Original Article

Outcomes of total knee arthroplasty following high tibial osteotomy

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Abstract

Background: Total knee arthroplasty (TKA) following high tibial osteotomy (HTO) is a technically demanding procedure with varying results. The purpose of our study was to analyze the clinicoradiological results of TKA following HTO and to identify the factors that may influence the final outcome.

Materials and Methods: 55 patients (58 knees) who had undergone a previous HTO were treated with a TKA from 1991 to 2009. There were 34 female and 21 male patients. The average age was 61.9 years (range 52-82 years) and the average weight was 79.5 kg (range 54-106 kg), with an average body mass index of 29.6 (range 21.8-34.6) at the time of TKA. The knee society scores (KSSs) and knee society functional scores were evaluated for every patient pre and postoperatively and the results evaluated.

Results: The mean period of followup was 11.2 years (range 3-18 years) and the patients were followed up every year. The average KSS score at final followup improved from 38.5 (range 0-80 points) preoperatively to 88.5 postoperatively (range 35-95 points) ($P < 0.05$). The mean femorotibial angle corrected from 6.8 degrees (range 5-12°) varus preoperatively to a valgus of 4.4 (2-8°) degrees postoperatively. The average joint line height improved to an average of 9.6 mm (range 4.4-22 mm) ($P < 0.01$) at the last followup. The average Insall Salvatti Ratio also improved (average 1.11 preoperative - 1.21 average postoperative) ($P < 0.05$). The average range of motion improved to 108° (range 85°-125°) from 76° preoperative (range 55°-100°) ($P < 0.01$).

Conclusion: Although TKA postHTO is a demanding surgery however, with newer component designs, results are comparable to primary TKA. Technical difficulties in exposure can sometimes lead to component malpositioning, which can affect the final outcome. Inadequate soft tissue balancing and limb malalignment should always be kept in mind. Regular followup to look for evidences of loosening is advised in such patients].

Key words: Femorotibial angle, high tibial osteotomy, total knee arthroplasty

Introduction

High tibial osteotomy (HTO) [Figure 1a] is a proven treatment option for medial compartment osteoarthritis with varus malalignment.[1] Although the goals of both HTO and total knee arthroplasty (TKA) are the same, namely load redistribution, axis realignment, pain relief and better mobility, these are often performed at different stages of arthritis.[1] HTO has been shown to be successful in well selected patients provided adequate intraoperative correction was achieved.[2,3] Even though short-term followup of tibial osteotomy have shown good clinical outcomes, the results seem to deteriorate over the course of time because of progressive arthritis and loss of alignment. Although the results of TKA after HTO are said to be comparable to that of primary TKA, conversion of an HTO to a TKA is technically demanding, with varying results.[4-7] The purpose of our study was to analyze our results of TKA following HTO, both clinically and radiologically and to identify any factors that may have an influence on the final outcome.

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Materials and Methods

62 patients (66 knees) underwent TKA between June 1991 and October 2009 in patients who had previous HTO of a cohort of 62 patients, five patients could not be traced due to change in address, one patient had passed away due to

unrelated reasons and one patient refused to be included in the study. Fifty-five patients (58 knees) were included in the final study. The surgeries were performed by the same senior surgeon (AR).

All patients included in the study had tricompartmental osteoarthritis following HTO. Patients with a previous history of inflammatory arthritis, infection or extraarticular deformities were excluded from the study. The average period between the two surgeries was 8.4 years (range 5-13 years) after the first intervention. There were 34 female and 21 male patients. The average age was 61.9 years (range 52-82 years) and the average weight was 79.5 kg (range 54-106 kg), with an average body mass index of 29.6 (range 21.8-34.6) at the time of TKA. The average followup was 11.2 years (range 3-18 years).

All patients had undergone a primary lateral closing osteotomy with various fixation devices. Eighteen knees were fixed with lateral tibial buttress plates and 22 knees were fixed using staples [Figure 1], 10 tension band wiring with two screws and eight knees had been treated with a cast with no fixation device *in situ* [Figure 2].

On admission, a thorough history, clinical examination and radiographic evaluation was performed. A knee society score (KSS) scoring was performed for all patients preoperatively and postoperatively. A radiographic evaluation (antero posterior, lateral view and full length standing scanograms) was carried out and the femorotibial angle (FTA), joint line height, tibial bone resection and Insall Salvatti Ratio (ISR) were recorded.[7] The lateral joint line height measured from the fibular head on the AP view of the standing X-ray was retrospectively recorded. The amount of bone resection of tibial plateau in TKA was measured on the AP view X-ray. The ISR was measured, which was the ratio of length of the patellar tendon to the length of the patella on the lateral view X-ray in 10 degrees of flexion. The preoperative ISR and that at the last followup were compared.

