

Total Knee Replacement After High Tibial Osteotomy

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Abstract

Total Knee Arthroplasty (TKA), post High Tibial osteotomy (HTO) continues to be an enigma with published reports of both good and suboptimal results in comparison to TKA for osteoarthritis (OA). The surgeons performing HTO must always employ TKR friendly techniques so that it is easy to apply the correct principles while conversion into TKA and have a very good results contradictory to the traditional historical conclusion. The bug bear of HTO is the post slope where common errors can occur even when performed by experienced surgeons. The norm is usually for the post slope to increase with the medial open wedge and for the post slope to decrease with lateral Closed wedge. The golden rule in Post HTO TKA conversion is to start off by resecting less bone. This is done so that inadvertent joint line variation from ideal is avoided. We then do extension space management by using various thickness of spacer hemi blocks. However individual cases may be different. Reliable results can be achieved in post HTO TKR if good planning and careful execution of the potentially problematic steps are undertaken. Residual soft tissue laxity necessitating increased constraint is more common in Post HTO TKR than in TKR for OA.

Keywords: Total Knee Replacement, High Tibial Osteotomy, Osteoarthritis

Introduction

Total Knee Arthroplasty (TKA), post High Tibial osteotomy (HTO) continues to be an enigma with published reports of both good and suboptimal results in comparison to TKA for osteoarthritis (OA). It is now well accepted that the good initial results obtained after HTO will deteriorate over time and many of these patients will end up requiring TKA. Historically, literature has been favoring the fact that TKR after HTO has inferior results when compared to TKA for osteoarthritis and inflammatory arthritis. However, this has to be interpreted in relation to the varied, non-standardized HTO techniques used earlier [1, 2, 3]. However, if the HTO is done in a TKA friendly fashion and the surgeon doing the TKA conversion applies the correct principles, this traditional historical conclusion from literature may not apply. In this article we will discuss HTO survivorship, assessment of failed HTO and pearls in conversion of HTO to TKA.

HTO survivorship

The success of HTO depends directly on age (<50), gender, the origin and extent of deformity (<15*), leg length discrepancy, ACL functional quality, joint line inclination and stability. The healing articular damage following HTO depends on patient's weight (BMI < 30), preoperative range of motion (ROM), post operative correcting angle and smoking habit [1, 2, 3]. The survival rate of properly done HTO at 5, 10, and 15 years may be up to 95%, 79%, and 56%,

respectively [3]. Several knee after HTO require conversion to total Knee Arthroplasty (TKA) due to progression of degenerative OA, loss of correction angle with changes in other joints and spinopelvic relation. This must be clearly explained to the patients preoperatively [4]. The long term results on survival rate of HTO shows varied difference due to wide heterogeneity, patient selection criteria, severity of varus deformity, surgical technique, fixation device and postoperative rehabilitation protocol [5]. According to International Cartilage Regeneration and Joint Preservation Society (ICRS) classification medial OA is associated with grade 2 or 3 chondral lesions. HTO without any associated arthroscopic procedures like microfractures or osteochondral transplantations will fail quickly following the index surgical procedure [6, 7]. Open wedge osteotomy which is fast becoming the most adopted technique of HTO causes relative shortening of the patellar tendon and patella baja. However, it is interesting to note that patella baja is also more common than patella alta in closed wedge osteotomies thought the reverse should occur theoretically. This is due to the infrapatellar scarring that occurs.

Assessment of failed HTO

HTO performed in cases with severe deformities and age > 60 years rapidly degenerates and there is a quick need of TKA [8]. Valgus or neutral mechanical alignment with medial joint space reduction and tibial rotational deformity are the common findings in failed post

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Figure 1: Post HTO TKA after a closing wedge osteotomy with under correction. Tibial stem is used even with minimal bone loss to minimize alignment errors and to address residual subtle soft tissue imbalances by slight increase of constraint

HTO [9]. The possible mode of tibiofemoral instability includes varus-valgus, recurvatum, flexion, and global instability. Medial instability is most common one encountered by the arthroplasty surgeon. There will be sagittal and coronal plane deformity of proximal tibia making a difficult ligament balancing while performing TKA. Soft tissue challenges increase along with the retained previously used hardware or bone graft substitutes [10, 11]. Assessment of medial instability is crucial, sometimes medial collateral ligament (MCL) is found detached from the tibia under the periosteum and sometimes found fibrosed. The integrity of MCL decides the choice of implant used [12, 13]. Iatrogenic fracture of opposite cortical hinge and articular fracture are some of the intra operative complications of HTO would alter the course of future TKA [14]. The bug bear of HTO is the post slope where common errors can occur even when performed by experienced surgeons. The norm is usually for the post slope to increase with the med open wedge and for the post slope to decrease with lat. Closed wedge. However individual cases may be different.

