

Clinical Research

Analysis of TKA Patients Following High Tibial Osteotomy with Matched Primary TKA Patients (HTO -TKA vs primary TKA)

Berkin TOKER¹, Tunay ERDEN^{1,a}, Ömer TAŞER¹

¹Acıbadem Fulya Hastanesi, Ortopedi Kliniği, İstanbul, Türkiye

ABSTRACT

Objective: High tibial osteotomy could change the anatomy of the knee and there may be technical difficulties while performing the surgery and thus dissatisfaction with the clinical results.

The purpose of this study is to compare the clinical and radiological results between primary TKA and TKA after HTO.

Material and Method: Between 2001 and 2019 we evaluated 26 patients who were performed total knee arthroplasty with a history of previous high tibial osteotomy. This group was compared with 26 patients with similar age, body mass index (BMI), follow-up time and prosthesis design from remain primary total knee arthroplasty (p-TKA). All patients were evaluated clinically according to range of motion (ROM), Knee Society Score (KSS), Knee Society Score-Function (KSSF), The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), preoperatively and postoperatively. Radiologic assessments were evaluated pre- and post-operatively by antero-posterior and lateral X-ray view, and orthoroentgenogram. Femoro-tibial angle (FTA), tibial slop and Insall-Salvati ratio were compared in both groups.

Results: In HTO group all 26 patients were female (100%) while in p-TKA group there were 19 female (73.1%) and 7 male (26.9%) patients. The mean age was similar (HTO = 65,7; p-TKA=65,2). Total follow-up time was 52 months in HTO group; 55 months in p-TKA group. The mean time interval between HTO and TKA was 125 ± 22 (45-192) months. There were no significant difference between the groups regarding preoperative demographic or clinical data.

Conclusion: The main finding of this study was that, both primary TKA and TKA after HTO had similar clinical and radiological results.

Keywords: High Tibial Osteotomy, Total Knee Arthroplasty Following High Tibial Osteotomy, Open Wedge High Tibial Osteotomy, Total Knee Arthroplasty.

ÖZ

Yüksek Tibial Osteotomiye Takiben TDA Hastalarının Eşleştirilmiş Primer TDA Hastaları ile Analizi (HTO -TKA ile primer TKA karşılaştırılması)

Amaç: Yüksek tibial osteotomi (HTO) diz anatomisini değiştirebilir. Ameliyat sırasındaki muhtemel teknik zorluklar klinik sonuçlarda memnuniyetsizlik doğurabilir.

Bu çalışmanın amacı, HTO sonrası total diz artroplastisi (TDA) ile primer TDA arasındaki klinik ve radyolojik sonuçları karşılaştırmaktır.

Gereç ve Yöntem: 2001 ve 2019 yılları arasında, yüksek tibial osteotomi geçirmiş ve daha sonra total diz protezi ile revize edilmiş 26 hasta çalışma amacıyla retrospektif olarak değerlendirildi. Bu grup benzer yaş, vücut kitle indeksi, takip süresi ve primer total diz artroplastisi (p-TDA) hastalarından benzer protez tasarımına sahip 26 hasta ile karşılaştırıldı. Tüm hastalar ameliyat öncesi ve sonrası eklem hareket açıklığı (ROM), Knee Society Score (KSS), Knee Society Score-Function (KSSF), The Western Ontario ve McMaster Universities Osteoarthritis Index (WOMAC) açısından klinik olarak değerlendirildi. Radyolojik değerlendirmeler ameliyat öncesi ve sonrası ön-arka ve yan direk grafiler ve ortoroentgenogram ile değerlendirildi. Femoro-tibial açı (FTA), tibial slop ve Insall-Salvati oranları gruplar arasında karşılaştırıldı.

