Standard of Care: High Tibial Osteotomy

ICD 9 Codes: 717.0-717.9

Case Type / Diagnosis:
High tibial osteotomy, also known as proximal tibial osteotomy, has become a common surgical intervention used to treat patients with medial compartment arthritic changes and tibiofemoral malalignment, specifically lower extremity varus malalignment. Medial gonarthrosis is caused by additional force on the medial compartment due to varus deformity of the lower extremity. High tibial osteotomy works to shift the mechanical axis laterally which takes the force off the medial compartment. One goal of high tibial osteotomy is to alter the history of underlying osteoarthritis by unloading the articular surfaces. High tibial osteotomy is a reasonable alternative to TKA in the younger patient population with osteonecrosis of the medial femoral condyle and may lead to regression of the disease. It is also used in younger patients with osteochondritis dessicans of the medial femoral condyle who have not improved with conservative treatment. This surgical procedure is commonly used in the younger patient population who want to be able to maintain a high activity level upon recovery.

Unicompartmental arthritic changes are becoming more abundant in the younger patient population ranging in age from patients in their twenties to forties due to a high interest in sports. High tibial osteotomy is best utilized when the patient is a non-smoker, has body weight less than 1.32 times normal, ROM in the affected knee is greater or equal to 90 degrees, and when the arthritic changes are limited to the medial compartment.

This procedure has been found to be a safe treatment and a technique that can be reproducible. It allows for future knee reconstruction to occur if needed. There is increased interest in the surgical technique secondary to cartilage repair procedures failing in the setting of malalignment of the lower extremity. High tibial osteotomy decreases knee pain, allows higher activity levels post operatively and much improved quality of life. Once the patient has recovered from the procedure and the osteotomy has healed sufficiently, there are typically no activity restrictions for the patient.

Surgeons can perform the high tibial osteotomy using a variety of techniques, predominantly opening wedge and closing wedge. Reports are conflicting which procedure is preferred. Both techniques provide good outcomes with decreased pain and improved function. Selection of open vs closed wedge technique for a patient by a surgeon is based on specific pathology that the patient has. For example, Hoell found that the opening wedge technique was more helpful for stabilization of the medial ligaments. In the same study, lateral closing wedge technique was used in patient with stable medial and lateral collateral ligaments. Each surgical technique has its advantages and disadvantages.
The closing wedge technique is typically done laterally. It allows for accelerated healing of the bone based on the position of the osteotomy which typically is distal to the tibial tubercle. This allows for good bone compression around the osteotomy. Lateral closing wedge has been found to increase patellar height. One criticism of this procedure has been the creation of patella baja due to the shortening of the patellar ligament. Recent studies have found that the incidence of patellar ligament shortening is greatly reduced by the use of rigid internal fixation and aggressive post operative mobilization. It is consistently reported that nonunion in patients who have had this technique is <1%. Lateral closing wedge is the conventional approach and optimizes inherent stability. The use of calibrated cutting guides, rigid internal fixation and early mobilization is the key to good results with low complication rates.

Medial opening wedge uses a plate, predominantly known as a Puddu Plate, which has different size spacers placed in the ostetomy opening and fixed with screws. One advantage of this type of high tibial osteotomy is that it is technically easier for the surgeon to perform. As stated above, this technique is used with patients with medial collateral ligament (MCL) instability as well. This technique has been noted to decrease patellar height.

Despite which technique is used by the surgeon, treatment for symptomatic early arthritic changes or chondral defects is imperative. Defects seen in younger patients are usually caused by trauma. It has been found that the longer these defects go untreated, the likelihood of a patient developing arthritis with loss of function increases. Of all radiologic findings in patients suitable for this technique, joint space narrowing in the medial compartment of the knee is the most common. The repair of these defects may delay the progression of medial joint space narrowing.

Patients with tibiofemoral malalignment have also been found to be at risk of a progression to symptomatic arthritis if the malalignment is not treated. In a study performed by Sharma et al, it was discovered that a malalignment of the tibiofemoral joint of just 5 degrees can increase the risk of developing medial joint osteoarthritis by four times. Other studies report actual regeneration of the repaired cartilage in the affected compartment.

