



Comparison of total knee arthroplasty after combined high tibial osteotomy with a matched group of primary total knee arthroplasty

Kombine yüksek tibial osteotomiden sonra total diz artroplastisi ile primer total diz artroplastisinin karşılaştırılması

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ABSTRACT

Objectives: This study aims to compare the results of total knee arthroplasties (TKAs) performed after previous combined high tibial osteotomy (CO) to those of a matched control group of primary TKA.

Patients and methods: Between 01 August 2006 and 31 December 2011, we performed 24 consecutive cemented TKAs in 24 patients (10 males, 14 females; mean age 69.5 years; range, 60 to 79 years) who had undergone previous CO (study group). The study group was compared to a control group of 24 patients (10 males, 14 females; mean age 69.9 years; range, 63 to 79 years) who were performed primary TKA during the same period. Pre- and postoperative The Knee Society knee and function score and range of movement were determined. The femorotibial angle, the distance between the tangent to the lateral subchondral plate and the top of the fibular head, the transposition of the tibial condyle, the length of the patellar tendon and the tibial slope angle were measured preoperatively. At final follow-up, the same parameters were calculated and the amount of lateral tibial bone resection was determined.

Results: The mean follow-up duration was 97 months (range, 61 to 124 months) in the study group and 97 months (range, 61 to 123 months) in the control group. TKA survivorship rate was 100% in both groups. At final follow-up, there were no significant differences regarding the clinical and radiographic data. However, only the amount of the resected lateral bone was significantly lower in the study group than in the control group.

Conclusion: In young and active people with medial knee arthrosis, in whom the planned correction is 10° or higher, we continue to suggest CO since it does not seem to influence the results of TKA negatively.

Keywords: Clinical scoring systems of The Knee Society, matched groups, primary total knee arthroplasty, total knee arthroplasty after combined high tibial osteotomy.

ÖZ

Amaç: Bu çalışmada önceki kombine yüksek tibial osteotomi (KO) sonrası total diz artroplastisi (TDA)'lerinin sonuçları eşleştirilmiş bir primer TDA kontrol grubununkiler ile karşılaştırıldı.

Hastalar ve yöntemler: 01 Ağustos 2006-31 Aralık 2011 tarihleri arasında önceden KO geçiren 24 hastada (10 erkek, 14 kadın; ort. yaş 69.5 yıl; dağılım, 60-79 yıl) 24 ardışık çimentolu TDA uygulandı (çalışma grubu). Çalışma grubu aynı dönemde primer TDA uygulanan 24 hastalık bir kontrol grubu (10 erkek, 14 kadın; ort. yaş 69.9 yıl; dağılım, 63-79 yıl) ile karşılaştırıldı. Ameliyat öncesi ve sonrası Diz Derneği diz ve fonksiyon skoru ve hareket açıklığı belirlendi. Femorotibial açı, lateral subkondral plağa tanjan ve fibula başının üstü arasındaki mesafe, tibial kondilin transpozisyonu, patellar tendonun uzunluğu ve tibial eğim açısı ameliyat öncesinde ölçüldü. Son takipte, aynı parametreler hesaplandı ve lateral tibial kemik rezeksiyonunun miktarı belirlendi.

Bulgular: Ortalama takip süresi çalışma grubunda 97 ay (dağılım, 61-124 ay) ve kontrol grubunda 97 ay (dağılım, 61-123 ay) idi. Her iki grubun TDA sağkalım oranı %100 idi. Son takipte, klinik ve radyolojik veriler açısından anlamlı farklılık yoktu. Fakat sadece rezeke edilen lateral kemik miktarı çalışma grubunda kontrol grubundan anlamlı olarak daha düşüktü.

Sonuç: Planlanan düzeltmenin 10° veya daha yüksek olduğu, medial diz artrozlu genç ve aktif kişilerde TDA'nın sonuçlarını olumsuz etkilemediği görülen KO'yu önermeye devam ediyoruz.