Bulgular: HTO grubunda 26 hastanın tamamı kadın (%100) iken p-TKA grubunda 19 kadın (%73.1) ve 7 erkek (%26.9) hasta vardı. Ortalama yaş benzerdi (HTO = 65,7; p-TKA = 65,2). HTO grubunda toplam takip süresi 52 aydı; p-TKA grubunda 55 ay. HTO ile TKA arasındaki ortalama zaman aralığı 125 ± 22 (45-192) aydı. Ameliyat öncesi demografik veya klinik veriler açısından gruplar arasında anlamlı bir fark yoktu.

Sonuç: Bu retrospektif çalışmada hem HTO sonrası TDA hem de primer TDA'nın benzer klinik ve radyolojik sonuçlara sahip olduğu gösterilmiştir.

Anahat Sözcükler: Yüksek Tibial Osteotomi, Yüksek Tibial Osteotomi Sonrası Total Diz Artroplastisi, Açık Kama Yüksek Tibial Osteotomi, Total Diz Protezi.

Bu makale atıfta nasıl kullanılır: Toker B, Erden T, Taşer Ö. Yüksek Tibial Osteotomiye Takiben TDA Hastalarının Eşleştirilmiş Primer TDA Hastaları ile Analizi (HTO -TKA ile primer TKA karşılaştırılması). *Firat Tıp Dergisi* 2021; 26(4): 230-233.

How to cite this article: Toker B, Erden T, Taşer Ö. Analysis of TKA Patients Following High Tibial Osteotomy with Matched Primary TKA Patients (HTO -TKA vs primary TKA). *Firat Med J* 2021; 26(4): 230-233.

ORCID IDs: B.T. 0000-0001-9453-7738, T.E. 0000-0002-0926-5879, Ö.T. 0000-0002-5938-776X.

Medial open wedge high tibial osteotomy (HTO) is a good treatment option for medial gonarthrosis in young population especially in short to mid-term period (1, 2). It is accepted that HTO could delay the need of arthroplasty at least 15 years (3). But in the long term some of the HTO are has to be revised with total knee arth-

roplasty (TKA) (4).

There are numerous studies with varying results. Some authors reported similar results with primary TKA (5-7) while some reported counterview (8, 9) due to possible technical difficulties like shortening of the patellar tendon and transposition of tibial condyle.

^aYazışma Adresi: Tunay ERDEN, Acıbadem Fulya Hastanesi, Ortopedi Kliniği, İstanbul, Türkiye

Tel: 0212 306 4000

Geliş Tarihi/Received: 03.05.2021

e-mail: tunayerden@gmail.com

Kabul Tarihi/Accepted: 28.09.2021

Also soft tissue scarring due to previous operation and difficulty in the exposure may give additional risk especially to the tibial tubercle avulsion (10).

The purpose of this study is to compare the clinical and radiological results between primary TKA and TKA after HTO. Our hypothesis was in both groups there would be similar results.

MATERIAL AND METHOD

Between 2001 and 2019 we evaluated 1651 patients who were performed total knee arthroplasty by senior author (Ö.T). Patients who had rheumatologic disease (n =68), revision TKA (114), needed to use femoral or tibial augment (n =81), >15 degrees of varus or valgus deformity or periprosthetic fracture (n =73), previous closing wedge medial or open wedge lateral HTO (n =19), and lost to follow-up (n =202) were excluded. From 1208 patients 26 of them had previous medial open wedge HTO operation. This group was compared with 26 patients with similar age, body mass index (BMI), follow-up time and prosthesis design from remain primary total knee arthroplasty (p-TKA) patients. All patients were investigated by a physical examination and the application of clinical scores by senior author.

All patients were evaluated clinically according to range of motion (ROM), Knee Society Score (KSS), Knee Society Score-Function (KSSF), The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), preoperatively and postoperatively.

Radiologic assessments were evaluated pre- and postoperatively by antero-posterior and lateral X-ray view, and ortoroentgenogram. All radiological measurements were performed by two trained orthopaedic fellows. Femoro-tibial angle (FTA), tibial slop and Insall-Salvati ratio were compared in both groups.

All HTO operations were made using opening wedge technique with medial longitudinal incision.

