

# CHANGES OF TIBIAL SLOPE AFTER CRUCIATE RETAINING-TOTAL KNEE REPLACEMENT AND THEIR FUNCTIONAL EFFECT OUTCOME

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## ABSTRACT

### *Background*

Total knee arthroplasty has been regarded as the primary surgical procedure for relieving severe pain in the last stage of degenerative arthritis and experiencing better functional outcomes. many previous studies have been described the effect of posterior tibial slope on functional outcome, but many debates exist.

### *Objectives*

To find changes of posterior tibial slope in total knee arthroplasty.

### *Patients and Methods*

Our study includes 50 patients (50 knees) who underwent Cruciate Retaining-Total knee Replacement (CR-TKR) from 10 January 2018 to Nov2019. Posterior tibial slope (PTS) was measured on lateral x-ray. According to the oxford knee score, the functional outcome and the posterior tibial slope were measured preoperatively and postoperatively for each patient.

### *Results*

Fifty patients underwent CR-TKR. Preoperative PTS and oxford knee scores were 11.7 and 11.72, respectively. Postoperative PTS and oxford knee scores were 9.3 and 39.64, respectively. We divided into Group A: PTS up to 9(24 cases) and Group B PTS more than 9 (26). We analyzed the relationship between PTS and functional outcome according to the oxford knee score.

### *Conclusion*

Clinical improvements were noticed in both patient groups after CR-TKR.

**Keywords:** *Total knee replacement, Posterior tibial slope, Oxford knee score.*

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## INTRODUCTION

Total knee arthroplasty is a surgical procedure where artificial joint components replace damaged joint surfaces beyond healing and repair. It can restore joint function by correcting deformities and maintaining its stability which enhances its function and eases pain <sup>(1)</sup>.

The posterior inclination of the tibial plateau is known as the Posterior tibial slope (PTS). The normal range for PTS has been reported in different studies anywhere between 3°–9° <sup>(2)</sup>, Hofmann et al. reported 7°, Laskin and Reiger have reported 8°-10°, and Chiu et al. said 14.8° <sup>(3)</sup>. However, the extent of PTS may vary depending on ethnicity, age group and patient's needs <sup>(2)</sup>,

Conventionally the PTS cannot be reconstructed correctly in every patient due to inter-patient variability and surgical instruments uncertainty <sup>(4)</sup>.

Many studies point to the significance of poster tibial slope in the biomechanics of knee joint and posterior cruciate ligament (PCL), affecting their stability and tension and easing femoral rollback <sup>(3)</sup>.

Cruciate retaining (CR) TKAs are often associated with tight flexion gaps, leading to the tightness of PCL and hindering flexion in the knee joint. In light of this, it has been reported that in CR-TKAs, the PTS affects the flexion gap and postoperative range of motion (ROM) <sup>(5)</sup>, allowing for knee motion with less quadriceps force <sup>(6)</sup>.

It is difficult to quantitatively measure the influence of PTS on the flexion gap since many factors other than the PTS also play a role, like a quadriceps stiffness, femoral component size (posterior condylar offset) and ligament tension and release. However, sacrificing the PCL in TKA can increase the flexion gap by 3-5 mm <sup>(5)</sup>.

On the other hand, an excessive posterior tibial slope can have undesirable consequences with abnormal tibial translation, anterior cam-post impingement, increased strain on the posterior cruciate ligament <sup>(7)</sup>, component subsidence, and posterior instability. All of which can lead to increased wear and biomechanical changes in the ultra-high molecular weight polyethylene (UHMWPE) with a subsequent decrease in TKA survivorship <sup>(8)</sup>.

## PATIENTS AND METHODS

A retrospective study was done in Twymalik hospital (Sulaimani) from 10 January 2018- to 25 November 2019. This study included 50 patients who underwent CR-TKR. The minimum follows up of 12 months. The exclusion criteria were inflammatory arthritis, peripheral vascular disease, revision TKA, and spinal disease like spinal stenosis. The inclusion criteria were grade 3 and 4 osteoarthritides according to Kellgren and Lawrence's classification. The average age was 62.84 years. The surgery was performed on the right knee in 26 cases and on the left knee in 24 cases. Thirty-eight of the patients were females, and 12 were males.

### Operation technique

All surgeries were done by the same surgeon under spinal anaesthesia and pneumatic tourniquet control using the standard medial Para patellar approach. First, the skin and subcutaneous tissue were opened, and then the synovium and lower part of the patellar fat pad was removed.

