Evaluation and Management of Unicompartmental Osteoarthritis
Role of Arthroscopy in Upper Tibial Osteotomy

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ABSTRACT: The evaluation of the patient with unicompartmental osteoarthritis of the knee and the appropriate management remain controversial. Although arthroscopy has not been shown to improve the accuracy of patient selection, it is useful in the management of associated intraarticular lesions and can be used for an intraarticular debridement procedure. Only long-term results of a prospective study will define if additional benefits over osteotomy alone are obtained by the addition of an intraarticular debridement.

Unicompartmental osteoarthritis of the knee is a frequent problem confronting the orthopedist (Fig. 1A). The decision regarding the appropriate management and the extent of evaluation preoperatively as well as intraoperatively can be difficult. A thorough knowledge of the biomechanics of the knee, the correlation between the alignment and force transmission across the knee, the frequency of intraarticular lesions, the potential for cartilage healing, and the clinical stability of the knee all must be considered in the decision-making process. The adjunctive use of debridement procedures for the knee at the time of osteotomy has remained controversial.1,2 The objective of the current review is to define the rationale behind the techniques available for the evaluation and management of the knee with unicompartmental osteoarthritis.

Biomechanical Considerations

The rationale behind osteotomy of the tibia to correct varus or valgus deformity is to decrease the load on the affected compartment. The technique was first reported by Jackson and Waugh in 1960.3 Morrison4 reported that the load across the knee may be as much as four times body weight during normal ambulation. The normal axial alignment of the knee on standing roentgenograms is between 5° and 9° of valgus.5

Full-length standing roentgenograms of the entire lower extremity are essential for obtaining an accurate view of the mechanical axis. This reflects the true load being applied across the knee and is defined by a line drawn from the center of the femoral head to the center of the ankle. This line should cross the center of the knee joint during weight-bearing (Fig. 1B). Small changes in the angle between the articular surface of the knee and the femoral axis can result in large changes in the position of the line of body weight relative to the knee.5 A variation of as little as 4° in either of these angles can move the mechanical axis from its optimal central position to the lateral third of the joint.5 A variation of 10° can place the mechanical axis beyond the articular surface of the knee, resulting in the severe loading of a single compartment.5 The greater the deviation of the mechanical axis, the greater the increase in muscle tension required to prevent subluxation of the knee with a resultant increase in force across the knee joint.

A dynamic gait analysis of the axial alignment and the resultant force transmission across the knee have been reported.6 For a normal valgus angulation of the knee, the load is primarily in the medial compartment.6 With a varus deformity, the load on the medial tibial plateau can be as high as 100% of the total load across the joint.6 This load occurs at a varus deformity of 4°. The use of static analysis based solely on the roentgenographic alignment would predict a load of 100% on the lateral compartment at 15° of valgus angulation.6 However, dynamic gait analysis in 28 cases revealed that, in spite of a varus alignment of the knee, the load remained medial in 71%.6 The reason for this deviation is that, in dynamic analysis, the horizontal component to the floor reaction force is medially directed, and this increases the load across the

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Fig. 1: A 49-year-old man with medial compartment osteoarthritis. A) Preoperative roentgenogram showing large, loose body. B) Postoperative roentgenogram after upper tibial osteotomy, with correction of the mechanical axis and removal of loose body arthroscopically. C) $^{99m}$Tc bone scan revealing bicompartamental disease on the left and medial compartmental disease on the right.

Fig. 2: Arthroscopic appearance of medial compartment, showing exposed subchondral bone. There is punctate bleeding from areas of abrasion arthroplasty.
medial compartment; this does not happen in static analysis.\textsuperscript{6} Therefore, clinical analysis of the roentgenograms is inadequate for determining joint load transmission.

A similar study of dynamic loading of the knee showed that the center of pressure varies throughout the stance phase of the gait cycle and is not directly related to the magnitude of the angulation of the joint.\textsuperscript{7} Peak loads occur, corresponding to contractions of the hamstring, quadriceps, and gastrocnemius muscles.\textsuperscript{7} An additional consideration is the inclination of the tibial joint line in the coronal plane. The magnitude of the abducting-adducting moments depends on the inclination of the tibia in the coronal plane, and the magnitude is not directly related to the femorotibial alignment.\textsuperscript{7} Therefore, the axial alignment of the knee is not strictly related to loading. However, in the knee with varus deformity, most of the load is medial, whereas in the knee with valgus deformity, the loading pattern cannot be easily predicted.\textsuperscript{6}

