

Original article:

Study of evaluation of correlation between posterior tibial slope and angle of flexion after total knee arthroplasty

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Abstract

Introduction: Excessive posterior tibial slope in patients undergoing total knee replacement may cause anteroposterior instability, leading to anterior subluxation of the tibial component, thereby increasing shear stresses on the posterior part of the tibial polyethylene and causing aseptic loosening.

Materials and methods: This is a non randomized prospective study done at this institution from October 2017 till September 2019. Patients were screened for exclusion criteria and 30 patients who satisfied the criteria were included in the study. All the patients had received the posterior- stabilized TKA (Indus knee implant of BioradMedisys Company).

Results: In the present study of 30 cases there are 15 cases of post operative posterior tibial slope of 4° to 7° having a mean ROM of 101.07° before surgery and with 109.50° at end of 3rd month after surgery. In the present study of 30 cases there are 4 cases of post operative posterior tibial slope of more than 7° having a mean ROM of 102.50° before surgery and with 112.50° at end of 3rd month after surgery.

Conclusion: From our prospective non randomized controlled study we conclude that, as posterior tibial slope increases upto 7° , post op range of movement increases significantly. A further increase in Posterior Tibial Slope beyond 7° does not appear to influence the post-op ROM as it does not increase statistically.

Keywords: posterior tibial slope , total knee arthroplasty

Introduction:

Excessive posterior tibial slope in patients undergoing total knee replacement may cause anteroposterior instability, leading to anterior subluxation of the tibial component, thereby increasing shear stresses on the posterior part of the tibial polyethylene and causing aseptic loosening⁽¹⁾. In contrast, a decrease in posterior tibial slope leads to increased stresses on the weak anterior subchondral bone, thereby increasing the risk of component subsidence⁽²⁾. Decreased posterior slope also leads to limitation of flexion due to a tight flexion gap⁽³⁾.

ROM is one of the critical factors in determination of the TKA effectiveness. Many studies have discussed the factors related to the postoperative knee flexion, but most of them are focused on the correlation between the tibial slope and the maximal knee flexion with the PCL-retaining TKA^(4,5,6,7). Few studies are available to assess the effect of knee ROM in posterior stabilized knees. Therefore the study is undertaken to ascertain the relationship of posterior tibial slope and maximal angle of flexion after total knee arthroplasty in posterior stabilized knee replacement.

Materials and methods:

This is a non randomized prospective study done at this institution from October 2017 till September 2019. Patients were screened for exclusion criteria and 30 patients who satisfied the criteria were included in the study. All the patients had received the posterior- stabilized TKA (Indus knee implant of BioradMedisys Company).

Inclusion Criteria

- All patients with osteoarthritis of knee requiring Total Knee Arthroplasty

Exclusion criteria

- Patients with associated malunited intra-articular fractures
- Rheumatoid arthritis
- Post traumatic arthritis

In the present study of 30 cases, 8 cases each were in the age group of 56- 60years and 61-65 years accounting for 53.22% of total no. of cases.

Results:

In the present study of 30 cases there are 15 cases of post operative posterior tibial slope of 4° to 7° having a mean ROM of 101.07° before surgery and with 109.50° at end of 3rd month after surgery.

In the present study of 30 cases there are 4 cases of post operative posterior tibial slope of more than 7° having a mean ROM of 102.50° before surgery and with 112.50° at end of 3rd month after surgery.

In the present study of 30 cases, there are 15 cases in group-B(post operative posterior tibial slope of 4° to 7°)having average ROM of 103.20° at end of 1st month and 109.50° at end of 3rd month.

Table-1: Pre-operative fixed flexion deformity and average ROM at the end of 3rd month

No. of cases	Pre op FFD	Average ROM before surgery	Average ROM at the end of 3 rd month
7	0° -5°	103.60°	108.80°
6	6° -10°	100.50°	108.30°
17	11° -15°	97.41°	105.60°

In this study 17 cases are in group of having pre-op FFD of 11° – 15° which accounts for 57% of cases having average ROM of 105.60° at the end of 3rd month after surgery.

