

HIGH TIBIAL OSTEOTOMY IN TREATMENT MEDIAL COMPARTMENT KNEE OSTEOARTHRITIS

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Abstract

Osteoarthritis (OA) of the medial compartment, where the lateral compartment and patella-femoral joint are relatively spared, is a common orthopaedic presentation. Most frequently, the treatment of choice would be a total knee replacement, which involves removing healthy joint surfaces in such patients. Arthroscopic debridement in the osteoarthritic knee has fallen out of favour due to poor clinical results. High tibial osteotomy (HTO) is the workhorse surgical procedure for treating medial knee OA. When performed precisely in the hands of an experienced surgeon, HTO can delay or avoid knee arthroplasty. Of course, the outcomes of knee arthroplasty are at best unpredictable in patients of younger age. Hence, there is a growing need for joint preservation procedures for younger patients presenting with knee OA, of which HTO is one.

Keywords: High tibial osteotomy, Medial compartment knee osteoarthritis.

1. Introduction

Many patients present to orthopaedic surgeons with a painful knee attributed to osteoarthritis of the medial compartment, where the lateral compartment and patella-femoral joint are relatively spared. Traditionally, the treatment of choice would be a total knee arthroplasty; however, this involves removing healthy joint surfaces. Arthroscopic debridement in the osteoarthritic knee has fallen out of favour due to poor clinical results [1]. High tibial osteotomy is another option for patients with isolated medial compartment osteoarthritis. The aim of the procedure is to alter the mechanical axis of the lower limb to offload the arthritic medial compartment and relatively increase the load on the unaffected lateral compartment, thereby reducing pain and improving function. Researchers have hypothesized that this may lead to cartilage regeneration in the affected medial compartment. High tibial osteotomy

can be performed by a medial opening wedge osteotomy, or lateral closing wedge osteotomy, in cases of the varus mal-aligned knee [2].

2. High Tibial Osteotomy

2.1. Indication

The main indication for high tibial osteotomy (HTO) is the correction of varus malalignment in medial compartment OA of the knee [3]. The leading intent of HTO is to shift the mechanical axis of a varus malaligned knee to a slightly valgus axis in order to reduce pain, slow down the degenerative process and avoid or delay the joint replacement. The effectiveness of the procedure is strongly related to the correct patient selection. So that the patient characteristics that support a strong indication for HTO include clinical and radiological varus and medial compartment arthritis [3].

2.2. The value of arthroscopy before performing HTO

Many authors stated that the usefulness of the arthroscope has been firmly established for diagnosis, grading, and treatment (arthroscopic debridement and osteoplasty) of osteoarthritic involvement of the cartilaginous surfaces of contra-lateral compartment and of the patellafemoral joint. The amount of involvement influences the decision of an osteotomy versus a total knee replacement. Direct visualization is far more reliable than any x-ray film [4].

If insufficient cartilage remains in the lateral compartment, the patient should not be considered as a candidate for high tibial valgus osteotomy [4].

2.3. Technique of open wedge high tibial osteotomy

The surgical procedure is done with the patients in dorsal decubitus. Before osteotomy, arthroscopy of the knee should be performed to treat the joint lesions: meniscus, cartilage and removal of loose bodies. Opening wedge osteotomy is done with the aid of fluoroscopy. First, longitudinal incision is made in the proximal and medial third of the tibia. This is followed by dissection of the pes anserinus and superficial medial collateral ligament [5]. Two 2.4-mm Kirschner guidewire was placed in the medial cortex of the tibia at the metaphysealdiaphyseal transition zone aimed toward the tip of the fibular head in a proximal and lateral direction taking care to pass over the anterior tuberosity of the tibia [6]. After confirming that the wires are in the correct position, the bone is cut, leaving the lateral cortical intact. The wedge opening calculated in the pre-operative planning is then performed. The alignment obtained can be checked during the surgery, with the navigation system or by means of a metallic guide that enables the axis of weight bearing of the knee to be verified, through fluoroscopy. For the fixation of osteotomy, there is variety of plates available that provide stabilization. These differ in terms of design, use of wedge and angular blocking system [5]. OWHTO creates a gap in the metaphysis of the tibia. To enhance bone healing and increase initial mechanical stability, a high degree OWHTO may require the application of bone graft or substitute to fill the osteotomy gap. Autologous bone graft is the “gold standard” to fill the bone defect. In the meantime, good short-term results of OWHTO without additional bone substitutes for filling the osteotomy gap were reported [7].