Patellar eversion was done. The tibiofemoral osteophytes, thick synovial membrane, and menisci were removed, and the distal femoral cut was done, followed by proximal tibial cut while maintaining the original slope of the articular surface by taking 3 degrees of the posterior slope of the tibial implant into consideration. The femoral component size was determined with an anterior reference system. Rotation of the femoral component was determined at 3 to 5 degrees of external rotation to the posterior condylar axis, followed by femoral osteotomy when femoral component size was determined.

The patella was not resurfaced in all cases, but electrocautery and desensitization were done for the Para patellar soft tissue, and patellar tracking was confirmed using no thumb technique. Finally, periarticular multimodal drug injection (60ml levobupivacaine 2.5%, 30mg ketorolac, 0.5mg adrenaline, 40ml normal saline) was injected into the posterior capsule, medial and lateral gutter, and suprapatellar synovium and wound closed in layers using the watertight technique without drain left, nearly operation time about 45 minutes; patients allowed total weight-bearing with a crutch on day one and dressing changed on day three.



**Figure 1. operation procedure.**

**Assessment and analysis**

**Method**

The posterior tibial slope was measured on the lateral radiograph pre-and postoperatively. The preoperative posterior tibial slope was defined as the angle created by a line perpendicular to the anterior tibial cortex and a line parallel to the tibial plateau (Fig. 1). The postoperative posterior tibial slope was defined as the the angle created by a line perpendicular to the anterior tibial cortex Furthermore, a line parallel to the tibial component. The postoperative the posterior tibial slope was measured from the radiograph taken immediately after surgeryThe posterior tibial slope was measured on the lateral radiograph pre-and postoperatively. The preoperative posterior tibial slope was defined as the angle created by a line perpendicular to the anterior tibial cortex and a line parallel to the tibial plateau (Fig.

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1). The postoperative posterior tibial slope was defined as the angle created by a line perpendicular to the anterior tibial cortex and a line parallel to the tibial component. The postoperative posterior tibial slope was measured from the radiograph taken immediately after surgery. The posterior tibial slope was measured on the lateral radiograph pre and postoperatively. The preoperative posterior tibial slope was explained as the angle produced by a line perpendicular to the anterior tibial cortex and a line parallel to the tibial plateau. The postoperative posterior tibial slope was described as the

angle designed by a line perpendicular to the anterior tibial cortex and a line parallel to the tibial component. The postoperative posterior tibial slope was measured immediately after surgery from the radiograph.

We divided patients into two groups according to the mean value of the

postoperative posterior tibial slope. Group A up to  $9^{\circ}$  [24 cases]. And group B over  $9^{\circ}$  [26 cases]. Knee function was assessed using the Oxford knee score preoperatively and, at last, follow up.



Figure 1. Post-operative posterior Tibial Slope. Figure 2. Pre-operative posterior Tibial Slope.

## RESULTS

Fifty patients were under consideration. The mean age was 62.84, and the female was 38(76%) cases while the male was 12(24%) cases, and the right side was 26(52%) while the left side was 24(48%) cases. Respective mean oxford knee score and posterior tibial slope were 11.72 and 11.7 preoperatively and 39.64 and 9.3 postoperatively. We divided the patients into two groups, group A [postoperative PTS up to  $9^{\circ}$ ] 24 knees and group B [postoperative

PTS over  $9^{\circ}$ ] 26 knees, group A had preoperative PTS 10,042 and postoperative 8,667 whereas group B had preoperative PTS 13,231 and 9,885 postoperatively. Preoperative oxford knee score was 13,42 in group A and 10,15 in group B. respectively, achieved postoperative oxford knee score of 41,25 in group A and 38,15 in group B at one year follow up.

The postoperative increase in oxford knee score compared to preoperative Oxford knee score was significant in both groups.