Surgical pearls in our experience

Assessment of deformity and its management

A multitude of proximal tibial deformities can occur in our experience inclusive of translational and rotational deformities which are not seen in non-operated cases. Assessment must include, one leg standing views, skyline view of patella, scannogram and a CT rotational profile in selected cases with significant patellar maltracking. It is not uncommon to see overall HKA (Hip Knee Axis) in varus but wear on the lateral tibial plateau and vice versa as well. These scenarios post special challenges for the surgeon. The surgeon must learn to use intramedullary reference for coronal deformity correction, desired slope restoration and centralization of the tibial tray. Many a times the surgeon will be compounding errors if he uses only the standard techniques of correction in TKA for OA.

Rotational component of the tibia is best determined by the floating tray technique, and this can be readily accepted as the femur is normal, provided patellar malalignment is not present. Very occasionally a tibial tubercle transfer may be required to establish patella femoral congruent tracking. Offset stems will be required in patients with a gross translational deformity and this must be worked out in the pre op scannogram. The golden rule in Post HTO TKA is to use stem along with the tibia if in doubt (Figure 1).

Using a stem and getting an intramedullary reference axis can solve alignment problems except that of rotation. In addition, subtle imbalances are very common in Post HTO TKA and one can use a PS plus insert in the presence of a tibial stem. The surgical pearl here is that trialing should be done with relatively long uncemented trials though finally a shorter, cemented stem can be used. As a general principle cruciate retaining designs can be avoided in post HTO TKA and a deep dish or PS insert can be used. Kim Hj et al reported on the use of fully constrained and semi constrained TKA prosthesis in neglected cases with gross medial instability [15]. If stems are not used in the presence of defect, it may cause problems on load bearing especially in the presence of mild residual instability. This was confirmed with long term radiological follow up of TKA following HTA indicating loosening of tibial component and hence stem extension of adequate length was recommended [16, 17].

Soft tissue issues and its management

A myriad of surgical incisions has been historically adopted for HTO by surgeons. However, it must be emphasized that surgeons doing HTO presently must use only TKA friendly incisions. The general principle of transverse or nearly transverse incision not interfering in TKA is true. As blood supply to the skin flap in front of the knee is from medial to lateral the surgeon must use the most lateral of the incision and subfascial dissection can be done to approach the midline. Very rarely post HTO infected cases can have very poor

anterior soft tissue status and may require input from a plastic surgeon.

Infra patellar scarring is almost invariable in post HTO situation, and this will cause difficulty in exposure and makes patellar tendon injury more likely than in TKA for OA. Formal address of infra patellar scarring is required in most cases in our experience. The quad snip has no disadvantage in terms of post op mobilization of the patient and can be done routinely when infrapatellar scarring is present to minimize the chance of patellar tendon injury. Removal of previous implants can be problematic. If inflammatory parameters are raised, we prefer to stage the surgery and achieve good wound healing following implant exit before doing a post HTO TKA as a 2nd stage procedure. We also employ this strategy when skin is tethered in the scar of the HTO surgery.

Ligamentous Imbalance and its management

The golden rule in Post HTO TKA conversion is to start off by resecting less bone. This is done so that inadvertent joint line variation from ideal is avoided. We then do extension space management by using various thickness of spacer hemi blocks (Figure 2). The concept is to reestablish the minimum required space for that prosthesis (18 to 20 mms) on the side which is laxer. The less involved side can be the tighter one in TKR post HTO. Lesser amount of lateral proximal tibial bone (average 3.3 mm) is resected in TKA following HTO in comparison with TKA without previous HTO (average 7.5 mm). The changes in the posterior slope and relation of the proximal portion to distal tibia should be taken in account [18, 19]. Further steps are carried out and usage of Ranawat flexion cutting blocks or similar can be useful for flexion space management. A judicious mix of measured resection and gap balancing techniques have to be employed in post HTO TKA. We employ pie crusting of the supl. MCL medially or the IT band laterally based on the situation with the trials in place. Having the trials in place during release is critical in Post HTO TKA as over release is commonly reported. Even when release is done sequentially and carefully, residual soft tissue laxity can be present. In this