Anahtar sözcükler: Diz Derneği klinik skorlama sistemleri, eşleştirilmiş gruplar, primer total diz artroplastisi, kombine yüksek tibial osteotomi sonrası total diz artroplastisi.

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High tibial osteotomy (HTO) is a well-established procedure for treatment of the varus osteoarthritic knee. High tibial osteotomy produces satisfactory clinical results in the short-term but these results may deteriorate with time.^[1-6] Many patients who undergo HTO require total knee arthroplasty (TKA).^[4,7,8]

Therefore, when setting up the indication of HTO, one should pay attention that HTO does not compromise the subsequent TKA and that the results do not deteriorate more rapidly compared to primary TKA alone.^[9]

Earlier studies produced varying results for TKA after failed HTO. Several authors reported that the results of TKA in patients with a previous HTO were similar to those after primary TKA.^[10-16] Others have demonstrated inferior results of TKA after HTO with technical difficulties^[5,9,17,18] because of shortening of the patellar tendon and transposition of the tibial condyle caused by previous HTO.

According to our former studies,^[19,20] a combined high tibial osteotomy (CO) does not change considerably the position of the tibial condyle and the patella, thus we believe that CO does not compromise the subsequent TKA, hypothesizing that the clinical and radiological results and survivorship of TKA performed after failed CO are similar to primary TKA in the medium-to-long term. Therefore, in this study, we aimed to compare the results of TKAs performed after previous CO to those of a matched control group of primary TKA.

PATIENTS AND METHODS

This retrospective study was conducted at Department of Orthopaedic Surgery, Borsod County Teaching Hospital. Between 01 August 2006 and 31 December 2011, we performed 24 consecutive cemented TKAs in 24 patients (10 males, 14 females; mean age 69.5 years; range, 60 to 79 years) who had undergone previous CO (study group). The study group was compared to a control group of 24 patients (10 males, 14 females; mean age 69.9 years; range, 63 to 79 years) who were performed primary TKA during the same period. The study group was matched to the control group according to age, gender, weight, etiology, prosthetic design and duration of follow-up. The study protocol was approved by the Borsod County Teaching Hospital Ethics Committee. A written informed consent was obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki.

We performed CO^[19,20] (combination of lateral closing and medial opening wedge osteotomy) in

all cases in 1993. We preferred CO if the planned correction was 10° or higher.^[19,20] Hardware was removed prior to TKA in all cases.

Preoperatively and at the final follow-up, the knees were evaluated according to the clinical scoring system of the Knee Society (knee and function score).^[21]

Preoperatively, in both groups, we determined the anatomical femorotibial angle, the distance between the tangent to the lateral subchondral plate and the top of the fibular head and the amount of the transposition of the tibial condyle with respect to its bony axis on a preoperative weight-bearing anteroposterior radiograph. The transposition of the tibial condyle was calculated according to the method of Yoshida et al.^[22]

In both groups, preoperative length of the patellar tendon was determined according to the method of Insall-Salvati^[23] and the tibial slope (TS) angle was determined according to the method of Bonnin^[24] on a lateral radiograph. We determined the amount of lateral tibial bone resection as the difference of the following two values: the distance between the tangent to the lateral subchondral tibial plate and the top of the fibular head measured on preoperative weight-bearing anteroposterior radiograph and the distance between the tangent to the distal surface of the tibial component and the top of the fibular head measured on the radiograph taken in the third postoperative month. At the final follow-up, we evaluated the alignment and the TS in both groups.

The indication for conversion from CO to TKA and for primary TKA was increasing pain with radiological progression of osteoarthritis. In both groups, posterior cruciate retaining prosthesis (DePuy Synthes; P.F.C. SIGMA; Warsaw, Indiana, USA) was used in all cases without utilizing any patellar component. All knees were approached through the standard medial parapatellar incision. In both groups, we recorded the number of the release of different types.