Patients with HTO who had persistent pain at least 6 months that were resistant to conservative treatment and severe osteoarthritis in their plain radiographs revised with TKA

(Genesis 2, Smith&Nephew, Memphis, TN, USA). Midline longitudinal skin incision were used in all patients. In HTO group the incision was extended due to hardware removal before arthroplasty procedure. Posterior cruciate retaining (CR) or sacrificing (PS) femoral component was used according to perioperative flexion contracture and posterior cruciate ligament stability.

Postoperative rehabilitation was the same in both groups. On the first postoperative day passive knee ROM exercises started with continuous passive motion (CPM) machine. Weight bearing is allowed with two crutches as patient tolerated.

The study was approved by Institutional Review Board (2021/02-23) and informed consent was obtained from each patient.

Statistical Analysis

The statistical analyses were performed using SPSS, version 22 (IBM SPSS Statistics for Windows, Armonk, NY; IBM Corp., Released 2013). First, a Kolmogorov-Smirnov test was used to determine which variables should be included in the data analysis and whether the data for the variables were normally distributed. Student T-test was used for normally distributed, and Mann-Whitney U test for non-normally distributed variables.

The Mann-Whitney U test was used to compare continuous variables across the groups. The mean ± standard deviation, median (Q1 (1st quartile)-Q3 (3rd quartile)), frequency and percentage were reported as descriptive statistics (p <0.05). Power analysis was not performed as all cases were included.

RESULTS

In HTO group all 26 patients were female (%100) while in p-TKA group there were 19 female (%73.1) and 7 male (26.9%) patients. The mean age was similar in both groups (HTO=65,7; p-TKA=65,2). Total follow-up time was 52 months in HTO group; 55 months in p-TKA group. The mean time interval between HTO and TKA was 125 ± 22 (45-192) months.

There were no significant difference between the groups regarding preoperative demographic or clinical data. Also no significant difference was found regarding KSS, KSS- f, WOMAC (Table 1).

Table 1. HTO: high tibial osteotomy, p-TKA: primary total knee arthroplasty, KSS: Knee Society Score, KSS-F: Knee Society Score-Function, WOMAC: The Western Ontario and McMaster Universities Osteoarthritis Index, Preop flex.: Preoperative flexion angle, Postop flex.: Postoperative flexion angle, Postop ext.def.: Postoperative extension deficit angle.

	HTO	p-TKA	p value
WOMAC	80 (79.5-81.2)	82 (79.7-82)	1,71
KSS	78 (74,6-81)	81,3 (77,4-84,5)	0,98
KSS-F	71,1(63-79)	72,2 (69-75,6)	0,81
Preop flex.	97 (91-114)	100,1 (94-112)	0,36
Postop flex.	110 (93,75- 120)	120 (117-122)	<0,05
Postop ext. def.	0,76	0,30	0,35

Only post-operative flexion angle was found to be significant which is better in p-TKA group. Between radiologic data only preoperative tibial slope is higher in HTO group which is expected (Table 2).

Table 2. HTO: High Tibial Osteotomy; p-TKA: Primary Total Knee Arthroplasty; FTA: Femoro-Tibial angle.

	HTO	p-TKA	p value
Tibial slope (preop)	9 (7-10)	8,2 (7,5-9)	<0,05
Tibial slope (postop)	8,5 (8-8,9)	6,5 (6-6,62)	<0,05
Insall salvati (preop)	0,85 (0,81- 0,88)	0,91 (0,91-0,91)	<0,05
Insall salvati (postop)	0,78 (0,76-0,82)	0,95 (0,95-095)	<0,05
FTA (preop)	5 (5-6)	5 (5-7)	0,25
FTA (postop)	4 (2,91-5,42)	4 (2,91-5,42)	0,82

Only one revision due to deep joint infection was performed in HTO group and two staged revision was performed, while there was none in p-TKA group. In 14 of the HTO group and 8 of the p-TKA group PS design prosthesis was used. We found no correlation between CR and PS design according to clinical and radiologic parameters.

