بسم الله الرحمن الرحيم

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بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

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Comparative Study Between Medial Opening Wedge High Tibial Osteotomy Using Puddu Plate With or Without Bone Graft "Systematic Review/Meta-Analysis"

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List of Abbreviations

Abb.	Full term
ACL	Anterior cruciate ligament
ANCOVA	Analysis of covariance
BMI	Body mass index
CI	Confidence interval
FT	Femoro-tibial angle
HTO	High tibial osteotomy
I2	I-square
KAM	Knee adduction moment
KL	Kellgren-Lawrence grading system for knee OA
K-wire	Kirschner wire
MD	Mean difference
MOWHTO	Medial opening wedge high tibial osteotomy
MRI	Magnetic resonance imaging
OA	Osteoarthritis
OR	Odds ratio
PCL	Posterior cruciate ligament
ROM	Range of motion
TFA	Tibio femoral angle

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REVIEW OF LITERATURE

Introduction:

Medial opening wedge high tibial osteotomy (MOWHTO) is a good choice to manage patients with symptomatic medial compartment arthritis and varus malalignment. Biomechanical data suggest that a biplanar osteotomy and the use of a plate fixator are perfect technique [(1)].

To correctly perform a medial HTO, knowledge of the functional surgical anatomy of the knee and the popliteal region are essential. Important structures within these anatomical regions are related to the osteotomy planes and there are potential risk at the different surgical steps [(2)].

Anatomy:

The knee joint is formed by three bones. The femur meets the tibia to form the main weight bearing part of the knee. The patella is located at the front of the knee and acts as a fulcrum to give the thigh muscles a mechanical advantage in straightening the knee [(3)].

These three bones are covered by cartilage, a white highly polished surface that allows frictionless motion of each bone against another. Cartilage coats the end of the femur, the top part of the tibia and behind the patella. Osteoarthritis (OA) occurs when this surface cartilage wears out [(3)].

The knee joint is divided into three "compartments". The weight-bearing compartment of the knee is called the tibio-femoral compartment, and this is subdivided into medial and lateral tibio-femoral compartments. The medial tibio-femoral compartment is on the inner part of the knee and the lateral tibio-femoral compartment is on the outer part of the knee [(3)].

These two compartments carry the majority of the body weight during walking and running. The patello-femoral compartment is the space at the front of the knee between the patella and the femur. This compartment is loaded when performing activities that involve a lot of knee bending, like walking up and down stairs, squatting or getting out of a chair [(3)].

Biomechanics of high tibial osteotomy:

1- Alignment Principle:

The ideal mechanical axis passes from the center of the hip, through the knee, to the center of the tibiotalar joint. The orientation of the normal anatomic axis of the knee is 5° to 7° valgus [(4)]. In addition, the articular surface of the femur 2° to 3° of valgus and that of the tibia averages 3° varus relative to the mechanical axis [(5)]. Schematic limb alignment assessment is shown in (Figure 1) [(4)].

In Figure 1: The mechanical axis of the limb (red line) is defined by a line from the center of the femoral head to the medial tibial spine and a line from the medial tibial spine to the center of the ankle. The weight-bearing line (also represented

by the red line, as this knee has normal alignment of 0°) is defined by a line from the center of the femoral head to the center of the ankle joint.

The anatomic axis of the limb (black line) is defined by mid-diaphyseal lines in the femur and tibia. In a varus knee, the weight-bearing axis passes medial to the medial tibial spine. In a neutral knee, the weight-bearing axis passes through the medial tibial spine. In a valgus knee, the weight-bearing axis passes lateral to the medial tibial spine.