In spite of these biomechanical studies, the best results after upper tibial valgus osteotomy for varus deformity have been achieved when the tibiofemoral angle has been corrected to 5° of valgus (Fig. 1).\textsuperscript{8} The success of upper tibial osteotomy correlates with an increase in stance phase flexion, which decreases both the force across the joint and the medial plateau force. A long-term success rate of 60% after upper tibial osteotomy in patients with one to 16 years of followup has been reported, and this rate correlated with a correction of between 7° and 9° of valgus and the opening of the medial joint space.\textsuperscript{9}

**Evaluation**

Preoperative clinical evaluation should include an evaluation of the stability of the joint and the plane of the joint line. Instability should be evaluated in both a nonweight-bearing and a weight-bearing position. A lateral thrust to the gait of the patient with a varus deformity while ambulating is indicative of instability and is a relative contraindication to osteotomy.\textsuperscript{1} However, success has been achieved in 32 of 41 patients treated by osteotomy in spite of subluxation of the joint line or extensive varus deformity of greater than 15°.\textsuperscript{10}

Additional techniques of evaluation of the knee, besides clinical examination and routine roentgenograms, have included the use of bone-scanning agents.\textsuperscript{1} The results of bone scan often correlate with areas of sclerosis on the roentgenogram and with an increased load. This technique is helpful in evaluating the difficult patient to determine whether unicompartmental or bicompartmental disease exists (Fig. 1C).

The importance of evaluation and management of intraarticular disease, such as loose bodies and meniscal tears, at the time of upper tibial osteotomy has remained controversial. Coventry\textsuperscript{1} has stated that degenerative tears of the meniscus are not important and once the knee is corrected to an appropriate alignment the load on the degenerative meniscus will be relieved. Coventry believes that intraarticular surgery should not be combined with osteotomy because stiffness may result. However, other authors have achieved improved results with a combination of osteotomy and joint debridement, having achieved satisfactory results in approximately 82% of patients after 13 years of followup.\textsuperscript{2} Morbidity has been no greater with combined debridement and osteotomy than with primary osteotomy alone.

**Role of Arthroscopy**

The role of arthroscopy in the management and evaluation of the patient with osteoarthritis in the knee has remained controversial. Coventry believes that arthroscopy is rarely indicated in the management of the patient with osteoarthritis.\textsuperscript{1,9} However, the identification of an area of denuded bone in the lateral compartment is a contraindication to osteotomy.\textsuperscript{1} A torn lateral meniscus also is a contraindication to valgus osteotomy and should be corrected first.\textsuperscript{1}

A recent report has suggested that arthroscopy was not helpful in the preoperative planning of upper tibial osteotomy in patients followed up for two to three years postoperatively.\textsuperscript{11} Short-term results have been reported to be satisfactory even in the presence of exposed bone in the lateral compartment.\textsuperscript{11} The results correlate more with the correction by osteotomy of the alignment to 13° of valgus than with the extent of articular cartilage degeneration and the number of compartments involved.\textsuperscript{11} We have found degenerative tears of the medial meniscus or loose bodies (or both tears and loose bodies) in approximately one third of the knees in which arthroscopy was performed before upper tibial osteotomy. These are the same types of lesions that cause symptoms in patients who do not undergo osteotomy. Treatment of these lesions may make a knee predictable and less symptomatic in the patient in whom osteotomy is not performed. Arthroscopy allows the additional possibility of drilling the exposed areas of bone or abrading the areas of exposed bone at the time of osteotomy (Johnson LL: Unpublished data) (Fig. 2).

The concept of knee debridement being performed during arthroscopy is simply a modification of the technique of Priddle and Magnuson.\textsuperscript{12,13} Whether the addition of arthroscopic intraarticular debridement will
improve long-term results over those after osteotomy alone, but with less morbidity than arthroscopy and debridement, remains to be determined. We believe that debridement, whether open or arthroscopic (without correction of malalignment), as has recently been reported, is not adequate. If arthroscopic debridement is performed in conjunction with osteotomy, early motion or continuous passive motion should be utilized to encourage fibrocartilaginous ingrowth. A cast brace combined with staple fixation allows early motion (Fig. 3).

**Conclusion**

Arthroscopic evaluation at the time of osteotomy is a useful adjunctive technique for defining and treating such intraarticular conditions as meniscus tears or loose
bodies. The addition of an extensive debridement procedure to osteotomy is feasible. Only a long-term prospective study will define which patients are likely to benefit from the addition of the debridement procedure to the osteotomy. Currently, arthroscopy cannot be utilized to define which patients are suitable candidates for osteotomy. Arthroscopy should be viewed as an adjunctive technique to roentgenography, clinical examination, and bone scanning and is primarily valuable in the management of associated meniscal lesions or loose bodies.

References