2.4. Plates used to secure osteotomy

To maintain the stability of the OWHTO, specialized implants were introduced. The two most commonly described are the Tomofix and Puddu plates [8]. Different fixation techniques have been described to prevent a possible loss of correction and incomplete osseous consolidation for the opening wedge HTO. Plates with a metallic chock interposed in the osteotomy plane and plates with angle stable screws are two common methods used to prevent gap closure of proximal tibial osteotomies [9]. Puddu Plate, which is specially designed for open wedge high tibial osteotomy, are butterfly shaped with four holes for the tibia. It has a spacer which is available in many different sizes from 5 to 17 mm in thickness. The size of the spacer tooth increases about 1mm from the thinnest to the thickest [10]. The strength of the first generation Puddu Plate was found to be marginally sufficient to withstand the estimated axial load on the proximal tibia during gait. As a result, design modifications were performed such as a second screw in both the proximal and distal plate segment to improve torsional stability and an increased block depth to enlarge the force transmission area [9]. The two upper holes of the plate allow the introduction of AO 6.5 mm cancellous screws, while the lower holes of the plate are cut for the AO 4.5 mm cortical screws. Innovative new plates, forged into a special titanium alloy, are now available. Dedicated cortical and cancellous screws for the new plates, also of titanium alloy [10].



Figure (1) The tibia opening wedge osteotomy plate (Puddu plate) [9]

The TomoFix Plate is a medial high tibia osteotomy plate that incorporates the locking compression plate (LCP) technique. It functions as a locked internal fixator. This fixation system relies on locked screw heads with all six degrees of freedom restrained [10]. The locking-head screws provide a stable fixation

without compression between plate and bone. This helps to preserve the bone blood supply and the free gliding of the pes anserinus under the plate [11] and without the necessity of bone graft [12]. The locking screws completely eliminate any toggling of the screws within a conventional plate thus largely enhancing the stability of the osteosynthesis. In the case of fractures of the lateral cortex an additional lag screw can be applied through the plate. This screw induces compression on the lateral hinge point of the osteotomy and eliminates any potential distraction or instability in this area. Eight locked bolts are used in the Tomofix device, four proximal and four distal to the osteotomy. The plate is introduced into the incision and then pushed distally into a soft tissue tunnel until the long arm is lying on the tibial shaft. The proximal bolts are inserted through the wound. The distal bolts are placed percutaneously via an additional stab incision over the plate. Compression of the medial collateral ligament and the pes anserinus is avoided by special distance bolts [13].



Figure (2) Internal plate fixator (Tomofix). The T-shaped rigid titanium plate is equipped with angle stabilized locking bolts which can be positioned percutaneously and completely eliminate toggling of the bolts within the plate [13]

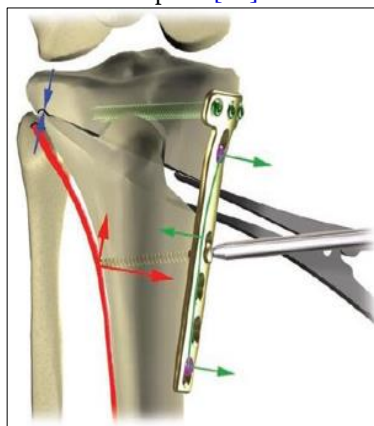


Figure (3) The plate is pretensioned by insertion of a temporary lag screw distal to the osteotomy. This manoeuvre induces compression on the lateral cortical hinge [13].

In case of an intact lateral cortical edge and good bone quality, patients with the TomoFix may be allowed of full weight bearing and with the Puddu Plate protected weight bearing of the operated leg, respectively. If the lateral cortical edge shows signs of fracture or displacement of the fragments, an additional lateral fixation is recommended for the Puddu Plate. Enough axial and torsional residual stability remains for the TomoFix Plate to allow careful partial weight bearing. Yet No consensus exists on the optimal fixation device [9].

3. Complications of High Tibial Osteotomy

3.1. Under correction

under correction is the most common cause of poor results with valgus HTO. There are two main reasons for under correction which are: **a)** failure to pre-operatively assess the severity of the deformity adequately which results in poor pre-operative planning, and **b)** failure to maintain the initial correction, which leads to progression of medial joint arthritis and patient dissatisfaction [14].

3.2. Delayed union or non-union

The incidence of nonunion after HTO has been reported to range from 0.7% to 4.4%. The risk factors for nonunion include large degrees of correction in HTO, smoking, and insufficient fixation [15].

3.3. Infection

High infection rates have been reported in association with osteotomy combined with joint debridement [16].

3.4. Internal fixation problems

Screws or plates can be applied improperly resulting in poor fixation, disrupting the congruity of the articular surface [15].

3.5. Intra-articular fracture

In open wedge HTO there is a risk of fracture of the proximal fragment extending into the tibial plateau, especially if a strong valgus force is applied [17].

3.6. Thromboembolic diseases

Most studies report rates of deep venous thrombosis of less than 3% [18].

3.7. Vascular injury

Posterior tibial neurovascular bundle injury is a rare complication of HTO. Pin or screw insertion for external or internal fixation of the tibia can produce vascular injury [18].

3.8. Peroneal nerve injury

The reported highest incidence of peroneal nerve injury occurs in closed wedge HTO technique but in open wedge HTO (OWHTO) the incidence is much less [18].

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