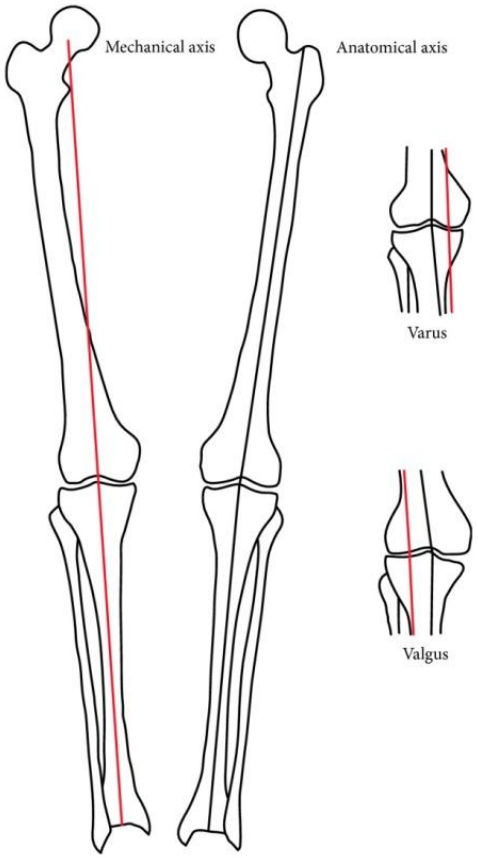

Figure (1): Radiographic lower limb alignment assessment.

The biomechanical objective of HTO is to realign the weight-bearing line (WBL) in the coronal plane. The aim is to achieve the shift of the weight-bearing line from the arthritic compartment to the opposite tibiofemoral healthy compartment.

Overall, leg alignment is important factor for the force distribution in the knee joint [6]. The decrease of load in the diseased compartment of the tibial plateau reduces knee joint pain and delays progression of osteoarthritis [7,8].

It's recommended to align the WBL of HTO through the 65%–70% coordinate of the width of the tibial plateau, which has been refined recently to 62.5% (range 62% ~ 66%). An average overcorrection of 3° valgus was supported by previous studies long ago [9].

The measured TFA by single-limb standing radiographs was significantly greater (−8.7° ± 4.0°) than that by supine radiographs (−5.5° ± 2.8°). Hence, the standing alignment may be better than the supine radiographs alignment [10].

2- Kinematics:

Medial compartment OA with varus deformity leads to the changes in kinematics of joint movement and gait. In addition to restoring the normal alignment of the lower limb, HTO is also successful in modifying the osteoarthritic gait [11]. Furthermore, the changes in gait could have multiple effects on

the trunk, non-operated limb, and hip and ankle joint in the operated limb after HTO [12].

Walking speed and step length were increased after HTO [9,13]. The range of motion of the knee joint was increased and maintained for 5 years after HTO with anterior cruciate ligament (ACL) reconstruction and that will produce changes in dynamic loading and function of knee joint [13].

HTO presented positive results in joint kinematics after postoperative 6 months, not only in the axial plane but also in the coronal and sagittal planes [14]. Leitch et al. [9] found MOWHTO resulted in decreased internal rotation and flexion during both level stair ascent and walking. In addition, to reduce the knee adduction moment (KAM) without necessarily decreasing the medial compartment force the gait modifications are an important approach to do this [15].

3- Knee Joint Moment and Force:

Balancing loads between lateral and medial compartments is an important factor in improving the short- and long-term survival rates of HTO. Ideally, an appropriate correction achieves a minimum overcorrection from baseline alignment important for adequate medial unloading, whilst avoiding overloading on the lateral compartment cartilage [16].

Some studies analyzed the biomechanical effects of varus knee deformity on the stress distribution in the articular cartilage. The contact stresses on the medial compartment were too high for HTO patients, and the medial contact stresses was necessary to be decreased and maintain relatively lower lateral contact stresses to avoid damaging the lateral tissues [(17)].

They suggested correcting the weight-bearing axis to 55% tibial width (1.7°–1.9° valgus) optimally distributes lateral and medial contact stresses [(17)]. Excessive shear stress to the articular cartilage may induced by a large amount of correction in MOWHTO with joint line obliquity of 5° or more. Zheng et al. [(11)] also found that balanced loading occurred at angles of 4.3° and 2.9° valgus for the femoral and tibial cartilage, respectively.

4- Posterior Tibial Slope and Patellar Height after HTO:

HTO can result in changes in posterior tibial slope and patellar height. Medial opening wedge osteotomy causes a decrease in patellar height because the tibial tuberosity is lowered due to opening of the proximal tibia during the procedure [(19)] (Figure 2)[(18)].