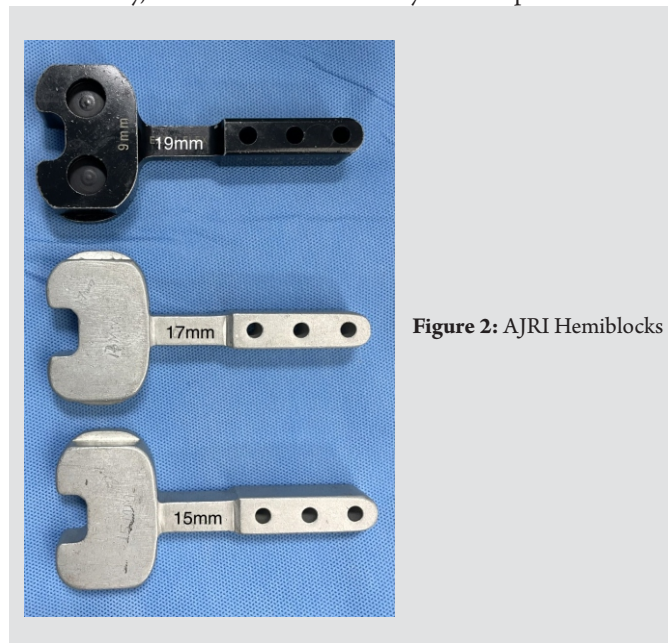


Figure 2: AJRI Hemi blocks

situation, constraint has to be increased and we have a low threshold for the same. Vince et al and others have reported medial and lateral soft tissue releases were same in TKA following with or without HTO [10, 11, 19]. Operative time was longer in TKA following HTO with high infection rate [20].

Discussion

Meding B et al 2000, study showed similar knee and function score between two groups (89.0 and 81.0 points, respectively, for the TKA group with a previous HTO and 89.6 and 83.9 points, respectively, for the TKA group without HTO). More number of knees were pain free in TKA group without HTO with a significant p value ($p = 0.4810$). Radiological assessment of femoral and tibial component alignment was similar in both groups. Two cases of TKA with HTO required manipulation to improve their knee ROM. One case underwent poly exchange in TKA with HTO group. There was no deep peri prosthetic joint infection [19].

Windsor et al (45 patients) and Katz et al (21 patients) had similar poor outcomes following TKA after HTO in terms of knee function and ROM [21, 22]. Rozkydal et al 2003 showed an average functional score of 82.7 and 81.4 and average Insall-salvati score of 1.09 and 0.91 in TKA with HTO and TKA without HTO groups respectively. Patella infera was recorded in 21 (42%) patients of TKA group with HTO [23].

Parvizi et al 2004 showed a mean knee society pain score improvement from 34.5 to 82.9 points and functional score improved from 44.6 to 88.1 points in group TKA without HTO. Thirteen knees (8%) were revised at a mean of 5.9 years following assessment of progressive radiolucent lines (RLL). They were indicative of loose tibial [17] and femoral [7] prosthesis [24]. Efe et al 2010, reported a significant difference between both the TKA with and without HTO groups only in range of movement (ROM) and knee score of HSS [5]. Song et al 2016, assessed the clinical and radiological results, revision rate, and complication rate were poorer in patients who underwent TKA after HTO in comparison to the TKA without a previous HTO [4].

Sun et al 2020 showed primary TKA had a better flexion angle in comparison with TKA without HTO. Flexion angle was better in TKA without HTO than the TKA with HTO ($P < 0.05$). There were no significant differences between the two groups in terms of KSS, and long term radiological results with a 10-year survival rate ($P > 0.05$) [20]. Codie A et al 2021, found that 79% of knees did not undergo TKR within 10 years after undergoing medial opening wedge HTO. The strongest predictor of conversion to TKR following HTO is the radiological extent of the arthritic disease during index surgical time.

Conclusion

The surgeons performing HTO must always employ TKR friendly techniques. Reliable results can be achieved in post HTO TKR if good planning and careful execution of the potentially problematic steps are undertaken. Residual soft tissue laxity necessitating increased constraint is more common in Post HTO TKR than in TKR for OA.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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