the procedure and postoperative schedule. Ring circumference should allow for two fingerbreadths of clearance from soft tissue circumferentially.

The construct the authors use is a single ring attached to the proximal fragment and two parallel rings attached to the distal fragment, which provides a stable construct.

The procedure is performed with the patient supine on a radiolucent table. A computer in the operating room allows adjustments in the parameters that may prove necessary during the course of frame application. A tourniquet is not necessary, and the leg is draped free. Bolsters are placed under the thigh and foot, allowing for circumferential access to the tibia from knee to ankle. The frame is sized and constructed preoperatively, and is checked once more to ensure appropriate fit on the patient’s leg. A fine wire is passed from lateral to medial parallel to the joint surface, at least 10 mm distal to the joint to minimize the risk for intrasynovial penetration with possible infection. The frame is applied to this wire and, using the undersurface of the frame as a template, a second fine wire is passed, taking care to keep the frame parallel to the joint surface in coronal and sagittal planes. The frame is then secured distally using a fine wire across the distal ring. The construct is then completed by adding two 5-mm half-pins to each ring. It is important to use the subcutaneous surface of the tibia as much as possible and avoid penetration of anterior compartment musculature. The proximal ring fixation should be at the level of or proximal to the tibial tubercle.

The osteotomy is then performed percutaneously at the lower border of the tibial tubercle through two small incisions using a Gigli saw subperiosteally. The two anterior struts are disconnected from the middle ring and deflected to facilitate performing the osteotomy. Wounds are closed and pin sites dressed, and the osteotomy is left static for 10 days, after which the correction is then performed gradually by the patient at home, usually over a 7- to 14-day period, depending on the degree of deformity. Range of motion as tolerated is allowed immediately, and touch weight-bearing is performed for the first 10 days while pin site wounds heal. Thereafter, partial weight-bearing with crutches is allowed. At the end of the initial correction, a long standing weight-bearing film is taken, parameters are re-entered into the computer software, and any necessary residual correction can be performed until optimal alignment is achieved. The frame is removed after healing is confirmed radiologically and clinically.

**Summary**

Proximal tibial osteotomy can be used to correct varus and valgus deformities in the management of isolated medial or lateral compartment osteoarthritis.

Several surgical techniques have been described for achieving this goal, and the relative merits of each have been outlined. Whatever the technique used, the selection of the appropriate patient and the attainment of a precise correction without complications are critical to the success of the procedure. If these goals are met, proximal tibial osteotomy should provide long-term relief of pain and restoration of function.
in patients who have localized knee osteoarthritis even in carefully selected, highly motivated, older active patients.

References