

## Does High Tibial Osteotomy Affect the Success or Survival of a Total Knee Replacement?

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### Abstract

**Background** Whether a previous high tibial osteotomy (HTO) influences the long-term function or survival of a total knee arthroplasty (TKA) is controversial.

**Questions/purposes** We compared long-term functional scores and survival of bilateral TKAs in patients who had a previous HTO in one of the knees.

**Patients and Methods** From 1980 to 1995, we performed 5043 primary TKAs; 39 of these patients had bilateral TKAs at an average of 8.7 years after unilateral HTO. Surgery was simultaneous in 32 patients and staged in seven. There were 12 women and 27 men with an average age of 66.9 years at the time of surgery. At last followup, 19 of the 39 patients were living and had been reevaluated since our previous study. We determined function with Knee Society scores. The length of followup for patients who had HTOs averaged 14 years (range, 3–21 years); for patients without HTOs, the average followup was 13.9 years (range, 3–22 years).

**Results** We observed no differences in Knee Society function and radiographic and pain scores between the knees without and with previous HTO. Terminal extension and flexion, arc of motion, and knee alignment were similar

between the knees. There were no femorotibial revisions in either group of knees. Survival at 15 years was 100% for knees without previous HTO and 97% for knees with previous HTO.

**Conclusions** Our observations suggest a previous high tibial osteotomy does not influence the function or survival of a knee long term.

**Level of Evidence** Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

### Introduction

Controversy exists regarding the success of a TKA after a prior HTO [2–4, 6–13]. One might question whether failures would be greater in the long term as the HTO shortens the proximal tibia, the ligaments become lax and the proximal bone is more sclerotic. We previously reported 39 patients with bilateral TKAs who had one prosthesis implanted in a knee with a previous HTO [8]. At an average of 7 years after surgery, they were clinically and radiographically similar.

We have followed these patients an additional 7 years and again asked if the prior HTO makes a difference in the function after a TKA, and if there is a difference in prosthetic survivorship between these knees?

### Patients and Methods

From 1980 to 1995, 5043 primary TKAs were performed at our institution. Of this group, 39 patients with previous unilateral closing wedge HTOs had bilateral, cemented TKAs. The osteotomies had been performed an average of

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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8.7 years (range, 2.0–15.4 years) before TKA. The original osteotomy failed in 28 of the 39 patients (72%) owing to recurrence of deformity; in the remaining 11 patients, the failure related to progressive osteoarthritis of the lateral compartment. There were 12 women and 27 men with an average age of 66.9 years at time of surgery. No patient was lost to followup. Twenty patients died, three in the first 7 years at the time of the first review [8] and 13 in the past 7 years. Thus, 19 of the 39 patients (49%) were alive. All had followups since the previous study. The followups for patients with HTOs averaged 14 years, (range, 3–21 years) and for patients without HTOs, 13.9 years (range, 3–22 years). No patients were recalled specifically for this study; all data were obtained from medical records and radiographs. This project (MV 102) was approved by our Institutional Review Board.

Both knees had the same posterior cruciate-retaining prosthesis implanted with the same surgical technique [8]. There were two important surgical concerns for the knee with a previous HTO. First, the patellar tendon may be fixed to the proximal tibia and theoretically is shorter. Great care must be taken to free it up to its original insertion and then protect it from being avulsed. Second, the proximal tibia has been shortened and therefore must be cut as thin as possible to expose cancellous bone for cementation of the tibial component and avoid a flexion and extension gap imbalance. Other important specific difficulties include the metadiaphyseal mismatch, ligament balancing in an original varus knee corrected to valgus, medial and lateral joint line level, and inverted tibial slope. Surgery was simultaneous in 32 patients and staged in seven at an average interval of 60 months (range, 10–97 months). Thirty-eight patients had an Anatomic Graduated Component (AGC; Biomet, Inc, Warsaw, IN, USA) implanted, and one had a posterior cruciate-retaining Posterior Cruciate Condylar Prosthesis (Howmedica; East Rutherford, NJ, USA). The data were collected prospectively and analyzed retrospectively.

Patients were followed at 2, 6, and 12 months and then every 2 years thereafter with clinical evaluations (ROM, extensor lag, and medial, lateral, and AP laxity) using the Knee Society clinical and radiographic scoring systems (standing AP and recumbent lateral and patellar views) preoperatively and postoperatively [1, 5].

Data were analyzed using the Wilcoxon signed-rank test (nonparametric paired test) and the paired t-test. The F-test was used to detect any differences in variance between knees that had HTOs and TKRs for equality of variance. Spearman and Pearson correlation coefficients were reported to evaluate the degree of correlation between paired knees. Survival analysis was performed using Kaplan-Meier survival analysis with failure defined as reoperation for any reason of the tibia or femur and

excluding metallosis secondary to a metal-backed patella. Patients who died were censored at their death date. Statistical analysis was performed using SAS software program (SAS Institute, Cary, NC, USA).

## Results

At latest followup, we observed no differences in the Knee Society scores for the knees without and with previous HTOs (Table 1). The pain scores were similar ( $p = 0.1252$ ) between knees.

Kaplan–Meier survival at 15 years was 100% for knees without a previous HTO, and 97% for knees with a previous HTO. There were no new revisions attributable to failure as defined by loosening or wear since the last study. There was one new revision attributable to metallosis secondary to patella disassociation in a knee having a previous HTO. We have had no revisions of the femoral or tibial components.

## Discussion

Concern remains regarding the results of a TKR after an HTO. Because of the difficulties doing a TKA after an HTO, we determined the function and survival of TKA in knees without and with previous HTOs.