DISCUSSION

The main finding of this study was that, both primary TKA and TKA after HTO had similar clinical and radiological results. Our hypothesis has been verified with the data obtained from the study.

HTO is a good option especially for young active medial compartment osteoarthritis. Even though mid to long term results are good in literature (1), there may be a need for a revision to arthroplasty in 30% of the patients (11).

There are some opposite views in the literature regarding the results of TKA after failed high tibial osteotomy. Haslam and Erak (8, 9) reported poorer outcomes after HTO. While Ramappa and friends (12) found no difference in complications, revisions and functional outcomes. Our study reveals that TKA after HTO had similar results compared to primary TKA.

The main concerns about TKA after HTO is patellar length and tibial tubercle position and tibial slope. Nha and colleagues (13) evaluated the posterior tibial slope in their meta analysis and found that open wedge HTO increases the slope. Theoretically increased posterior slope may weakened posterior cruciate ligament (14). In our study PS design prosthesis was used more in HTO group (which is more than half of the cases) as expected. Also our posterior slope angles were higher in HTO group. But we did not find any correlation between increased slope and clinical scores.

In HTO group we found lower insall-salvati ratios (patella baja) which is significantly important. Kazakos et al (15) found similar results in their study. This may cause anterior knee pain and increase in revision rates.

However we could not match this finding with our overall clinical findings.

We prefer open wedge technique in correcting varus malalignment. Some authors compare open wedge and closing wedge technique regarding the results of TKA. Badawy and Bastos (16, 17) found similar results in both technique.

An important finding in our study was postoperative flexion differences. Even though it was not changed the overall clinical scores in primary TKA group flexion angles were better. There may be some reasons to explain it. First of all preoperative flexion angles were lower than p-TKA group which may be related with previous surgery. As known most predictor of the postoperative flexion angle is preoperative degree (18). To balance soft tissues is more difficult in osteotomised patients which is also the other possible factor for decreased flexion (19).

Postoperative infection is another possible complication in osteotomised group. Due to higher operation time, soft tissue scarring, implant removal some authors reported increased infection rates (20). In the review of Chen (21) and friends infection rates was found to be 1.4%. In our HTO group only 1 patient (3.8%) revised due to infection where there is none in primary TKA group. Due to small sample size it is difficult to make an inference.

This study has several limitations. Besides being retrospective design sample sizes are small. We try to match two groups as close as possible regarding age, BMI, follow up time, prosthesis design. All operations were done by a single senior surgeon. But still we could not eliminate all of the selection bias.

In conclusion as in our hypothesis total knee arthroplasty after previous high tibial osteotomy has satisfactory results. Overall functional scores, patient satisfaction and pain relief are similar with primary knee arthroplasties. High tibial osteotomy is a good option in active young patients with medial compartment osteoarthritis, although some of them need to be revised after a while.