All the TKAs were performed under combined spinal epidural anesthesia. A cemented implant (NEXGEN, Zimmer Warsaw,

Figure 1: Preoperative X-ray of knee joint anteroposterior (a) and lateral views (b) showing high tibial osteotomy fixed with a staple (c) Postoperative X-ray anteroposterior view showing total knee arthroplasty following high tibial osteotomy

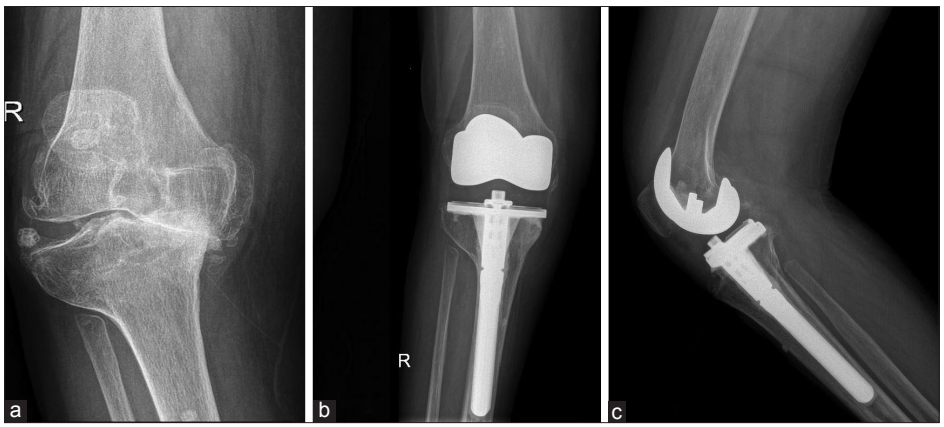

Figure 2: (a) Preoperative X-ray anteroposterior view of knee joint showing high tibial osteotomy with no fixation device (b,c) Postoperative X-ray of knee joint (anteroposterior and lateral views) showing total knee arthroplasty with a stem following high tibial osteotomy

IN, USA) was used in all cases [Table 1]. A tibial stem was used in nine cases due to a nonunion of the osteotomy site in six cases and severe osteopenia in three cases [Figure 2].

The previous incision was incorporated where possible and in cases of multiple previous scars, the lateral most incision was chosen. It is well documented that after HTO, the length of the patellar tendon tends to shorten and, thus, at exposure for TKA, due to the inability to retract the patella, a rectus snip was required in seven cases to optimize exposure in such difficult situations. Tibial scarring was present in almost all cases and careful subperiosteal dissection was carried out. In the presence of patella baja preoperatively, distalisation of the distal femur was performed by taking the −2 mm cut on the distal femur resection jig. Minimal amount of bone was resected from the lateral tibial condyle and the component was medialised as much as possible to avoid perforation of the lateral tibial cortex. In many cases, the previous hardware was not removed completely if it did not interfere with the placement of the tibial component. Patellar tracking was checked intraoperatively after deflating the tourniquet. Two cases required a lateral retinacular release. Release was performed from inside to outside in both the cases.

Postoperatively, epidural analgesia was given to all patients for 48 h, knee mobilization was started 1 day after surgery and all patients were mobilized with a walker 2-3 days after surgery as per the pain tolerance of the patient. Deep vein thrombosis (DVT) prophylaxis in the form of low molecular weight heparin was given till 3 weeks after surgery The patients were discharged average at 7 days (range 5-9 days) after surgery.

All patients were followedup at 6 weeks, 3 months, 1 year and then yearly. At each followup, the KSS scores were recorded. Radiographs (antero posterior, lateral view and full-length standing scanograms) were taken immediate postoperatively, at 3 months and yearly thereafter. Radiological assessment was performed for loosening, alignment (mechanical axis), patellar position (Insall Salvati index), component position and any evidence of polyethylene wear. Loosening was said to be present if radiolucent lines of more than 2 mm were seen, or if they appeared to be progressive as compared with the previous X-ray. Malalignment was considered if the tibiofemoral angle was less than 5° valgus (varus deformity) or more than 7° (valgus deformity).

Table 1: Types of Implant used following conversion of HTO to TKR

Type of implant	Number of knees
Unconstrained (CR)	49
Semi-constrained (LPS)	8
Constrained (LCCK)	1

CR=cruciate retaining, LPS=legacy posterior stabilized knee, LCCK=legacy constrained condylar knee

Results

The average KSS score at final followup improved from 38.5 (range 0-80 points) preoperatively to 88.5 postoperatively (range 35-95 points) ($P < 0.05$). The average FTA changed from 6.80 (degree) (range 5-12°) varus preoperatively to a valgus of 4.4^0 (range 2-8°) postoperatively. The average joint line height (JLH) improved an average of 9.6 mm (range 4.4. - 22 mm) ($P < 0.01$) at the last followup. The average ISR also improved postoperatively (average 1.11 preop to 1.21 average postoperative) ($P < 0.05$). Range of motion improved to 108° (range 85°-125°) from an average of 76° preoperative (range 55°-100°) ($P < 0.01$).

Progressive loosening was seen in one patient around the tibial component after 12 years and was revised to a NexGen LCCK implant. Nonprogressive radiolucent lines were seen in four patients at the last followup (three patients in zone 2 tibia and one patient in zone 3 in the femur). In terms of complications, revision was performed in one patient for deep infection, which was diagnosed at 7 months postoperative and a two stage revision surgery was planned for her. In the first stage, the entire implant was removed along with wound debridement and insertion of antibiotic spacer. The second stage was performed after 9 weeks of the first stage following a negative four-quadrant biopsy. The definitive implantation was performed with a Nexgen LCCK implant. In two patients, after sustaining a periprosthetic fracture, there was loosening of the tibial component requiring revision. One patient was 3½ years and another was 7½ years postTKA.