Success rates of high tibial osteotomy are determined by several factors and time frames. Factors such as the age, weight and degree of cartilage lesions affect the long-term result of a high tibial osteotomy. There has been several studies completed which follow-up with patients up to fifteen years and have used different types of qualitative and quantitative measures rating the success or failure of this procedure. In one study by Coventry et al, eighty-seven high tibial osteotomies were performed in seventy-three patients. The patients were all older than thirty and all had medial compartment osteoarthritis. The failure definition of this study was two-part; either the patients ended up having a total knee arthroplasty or they had moderate to severe pain in patients who declined total knee arthroplasty. In terms of results, as the patients’ weight increased, the likelihood of failure increased as well. At nine year follow-up 67% of patients had less pain, 24% had the same amount of pain and 8% had severe pain. The patients’ walking tolerance followed the same trends of pain. In terms of failure, this factor was measured based on the degree of valgus angulation used to correct the defect. Survival rate at 10 years was 94% if the valgus angulation correction was 8% or greater but not more than 10%. It has been determined that high tibial osteotomy will fail if the correct angle of correction is not achieved.
In another study by Rinonapoli et al, fifty-eight patients were followed for an average of fifteen years. The procedures were performed between 1975 and 1986. The surgeons used closing wedge osteotomies with casting post-operatively for an average of 51 days. Patients were allowed to partial weight bear using crutches as soon as three days post-operatively and transition to a cane by three weeks. Excellent and good results were noted in 73.5% of cases at fourteen years but decreased to 46% for cases fifteen years or greater post-op. The authors of this study now use internal fixation resulting in more rapid return of ROM and fewer complications. The overall conclusion from this study is that high tibial osteotomy provides patients 10-15 years with pain relief, adequate ROM and return to pre-operative activity.

In terms success rates and type of technique used, Hoell found that the outcomes of pts that had opening wedge vs closing wedge were not that very different. One difference was the time the patient in the operating room. This time was increased in patients that had the opening wedge technique performed. In both groups, pain decreased, patients were able to weight bear around 12-13 weeks, and patients had about the same knee ROM. It was also discovered that there was no significant increase in arthrosis found between the 2 groups and no significant loss of angle of correction.

As discussed above, high tibial osteotomy is a good method in treating patients with early arthritic changes or chondral defects affecting the medial compartment of the knee. Results depend on surgical technique, type and severity of defect, motivation of the patient and early ROM and rehabilitation. This procedure allows relief of pain and for return to high activity levels in the younger patient population.

**Indications for Treatment:**
This standard of care outlines guidelines for patients have undergone high tibial osteotomy (HTO) secondary to early medial compartment joint space narrowing or chondral defects and present with the following impairments:

- Pain
- Impaired flexibility/ROM at the knee
- Impaired strength
- Impaired function related to sports, ADLs
- Impaired gait

**Contraindications / Precautions for Treatment:**
This standard of care reflects common practices used at Brigham and Women’s Hospital with this patient population.

- Age
- Obesity
- Degree of degeneration, malalignment and chondral defect
- Patients who have tibial tubercle osteotomies performed concurrently will have more conservative treatment guidelines for the first six weeks post-operatively.
- When gait training, weight-bearing status is restricted to touch-down (TDWB) for 6 weeks with foot flat. A hinged knee brace must be worn and locked in extension for any out of bed activity.
Evaluation:

**Medical History:** Perform a complete review of the medical record including the surgeon’s pre-operative note when the note is available, review the full operative note in BICS or in LMR and any radiography pre-operative or post-operative in Centricity. It is also important to obtain a complete past medical history from the patient’s chart or from their medical health questionnaire depending if they are being treated in the inpatient or outpatient setting, respectively.

**History of Present Illness:** Thoroughly review any office visit documentation from the surgeon available in the patient’s medical record. Investigate any past injuries or trauma that may contribute to the patient’s need for surgical intervention.

**Social History:** Review with the patient their home environment in terms of barriers in the home as well as their work situation. Also investigate their social situation and recreational activities prior to surgery.

**Medications:** During the inpatient phase, patients will typically have a lumbar epidural with bupivaine and dilaudid for the first 24-48 hours post-operatively for analgesia. If needed, additional analgesia will be provided to the patient intravenously using a patient controlled pump. Patients are then converted to oral pain medications. In addition, patients will often be on their regular medications that they take at home if approved by the surgeon in addition to multi-vitamins found to promote good healing post-operatively. When the patient reaches the outpatient setting, it is important to be aware of medications the patient is currently taking which should be listed in the medical health questionnaire.

**Examination**

**Inpatient Phase:**

**Pain:** Utilize the Visual Analog Scale/ Numeric Rating Scale and qualify as to whether pain is at rest, with ROM, functional mobility or with CPM. Investigate location of pain as well.

**Incision Inspection:** Investigate the patient’s incision as best able given the dressing the patient may have as well as the color surrounding the wound.

**Sensation:** Assess the patient’s sensation to light touch through a gross assessment of bilateral lower extremities and investigate any baseline impairments the patient may have with regard to sensation.

**Motor:** Test the patient’s motor control in the bilateral lower extremities. This is vital especially when the patient’s pain is being managed using a lumbar spine epidural.
**ROM:** Assess the patient’s range of motion in the bilateral upper extremities as well as in the non-operative lower extremity. Test the available ROM in the operated knee for both passive and active extension as well as passive and active flexion. Patellar mobility should be assessed as early as possible post-operatively.

**Strength:** Assess the patient’s strength in the bilateral upper extremities as well as in the non-operative lower extremity with at least a gross assessment. Assess patient’s ability to perform a straight leg raise with knee immobilizer or hinged knee brace donned.

**Functional Mobility:** Assess patient’s ability to perform bed mobility, transfers, gait training on the level and on stairs.