REFERENCES

1. Insall JN, Joseph DM, Msika C. High tibial osteotomy for varus gonarthrosis. A long-term follow-up study. *J Bone Joint Surg Am* 1984; 66:1040-8.
2. Akasaki Y, Matsuda S, Miura H et al. Total knee arthroplasty following failed high tibial osteotomy: mid-term comparison of posterior cruciate-retaining versus posterior stabilized prosthesis. *Knee Surg Sports Traumatol Arthrosc* 2009; 17: 795-9.
3. Ollivier B, Berger P, Depuydt C, Vandenneucker H. Good long-term survival and patient-reported outcomes after high tibial osteotomy for medial compartment osteoarthritis. *Knee Surg Sports Traumatol Arthrosc* 2020. Epub 2020/09/11. doi: 10.1007/s00167-020-06262-4.
4. Preston S, Howard J, Naudie D, Somerville L, McAuley J. Total knee arthroplasty after high tibial osteotomy: no differences between medial and lateral osteotomy approaches. *Clin Orthop Relat Res* 2014; 472: 105-10.
5. Amendola L, Fosco M, Cenni E, Tigani D. Knee joint arthroplasty after tibial osteotomy. *Int Orthop* 2010; 34: 289-95.
6. A WD, Robertsson O. Similar outcome for total knee arthroplasty after previous high tibial osteotomy and for total knee arthroplasty as the first measure. *Acta Orthop* 2016; 87: 395-400.
7. El-Galaly A, Nielsen PT, Jensen SL, Kappel A. Prior High Tibial Osteotomy Does Not Affect the Survival of Total Knee Arthroplasties: Results From the Danish Knee Arthroplasty Registry. *J Arthroplasty* 2018; 33: 2131-5 e1.
8. Haslam P, Armstrong M, Geutjens G, Wilton TJ. Total knee arthroplasty after failed high tibial osteotomy long-term follow-up of matched groups. *J Arthroplasty* 2007; 22: 245-50.
9. Erak S, Naudie D, MacDonald SJ, McCalden RW, Rorabeck CH, Bourne RB. Total knee arthroplasty following medial opening wedge tibial osteotomy: technical issues early clinical radiological results. *Knee* 2011; 18: 499-504.
10. van Raaij TM, Bakker W, Reijman M, Verhaar JA. The effect of high tibial osteotomy on the results of total knee arthroplasty: a matched case control study. *BMC Musculoskelet Disord* 2007; 8: 74.
11. Schuster P, Geßlein M, Schlumberger M et al. Ten-Year results of Medial open-wedge high tibial osteotomy and chondral resurfacing in severe medial osteoarthritis and varus malalignment. *Am J Sports Med* 2018; 46: 1362-70.
12. Ramappa M, Anand S, Jennings A. Total knee replacement following high tibial osteotomy versus total knee replacement without high tibial osteotomy: a systematic review and meta analysis. *Arch Orthop Trauma Surg* 2013; 133: 1587-93.
13. Nha KW, Kim HJ, Ahn HS, Lee DH. Change in Posterior tibial slope after open-wedge and closed-wedge high tibial osteotomy: A Meta-analysis. *Am J Sports Med* 2016; 44: 3006-13.
14. Windsor RE, Insall JN, Vince KG. Technical considerations of total knee arthroplasty after proximal tibial osteotomy. *J Bone Joint Surg Am* 1988; 70: 547-55.
15. Kazakos KJ, Chatzipapas C, Verettas D, Galanis V, Xarchas KC, Psillakis I. Mid-term results of total knee arthroplasty after high tibial osteotomy. *Arch Orthop Trauma Surg* 2008; 128: 167-73.
16. Bastos Filho R, Magnussen RA, Duthon V et al. Total knee arthroplasty after high tibial osteotomy: a comparison of opening and closing wedge osteotomy. *Int Orthop* 2013; 37: 427-31.
17. Badawy M, Fenstad AM, Indrekvam K, Havelin LI, Furnes O. The risk of revision in total knee arthroplasty is not affected by previous high tibial osteotomy. *Acta Orthop* 2015; 86: 734-9.
18. Matsumoto T, Muratsu H, Kubo S et al. Soft tissue balance measurement in minimal incision surgery compared to conventional total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc* 2011; 19: 880-6.
19. Papp M, Zsakai Z, Gomori A. Comparison of total knee arthroplasty after combined high tibial osteotomy with a matched group of primary total knee arthroplasty. *Eklem Hastalık Cerrahisi* 2019; 30: 79-84.
20. Haddad FS, Bentley G. Total knee arthroplasty after high tibial osteotomy: a medium-term review. *J Arthroplasty* 2000; 15: 597-603.
21. Chen X, Yang Z, Li H, Zhu S, Wang Y, Qian W. Higher risk of revision in total knee arthroplasty after high tibial osteotomy: a systematic review and updated meta-analysis. *BMC Musculoskelet Disord* 2020; 21: 153.