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Review Article

Total knee arthroplasty after high tibial osteotomy

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Abstract

Total knee arthroplasty (TKA) after a previous high tibial osteotomy (HTO) is a technically demanding procedure. Previous approach, fixation devices, defect of tibial plateau, position of patella and anatomic position of proximal of tibia should be carefully evaluated before the operation. According to the literature the previous HTO has no adverse effect on the TKA outcome.

Keywords: Total knee arthroplasty (TKA), high tibial osteotomy (HTO), TKA outcome.

Isolated medial compartment osteoarthritis of the knee with varus deformity is a common problem in Iran. An acceptable option for young active patients with this problem is high tibial osteotomy (HTO) that yields excellent pain relief and functional improvement. The positive effect of HTO is thought to be based on a redistribution of the body weight from arthritic medial femorotibial compartment towards the opposite unaffected side (1-3).

In other words, as said by Sherman and Cabanella (4) "the goals of osteotomy include: to relieve pain, to redistribute weight bearing forces, to improve function and thereby potentially increase the longevity of the native knee joint" (4).

It has been well established that good short and medium-term outcomes can be achieved with HTO for medial compartment osteoarthritis of the knee. Unfortunately, these results have been shown to deteriorate over time (5-9).

Various studies have reported satisfactory outcomes of approximately 80% at 5 years and 60% at 10 years after the HTO (9-14).

Thus, while a HTO is capable of providing adequate pain relief for a young patient, it is unlikely to provide permanent relief, but nevertheless the need for total knee arthroplasty (TKA) is delayed (14).

Some studies have shown inferior results after TKA in patients who had a previous HTO (15,16), and some others have demonstrated similar results in patients with and without a previous HTO (17-27). This review aims to highlight the current literature findings regarding the problems that can complicate the TKA procedure in patients after HTO.

The TKA after a previous HTO is technically challenging and influenced by a number of factors, which will be discussed in details (Table.1).

Prior incisions

Unlike the hip joint, the knee could not tolerate multiple parallel or crisscrossing incisions. In the knee, the vascular supply and lymphatic drainage are dominant on the medial side which increases lateral flap vulnerability. The most vulnerable knee is one with a long lateral parapatellar incision and occurs when a surgeon plans a parallel median parapatellar incision for a medial arthrotomy. In these situations, when multiple incisions are present, the most laterally based incision is preferable. Transverse incisions can be safely crossed at

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90° angle, although angles lesser than 60° should be avoided. In unclear situations, the "delayed technique" or "sham incision" can be considered.

In the sham incision, the skin incision is performed without using tourniquet, the flaps are elevated, and the medial and lateral skin edges are carefully inspected for active bleeding. If the blood flows insufficiently, the procedure is aborted.

In the delayed technique, skin incision is made, the skin flaps are elevated for the arthrotomy, and then the wound is closed. Assuming no occurrence of skin necrosis the TKA is carried out through the same incision 4 to 6 weeks later.

Operative exposure

Because of the adhesions around the osteotomy site and patella baja that are present after HTO, exposure and eversion of patella could be troublesome. For this reason, quadriceps snip or tibial tubercle osteotomy may be required.

Previous implants

Fixation devices used for HTO are not routinely removed unless the fixation device interferes with proximal tibial cut or with fixation of tibial component. If hardware removal was necessary, it could be performed in a separate procedure or at the time of arthroplasty.

Screws and staples usually could be removed during arthroplasty procedure. However, plates' removal could be performed through a large separate incision optimally 4 to 6 weeks prior to the arthroplasty.

Patella baja

Patella baja (infra) may follow HTO. The surgeon can employ several techniques to resolve this situation. These include attempts to lower the joint by decreasing the distal femoral resection and increasing the proximal tibial resection. The increased tibial resection, of course, will loosen the flexion gap. The surgeon should use oversize femoral component.

Table 1. The factors that influence the TKA results after HTO.

Prior incisions
Operative exposure
Patella baja
Previous implants
Joint line distortion
Offset tibial shaft
Deficiency of the lateral tibial plateau
Malunion
Nonunion

Another technique is to use a smaller patella component or put the patella higher on the bone cut surface.

Tibial implant alignment

Closing wedge osteotomy may create lateral tibial bone deficiency. Care should be taken to resect the least amount of bone from the tibial plateau. Rarely, tibial wedges or graft may be required.

After HTO, the offset of the plateau relative to the tibial shaft may be changed. The tibial anatomical axis may pass the medial of tibial plateau and the tibial component stem may come into contact with the lateral tibial cortex (21).

The tibial component may have to be shifted medially and undersized or used with an offset stemmed tibial component (22).

Change in the posterior tibial slope can occur after HTO, and one must care to cut the tibia in sagittal plane properly for creation a normal slope.

Malunion

Malunion may be in the varus or valgus plane, one should decide whether the secondary deformity can be corrected through the joint with ligament release or whether the corrective osteotomy is necessary. For elderly patients, correction through the joint by ligament release is usually preferred. A semi-constrained prosthesis may be required. In younger patients, osteotomy in malunion site is preferred. This could be performed as a two or one-stage procedure to fix the osteotomy site with a long stem tibial component.

Malunion may occur in the flexion–

extension plane. In anterior bowing of the tibia, fully functional extension can be achieved by allowing hyperextension at the joint surface. In tibial bow extension, hyperextension can be avoided by tightening the extension gap.

TKA procedure after an osteotomy in excessive valgus can be challenging due to the following issues (26):

1. A valgus joint line in the knee joint that used to be in varus alignment prior to osteotomy,
2. The lateral plateau bone deficiency,
3. In a failed osteotomy with a valgus tibial joint line, the femur will be externally rotated. Thus, the femoral component will have to be internally rotated to restore flexion gap symmetry with a 90° tibial resection (26). This plan is unprecedented in classic practice.

Nonunion

A nonunion after a HTO should be addressed during the conversion to the TKA. A single stage TKA could be planned preparing the tibia in a standard fashion with a long stem tibial component to internally fix the nonunion. Nonunion of the HTO site may be approached as a staged procedure using bone grafting.

Type of prosthesis

Posterior cruciate ligament substituting prosthesis is recommended because there are contracture of posterior cruciate ligament (PCL), patella infra, and tibial plateau bone defect. In PCL retaining prosthesis, it will be very challenging to balance flexion and extension gaps (17,22,27,28).

Open wedge HTO

Today, open wedge HTO has been accepted as a good procedure, but in conversion to the TKA following issues may occur:

1. The lateralized incision which can compromise the TKA outcomes.
2. Removal of hardware may be needed using a separate incision, which in turn can cause problems during TKA approach.
3. If commercial bone substitutes are used as a graft during a previous open wedge HTO, the weakness of the osteotomy site may be a serious concern and thus a stem for the tibial tray should be applied.

Outcome

Several studies have reported inferior results after the TKA in patients with previous HTO. However, other studies demonstrated no significant difference in knee scores between TKA after a previous HTO compared to a matched group with primary TKA (17-19,23). Parvizi et al (24) studied TKA outcome following proximal tibial osteotomy over 115 patients (15.1 years mean follow up). They showed that the overall functional and radiographic outcomes were slightly inferior. The risk factors included higher rates of limb mal-alignment, instability, increased prevalence of radiolucent lines and higher rate of revision (24).

Conclusion

The HTO is still performed as an effective procedure that can markedly relieve pain and increase knee function in young patients, and thus postpone the need for a possible TKA.

Although TKA after HTO seems to be technically demanding compared to a primary knee arthroplasty, the previous HTO has no adverse effect on the outcome of a well-designed subsequent TKA.

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