**Outpatient phase:**

**Pain:** Utilize the visual analog scale or numeric rating scale. Also assess location of discomfort, course of pain, provocative and relieving activities.

**Observation:** Visualize incision and skin integrity around the knee joint.

**Sensation/Motor:** A gross sensory/motor screen involving the dermatomes and myotomes of bilateral lower extremities should be performed.

**Edema:** Measurements should be obtained on the operative knee as well as the non-operative knee in order to achieve baseline measurements.

**ROM:** Obtain measurements of the hip, knee and ankle on the operative lower extremity as well as the non-operative lower extremity for baseline values.

**Patellar Mobility:** Assess degree of mobility.

**Flexibility:** The hamstrings, quadriceps, iliopsoas and gastroc/soleus should be assessed bilaterally.

**Strength:** Assess the strength of the hip, knee and ankle on the operative lower extremity as well as the non-operative lower extremity for baseline comparison.

**Gait Assessment:** A gross gait assessment detailing type of device, if any, still being used, limitations in gait, balance, weight bearing compliance, and how the patient is performing stairs should be done.
Evaluation/Assessment:

Problem List:
- Pain
- Impaired Knee ROM/LE flexibility
- Impaired Knee Strength
- Impaired patellar mobility
- Edema
- Impaired functional mobility
- Impaired gait on level and uneven surfaces
- Impaired knowledge re: Bledsoe brace, weight bearing status and home exercise program

Prognosis: It has been reported that after six to nine months, patients report 90% pain relief compared to their pre-operative rating. Five years after their proximal tibial osteotomy, patients continue to report an average of 80% pain relief, though this number does fall to 60% at eight year follow-up. At ten years, one-third of patients who have had this procedure require total knee arthroplasty. Other patients report they are able to participate in “outdoor activities” for ten to fifteen years after their procedure (6).

Goals Short-term goals to be met 3–4 days post-op:
1. Decrease pain with ROM/Mobility.
2. Increase active/passive ROM to 0–90.
3. Increase knee strength to 3/5.
4. Independent with locking/unlocking hinged knee brace.
5. Independent with bed mobility/transfers.
6. Independent with gait using bilateral axillary crutches on the level and on stairs, TDWB with Bledsoe brace donned and locked.
7. Independent with early, conservative HEP.

Long-term goals to be met by 12 weeks:
1. Pain free ROM and functional mobility.
2. Restore full ROM.
3. Strength at least 4+/5 hamstrings and quads.
4. Normalized gait without assistive device.
5. Independent with HEP and patellar mobilizations.

Treatment Planning / Interventions

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Frequency & Duration:

- **Phase I** – Acute/sub-acute:
  
  **Acute:** In the hospital, the patient will be seen daily or as needed depending on patient progression.

  **Sub-acute:** Home PT with transition to outpatient will see the patient between 2-3x/week based on patient needs.

- **Phase II:** The patient will be seen 2-3x/week based on patient needs in the outpatient setting with the expectation the patient will have a home exercise program they should be compliant with outside of the clinic focused on strengthening.

- **Phase III:** The patient will be seen 1-2x/week based on the needs of the patient with the expectation of continuation of performance of the home exercise program.

Patient / family education:

- Instruction in pain/edema control using cryocuff.
- Instruction in functional mobility using crutches.
- Instruction in isometric exercises, SLR with Bledsoe brace, ROM, patellar mobilization.
- Instruction in hinged knee brace management and wearing schedule.
- Instruction in use of home CPM.

Recommendations and referrals to other providers:

- To home PT upon discharge from hospital for home safety evaluation and continuance of exercise program.
- To outpatient PT when discharged from home PT and approval is achieved from the surgeon.
- To surgeon if any problems arise such as high fever, or the wound becomes red, hot and/or swollen.

Re-evaluation

**Standard Time Frame:** Every 10 days or with any change in medical status or additional procedure while in-patient and every 30 days in the outpatient phase.
Discharge Planning

Acute Phase – Inpatient:

Commonly expected outcomes at discharge:

- Usual length of stay is 3-4 days.
- Decreased pain level tolerable to patient.
- Increased ROM from initial evaluation by 20 degrees.
- Independent SLR with Bledsoe brace donned and locked.
- Independent with HEP, brace management and precautions given specifics of surgery.
- Safe and independent functional mobility and gait with assistive device.

Patient’s discharge instructions:

- Perform therapeutic exercises 3x/day.
- CPM as tolerated 6-8 hours/day.
- TDWB gait training until changed by MD.
- Cryotherapy for pain/edema control after home PT or PRN.
- Call MD if marked increase in wound redness, warmth, and pain.

Outpatient:

- No pain with functional activities, ADLs and return to sports.
- Full ROM operative knee.
- Normal strength operative knee.
- Normal gait on even and uneven terrain.
- Return to work/sports activities with no restrictions.

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REFERENCES:


2. Minas TM. Tibial Ostetomy Revisited.