Other complications seen in our study included three superficial infections, which were managed aggressively with debridement. One patient had a patellar tendon avulsion 6 weeks after surgery, which was reconstructed with an autologous semitendinosus graft. Two patients, despite extensive physiotherapy, required manipulation under anesthesia. One of these did not achieve a good range of motion. One patient had a patellar subluxation, which was nonsymptomatic and was left alone.

The survival rates of TKA postHTO in our series at 10, 15 and at 18 years were 90.7%, 86.5% and 81%, respectively, which were comparable to those in the literature.

Discussion

Since the earliest times when osteotomy below the tibial tubercle was initially described by Jackson and Waugh,[8] various modifications of HTO have been described.[8]

The principle behind the technique is to partially offload

the medial compartment and to cause transfer of weight to the still healthy lateral compartment, in turn reproducing the normal valgus angle. Different HTO fixation techniques have shown variable success in the early stages, with failures in the long term necessitating conversion to TKA. Many studies have correlated the failure of HTO mainly to knees with preoperative Kellgren–Lawrence[9] grade more than two.[1,4-6,10-12] Survival of HTO at 10 years with TKA as the endpoint varies from 51% to 92% in various reports in the literature.[3]

Windsor and Insall[7] in 1988 reported on 45 TKA postHTO followedup for a minimum period of 2 years. There were 80% excellent and good results and 20% had fair and poor results. A reduced rate of satisfactory results and increased difficulty in exposing the knee was also inferred. They opined that their results were comparable to those after revision TKA. Mont and Krackow[5] in 1994 found that 36% of their patients had an inferior result at an average followup of 73 months. The factors leading to a poor result were related to workmen's compensation, reflex sympathetic dystrophy, early onset of pain postHTO and multiple surgeries.[5,7] Recent studies show relatively better results probably due to a better understanding of the technical difficulties involved and also the availability of more refined implants.[10-12]

Parvizi *et al.*,[6] in a recent study reported high femoral and tibial component loosening rates in patients who underwent TKA following a previous HTO. They found a higher rate of revision and prevalence of radiolucent lines in younger and heavy male patients. Despite the increased prevalence of radiolucent lines and a high rate of revision in their study, the prosthetic survival rate of postHTO TKA was high. They had attributed this to better prosthetic designs and improved surgical techniques. They had however excluded prosthesis known for poor outcomes such as metal-backed patellar components, all polyethylene tibial components, uncemented prosthesis and rotating hinged condylar prosthesis.[6]

In our study, at an average followup of 11.2 years, there were 89% excellent and good results and 11% fair and poor results. The poor results in four knees were due to the presence of patella baja. The patients were in pain while descending the stairs and had reduced range of motion. Patella baja has been hypothesized to be due to patellar tendon shortening resulting from 6 to 8 weeks of immobilization in a cast postHTO. The average KSS, knee society functional score and range of motion had improved significantly. On radiological comparison, the average femorotibial angle and joint line height had been corrected well and there were no major changes in the pre- and postoperative ISR.

Staeheli *et al.*,[10] at a followup of 44 months, reported on 35 TKAs and found good to excellent results in 89% of the knees. Amendola *et al.*[11] observed 42 knees at an average followup of 37 months and found no clinical differences between the group with previous HTO and those without. Meding *et al.*[12] reported a 10 year survival of greater than 98%. His 1, 3, 5 and 7 year knee scores averaged 77, 77, 78 and 75.3 points.

The average KSS knee score in our study improved from 38.5 points to 88.5 points at the time of final followup (average 11.2 years, range 3-18 years). These knees deteriorated at an average of 8 years and 5 months after their HTO. Preexisting incisions were incorporated in the surgery. Sharp dissection was used for proximal tibial release. Insall *et al.*[7] and Mont *et al.*[5] had reported on an increased incidence of lateral retinacular release to aid in exposure in their series. In our experience, the percentage of patients requiring lateral release was less than that reported by Insall and Mont.

A thicker than average articular surface height is used to restore the lateral joint line distance. Meding *et al.*[12] re-established the anatomical position of the lateral joint line by means of minimal resection of the lateral tibial bone and with use of a relatively thicker tibial component.

The limitation of our study was its retrospective nature. A matched pair analysis with that of primary TKR would have ruled out some bias. The strength of our study was the large number of patients with a long followup.

In conclusion, with better availability of component design and better understanding of technique, one can achieve favorable outcomes as suggested by our data. However, one should be cautious as technical difficulties in exposure can sometimes lead to component malpositioning, which can affect the final outcome. A possibility of inadequate soft tissue balancing and limb malalignment should always be kept in mind. Such patients require a regular followup to look for evidences of loosening. One should also counsel the patient and give a guarded prognosis in obese patients, those with patella Baja and patients who have had multiple previous surgeries of the affected knee.

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