**Table 1. Socio-demographic data.**

Variables	Frequency	Percentage %
<b>Gender Male</b>	12	24.0
<b>Female</b>	38	76.0
<b>Site Right</b>	26	52.0
<b>Left</b>	24	48.0
<b>Mean age ± SD</b>	62.84 ± 6.018	
<b>Total</b>	<b>50</b>	<b>100.0</b>

**Table 2 .Some variables mean & SD.**

		Mean	N	Std. Deviation
<b>Pair 1</b>	<b>Oxford Knee Score (Preoperative)</b>	11.72	50	2.976
	<b>Oxford Knee Score (Postoperative)</b>	39.64	50	3.590
<b>Pair 2</b>	<b>Tibial Slope (Pre)</b>	11.700	50	2.0304
	<b>Tibial Slope (Post)</b>	9.300	50	.7559

**Table 3. Association between some variables.**

Associations between variable	Tibial Score ≤9 (post-op. score) Mean ± SD	Tibial Score >9 (post-op. score) Mean ± SD	Total Mean ± SD	P-value
<b>Oxford knee score (preoperative)</b>	13.42 ± 2.992	10.15 ± 1.953	11.72 ± 2.976	<0.001
<b>Oxford knee score (postoperative)</b>	41.25 ± 2.4	38.15 ± 3.896	39.64 ± 3.59	0.002
<b>Tibial Slop (pre-operative)</b>	10.042 ± 0.9882	13.231 ± 1.45	11.7 ± 2.03	<0.001
<b>Tibial Slop (post-operative)</b>	8.667 ± 0.4341	9.885 ± 0.454	9.3 ± 0.755	<0.001

## DISCUSSION

As we know, postoperative ROM is an essential indicator of the success of TKA. There are various factors that may influence the postoperative ROM; importantly, the posterior tibial slope has been considered positively correlated with the maximal angle of flexion <sup>(12)</sup>. Bauer et al. <sup>(13)</sup> reported that the correlation between PTS and maximal knee flexion observed after PCL-retaining TKA was not noted after PCL-sacrificing TKA. In our study, the mean age was 62.84±6.01 years, whereas the mean age was 63.95±6.61 in the study of song X et al. <sup>(1)</sup> and 68.4±8.1 years in the study of Seo SS et al. <sup>(3)</sup>. Our study showed predominant females over the male (male 12 cases 24%, female 38 cases 76%), which is compatible with the study of parsley BS et al. <sup>(15)</sup> (male 270 cases 39%, female 428 cases 61%) and study of Jason Lim JB et al. <sup>(14)</sup> (male 214 cases, female 1040 cases).

In our study, the mean preoperative PTS was 11.7±2.03, whereas the mean preoperative PTS was 7.1±5.4 in the Seo SS et al. <sup>(3)</sup>, and the mean preoperative PTS was

7.8 in the study of the song X et al. <sup>(9)</sup>. This difference in our study from other studies in preoperative tibial slope is related to racial factors since this study was carried out among the Kurdish population. In our study, the mean PTS was 9.3±0.755 postoperatively. We divided the patients into group A with TS ≤ 90 and group B with TS > 90. According to the oxford knee score, we found no statistically significant difference between the two groups in pre and postoperative functional outcomes.

While in the study of Seo SS et al. <sup>(3)</sup>, the mean PTS was 7.2±2.8, they divided the patients into five groups according to the pre and postoperative posterior tibial slope changes. They found significant clinical improvement in all groups after PCL-retaining TKA. However, the improvement was especially notable in groups 2 and 3, with a 3 to 1 increase in PTS compared to the other groups.

In the study of Vaidya N et al. <sup>(9)</sup>, the mean PTS was 5.7 postoperatively; they divided the patients into two groups, group A had PTS below eight, and group B

had PTS above 8, and they found that there was an improvement in postoperative ROM in all patients [both groups]. Postoperative ROM in both groups was comparable.

Kim KH et al. <sup>(10)</sup> reported the mean PTS to be ten and divided the results into two groups, group A with PTS below ten and group B with PTS above 10; they found no significant difference between both groups in terms of maximal angle of flexion.

Regarding patient's clinical outcome, results showed improvement in the Oxford knee score from 13.42 to 41.25 in group A and from 10.15 preoperatively to 38.15 postoperatively in group B; this means a significant improvement in both groups that were compatible with the studies of Seo SS et al., Vaidya N et al. and Kim KH et al.

Many limiting factors are not considered in our studies, such as sex, co-morbidities, posterior condylar offset, BMI and other patient-related factors like preoperative range of motion.

In conclusion, the clinical improvement after CR-TKR was significant in both groups since the change in the tibial slope has no significant effect on the outcome. Although we concluded that change in the tibial slope does not affect the functional outcome of knee replacement in our study, we can prove that the improvement in the clinical effect is related to knee surgery itself.

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