

# A MULTI-COMPONENT IMPLANT FOR USE IN TIBIAL OSTEOTOMY TO CORRECT VARUS DEFORMITY IN THE MORBIDLY OBESE

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## ABSTRACT

Medial opening wedge high tibial osteotomy (OWHTO) offers an alternative to total knee arthroplasty (TKA) for patients with varus knee deformity. This report describes a novel, modular implant intended to occupy the wedge osteotomy space via a small medial incision to reduce surgical complications associated with patients having a BMI of 40 or greater (morbidly obese). The wedge-shaped, 3-D laser-sintered titanium alloy implant consists of interlocked components to be assembled in situ. Components were fabricated with a continuous laser-sintered surface lattice structure for bone ingrowth. The sliding resistance of a range of geometrically scaled lattices was assessed to determine the optimal lattice structure for initial implantation. The lattice structure had a 550mm surface opening (150mm internal pore size). Finite element models were created to evaluate three OWHTO scenarios including a medial restraining T-plate and implant combination, a T-plate alone as commonly seen clinically, and a model of only the implant within the osteotomy. Axially loaded models revealed implant stresses to be well below titanium fatigue strength, but the model of the T-plate alone indicated large plate and screw stresses comparable to the fatigue strength. Investigations are ongoing to assess multifunctional loading and experimental strain measurement. These results suggest this modular implant design may provide BMI > 40 patients an effective treatment option to early TKA.

**Keywords:** BMI, obesity, varus deformity, tibial osteotomy, modular implant, bone ingrowth, lattice, finite element model

## INTRODUCTION

Medial opening wedge high tibial osteotomy (OWHTO) offers an alternative to total knee arthroplasty (TKA) for patients with varus knee deformity due to medial compartment cartilage degeneration, trauma, or osteoarthritis [1,2]. In the morbidly obese patient (BMI>40) with a likelihood of co-morbidity, the increased incidence of surgical complications associated with TKA has generated interest in OWHTO as an alternative treatment, particularly in the younger obese patient [2,3,4]. However, the current procedures for OWHTO in non-obese patients (BMI<30) are poorly suited for patients with BMI>40 because of the extreme stresses generated on an implant designed for this type of deformity correction [5,6,7].

A OWHTO is a procedure whereby the proximal tibia is resected starting from the medial cortex, extending at an upward angle, as seen in the frontal plane, to nearly the lateral cortex such that the surgeon can apply a valgus displacement of the foot to align a varus knee deformity. In doing so, the surgeon creates an “open-wedge” shaped space, or osteotomy, in the proximal tibia. Commonly, the OWHTO requires a plate and/or screws placed across the medial wedge opening to stabilize the site and shunt the load around the osteotomy while the grafted or un-grafted bone heals.

It is generally accepted that obesity is a contra-indication for OWHTO [8]. A recent study of the complications of tibial osteotomy demonstrated that obese patients, defined as having a BMI >27.5, were