The postoperative care was similar in both groups. On the first postoperative day, the patients started passive exercises with a continuous passive motion device and active exercises as well. Partial weight-bearing was permitted on the fourth postoperative day and full-weight-bearing on the 10th day.

Statistical analysis

Microsoft Excel 2007 and 2010 furthermore SysStat Sigmaplot 12.0 were used with the same results. Results of the study and the control groups were

compared using the paired t-test. *P* values below 0.05 were considered statistically significant.

RESULTS

There were no significant differences between the two groups regarding their preoperative demographic or clinical radiographic data. Only the distance between the tangent to the lateral tibial subchondral plate and the top of the fibular head was significantly

less in the study group than in the control group ($p=0.0000008$) (Tables I, II, III).

More releases were required for soft tissue balancing in the study group (10 deep and 5 superficial medial collateral ligaments, 9 lateral retinacular releases) than in the control group (6 deep and 2 superficial medial collateral ligaments, 7 lateral retinacular releases).

TABLE I
Demographic data of patients

	Mean	Range	<i>p</i>
Follow-up patient's group (months)	97	61-124	-
Follow-up control group (months)	97	61-123	-
Conversion interval (months)	102	60-156	-
Age in patient's group (years)	69.5	60-79	0.80
Age in control group (years)	69.9	63-79	
Body mass index in patient's group (years)	31.43	22.20-37.87	0.82
Body mass index in control group (years)	31.17	24-38.02	

TABLE II
Preoperative clinical data

	Mean±SD	F value	<i>p</i>
Knee Society knee score patient's group	40.83±4.46	0.94	0.87
Knee Society knee score control group	41.04±4.53		
Knee Society function score patient's group	41.67±9.29	0.86	0.94
Knee Society function score control group	41.88±8.95		
Flexion (°) patient's group	109.2±8.0	0.30	0.94
Flexion (°) control group	109.0±10.0		
Flexion contracture (°) patient's group	2.9±4.4	0.79	0.87
Flexion contracture (°) control group	2.7±4.2		

SD: Standard deviation.

TABLE III
Preoperative radiological measurements

	Mean±SD	F value	<i>p</i>
Tibial slope angle (°) patient's group	6.3±2.5	0.02	0.41
Tibial slope angle (°) control group	6.8±1.5		
Alignment (FTA) (°) patient's group	181.4±2.1	0.23	0.82
Alignment (FTA) (°) control group	181.3±1.6		
Insall-Salvati ratio patient's group	1.03±0.07	0.71	0.13
Insall-Salvati ratio control group	1.05±0.06		
Offset patient's group	0.49±0.03	0.15	0.25
Offset control group	0.48±0.02		

SD: Standard deviation; FTA: Femorotibial angle.

TABLE IV
Postoperative clinical data

	Mean±SD	F value	<i>p</i>
Knee Society knee score patient's group	81.9±6.8	0.96	0.65
Knee Society knee score control group	82.8±6.9		
Knee Society function score patient's group	71.5±7.1	0.16	0.58
Knee Society function score control group	72.5±5.3		
Flexion (°) patient's group	106.9±8.1	0.14	0.46
Flexion (°) control group	109.0±11.0		
Flexion contracture (°) patient's group	2.9±3.6	0.68	0.83
Flexion (°) contracture control group	2.7±3.3		

SD: Standard deviation.

TABLE V
Postoperative radiological measurements

	Mean±SD	F value	<i>p</i>
Tibial slope angle (°) patient's group	3.78±1.45	0.49	0.84
Tibial slope angle (°) control group	3.70±1.27		
Alignment valgus (°) patient's group	4.9±1.9	0.94	0.10
Alignment valgus (°) control group	5.8±1.9		

SD: Standard deviation.

To restore the preosteotomy position of the lateral joint line in the study group, we used 10 mm or thicker tibial insert in 54.2% of the cases, while in the remaining 45.8%, 8 mm thick insert was sufficient. In the control group, we used 8 mm thick tibial insert in 21 cases and 10 mm thick tibial insert in three cases. There were no postoperative complications in either group. No patient required revision of the TKA components during the duration of follow-up.