Our study has some limitations. First is the sample size. As we had only 19 surviving patients, we found no difference in survival rates between the knees without and with previous HTOs. Given the limited power there is a possibility of a Type II error. However, as patients had one knee without and one with an osteotomy, the knee without the osteotomy served as an internal control, avoiding the variability that would occur if the knees without and with HTOs were in different patients. Second, some elements (eg, walking distance) of the Knee Society score are not independent variables [1, 5]. That is, they cannot be segregated for an individual knee, affect the function of both knees simultaneously, and cannot be distinguished in a statistical analysis. Other elements (eg, ROM) are independent but we did not separately analyze them in knees without and with previous HTOs. Third, owing to the retrospective nature of this investigation, we did not have a true control group, which would have been the group of patients electing to proceed with primary TKR despite being a candidate for tibial osteotomy. A true control group would have eliminated the high correlation between patients' left and right knees in the statistical testing.

Our data suggest there is no difference in the function after a TKA, for patients with or without a prior HTO. Since our previous study [8] in 2000, numerous studies

**Table 1.** Clinical results

Variable	Knees with high tibial osteotomy	Knees without high tibial osteotomy	Correlation (p value)		p Values		Raw observed difference (paired data)	Observed power	Patients needed for power $\geq 0.80$	Required difference for power $\geq 0.80$ at present number
			Spearman (nonparametric)	Pearson (parametric)	Wilcoxon signed-rank (nonparametric)	Paired t-test (parametric)				
Followup (years)	16.7 $\pm$ 2.4 (12.7,21.0)	16.6 $\pm$ 2.9 (2.5,22.4)			0.5000	0.2559				
Knee score (points)	87.2 $\pm$ 15.4 (33,100)	90.3 $\pm$ 7.6 (69,100)	0.16 (0.3414)	0.03 (0.8713)	0.5042	0.2364	3.4 points	0.220	198	8.1 points
Alignment (degrees)	4.6 $\pm$ 4.0 (-10,14)	4.6 $\pm$ 2.8 (-7,10)	0.50 (0.0017)	0.15 (0.3712)	0.9790	0.9711	0.0 degrees	0.050	178608	2.2 degrees
Pain (points)	47.0 $\pm$ 8.7 (0,50)	49.1 $\pm$ 3.5 (30,50)	0.56 (0.0003)	0.33 (0.0473)	0.0313	0.1252	2.2 points	0.353	112	3.9 points
Range of motion										
Extension (degrees)	-0.1 $\pm$ 4.7 (-20,10)	-0.3 $\pm$ 3.7 (-20,10)	0.77 (< 0.0001)	0.85 (< 0.0001)	1.0000	1.0000	0.0 degrees	0.050	487966	1.2 degrees
Flexion (degrees)	110.6 $\pm$ 11.7 (80,130)	112.6 $\pm$ 10.2 (90,130)	0.82 (< 0.0001)	0.82 (< 0.0001)	0.0740	0.0779	1.9 degrees	0.387	101	3.2 degrees
Function score (points)	70.1 $\pm$ 23.2 (0,100)	72.6 $\pm$ 20.5 (25,100)	0.99 (< 0.0001)	0.99 (< 0.0001)	0.5000	0.1601	0.5 points	0.112	530	2.0 points
Walking score (points)	37.9 $\pm$ 15.6 (0,50)	39.2 $\pm$ 14.6 (10,50)	0.98 (< 0.0001)	0.99 (< 0.0001)	1.0000	0.3240	0.3 points	0.117	487	1.2 points
Stairs score (points)	32.2 $\pm$ 11.7 (0,50)	33.4 $\pm$ 10.5 (0,50)	0.97 (< 0.0001)	0.99 (< 0.0001)	1.0000	0.3240	0.4 points	0.147	342	1.0 points

Values are expressed as means, with ranges in parentheses

have reported on TKAs after HTOs with and without patient-matched comparisons [2–4, 6, 7, 9, 10, 12, 13]. Three studies without patient-matched comparisons concluded the outcome of TKAs after HTOs is inferior to that of TKAs without previous HTOs [7, 9, 10]. They all note the technically demanding nature of the procedure as the cause for the inferior results. Several patient-matched studies arrive at opposing conclusions from those of the aforementioned studies. Walther et al. [13], in a study of 35 patients, noted similar complications in both knees. They found extended hematomas more frequent in patients with previous HTOs. Postoperative knee scores were lower for patients with previous HTOs, but they observed no difference in function scores, ROM, or alignment. The study by Haddad and Bentley [3] included 50 knees in 42 patients with an average followup of 6.2 years. They found overall outcomes “good to excellent” for most patients with subtle clinical differences in their patient-matched comparison. Similarly, Huang et al. [4] concluded a previous HTO does not negatively affect the outcome of a TKA. The 17 knees followed at an average of 59.4 months had outcomes of 94% with excellent or good results and no differences in knee score, function score, or ROM [4]. van Raaij et al. [12] reported no differences between the knees in their patient-matched comparison with an average followup of 3.7 years. The final patient-matched studies also found HTOs do not have a negative effect on later TKAs [6].

As there were no femorotibial revisions, there seemed to be no major differences in the survivorship of a TKA in either group of knees. However, we reiterate we had limited power, so the finding should not be considered definitive.

In our previous study [8], we found the knee scores and survival for TKAs were similar for patients having a previous HTO and patients without a previous HTO. After analysis of the updated data, which included longer followup (with HTO, 14 years; without HTO, 13.9 years), we reached similar conclusions. Clinical scores were similar between knees, and survivorship for a TKA with previous HTO appears similar to that for patients having a TKA without previous HTO. Ranges of motion were similar for the two knees. Our observations suggest the concerns of diminished ROM and residual instability are not warranted. A TKA for patients having had an HTO appears to

continue to provide the same outcomes as those for patients without a previous HTO.

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