At the time of the final follow-up, there were no significant differences regarding clinical or radiological data. (Tables IV, V). However, lesser lateral bone was resected in the study group than in the control group (5.11 [range, 2-10] vs. 8.42 [range, 8-12]) ($p \leq 0.05$) (Tables III, IV).

DISCUSSION

During subsequent conversion to TKA after osteotomy, the soft tissue scarring and the shortening of the patellar tendon make the subperiosteal exposure of the proximal tibia and eversion of the patella more difficult with the additional risk of avulsing of the tibial tubercle.^[4,16,18,25] During the exposure, the rectus snip, V-Y plasty of quadriceps and tibial tubercle osteotomy may be required.^[16,18,26,27]

No additional procedure for eversion of the patella was needed in any case. The distance between the tibial tubercle and the joint line does not change after CO and thus the length of patellar tendon does not change significantly.^[19,20]

Excessive undercorrection, overcorrection and rotational deformity are not uncommon after a failed HTO^[14,28] and the HTO inevitably produces some transposition of the tibial condyle with respect to its bony axis.^[29] These factors can lead to difficulty in obtaining optimal soft tissue balancing, appropriate alignment and optimal positioning of the tibial component during the subsequent TKA^[15,18,30]

In our study, similar to Meding et al.,^[30] the impingement of the peg of the tibial component against the truncated lateral metaphysis did not occur, the tibial component was not medialized or downsized in any case, because the CO does not lead to significant lateral tibial bone loss and to lateral overhang.^[19]

After HTO, reduced amount of bone stock can be present on the lateral side of the tibial condyle. Because of the lateral bone loss, only minimal lateral tibial bone can be resected during the subsequent TKA. To restore the preosteotomy lateral joint line position,

the use of a relatively thicker tibial component is necessary.^[14,16,18,30]

Similar to Meding et al.,^[14,15,30] we resected significantly less lateral tibial bone in the study group than in the control group. Furthermore, the HTO usually changes the TS angle and may weaken the attachment of the posterior cruciate ligament (PCL).^[15-20,31-33]

We did not note the tenuous PCL in any case in the study group, because the CO does not weaken the distal insertion of the PCL significantly and the TS decreases only in a small degree after CO.^[19,20]

We aimed for a postoperative alignment of 6° valgus in both groups. In the study group, we noticed slight undercorrection, while 66.66% of cases was in the range of 4-8° of valgus.

Our study confirmed our hypothesis, showing similar knee and function score in both groups at the time of the final follow-up and a 100% survivorship of total knee arthroplasty in both groups.^[34] Similar to Badawy et al.,^[35] we detected no higher risk of revision in the study group than in the control group.

Some authors investigated the results of TKA after closing wedge osteotomy (CWO)^[10,12-16,27,30,35] while others investigated the results of TKA after opening wedge osteotomy (OWO).^[17,27,36] The results of TKA indicated after CWO as well after OWO are similar to the ones of primary TKA.^[9,10,11,14,16] There were no significant differences between the groups underwent TKA after CWO or OWO.^[9,27,35] Lateral bone loss and lateral overhang were common findings in the post-CWO group.^[10,14,35] The TS was reported to decline after CWO^[10,16] and to increase after OWO.^[17] Patella infera was reported both in the post-CWO and the post-OWO studies.^[10,17] To comparison in our study group there was no lateral bone loss, significant change in TS or patella infera.

The limitations of this study are its small sample size and retrospective design. However, to our knowledge, this is the first study in the literature that elaborates the TKA long-term results after high tibial osteotomy (CO).

In conclusion, in young and active people with medial knee arthrosis, we continue to suggest CO since previous CO in the medium-long term does not seem to influence the results of TKA negatively.

Declaration of conflicting interests

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