Table-2: Difference in posterior tibial slope (Post operative – Pre operative)

No. of cases	Posterior tibial slope (Post op – Pre op)
2 (7%)	$<-7^{\circ}$
4 (13%)	-7° to -4°
14 (47%)	-4° to 0°
10 (33%)	$>0^{\circ}$

Table-3: Difference in posterior tibial slope (Post operative – Pre operative) and average ROM at the end of 3rd month

No. of cases	Posterior tibial slope (Post op – Pre op)	Average ROM at the end of 3 rd month
2 (7%)	$<-7^{\circ}$	105.00 ^o
4 (13%)	-7° to -4°	110.00 ^o
14 (47%)	-4° to 0°	106.00 ^o
10 (33%)	$>0^{\circ}$	107.30 ^o

In this study 14 cases are in group of having difference in posterior tibial slope (Post op – Pre op) of -4° to 0° which accounts for 47% of cases having average ROM of 106.00^o at the end of 3rd month after surgery and 10 cases are in group of having difference in posterior tibial slope (Post op – Pre op) of more than 0° which accounts for 33% having average ROM of 107.30^o at the end of 3rd month after surgery which is highest.

Discussion:

In our study data collected was analyzed by using SPSS 19th version software. we have total 30 patients and the patients were divided in 3 groups based on the posterior tibial slope after the operation Group A - $<4^{\circ}$, Group B- 4 to 7 degrees, Group C- $>7^{\circ}$ degrees. Mean post operative range of motion for each group was 101.30^o, 109.50^o and 112.50^o respectively. Difference in postoperative flexion was found to be statistically significant when Group A is compared with both Group B and C. But when compared between Group B and Group C, it is not statistically significant. Thus as the slope increases till 7° there is increased knee range of movement and after that flexion and ROM is not increasing statistically. In this study, the mean post-operative maximal flexion angle is 106.90^o which showed a significant

relation with post-operative posterior tibial slope of 4.66° ($p=0.000$). In the patient with post-operative average posterior tibial slope with $< 4^{\circ}$ have a mean range of motion of 101.30° at the end of 3rd month, as the post-operative posterior tibial slope increases, range of motion increases with in the group ($p=0.03$). In group B with post-operative posterior tibial slope 4° - 7° , as the tibial slope increases ROM also increases with in the group ($p=0.01$). In the group-C with post-operative posterior tibial slope $>7^{\circ}$, as slope increases range of motion does not increase statistically. As the patients in this study underwent TKR with INDUS knee which is a monoblock (Tibial) component with in built 3° slope in the poly, Based on effective difference of slope (postoperative – preoperative) all patients in this study are categorized into 4 categories $<-4^{\circ}$, -4° to -1° , -1° to 3° and $>3^{\circ}$. However in patients with difference of tibial slope (post-operative – pre-operative) of $<-4^{\circ}$ and -4° to -1° , as difference increases, range of motion is not increasing statistically ($p=0.180$ and $p=0.66$ respectively) where as in patients with difference of posterior tibial slope of -1° to 3° and $>3^{\circ}$ as the difference increases, range of motion increases statistically ($p=0.01$ and $p=0.05$ respectively).

In this study, patients are divided into 3 categories based on preoperative fixed flexion deformity with $<5^{\circ}$, 6° - 10° and 11° - 15° and their average range of motion at the 3rd month post operative are 108.80° , 108.30° and 105.60° respectively. It suggests that as preoperative fixed flexion deformity is increasing, post operative range of motion is decreasing. Our study findings are further supported by Jong-Heon Kim et al study (2013) in which he studied Forty-five knees in 35 patients who could be followed up more than 1 year after PCL-sacrificing TKA. The mean maximal flexion angle after TKA was $118.44^{\circ} \pm 9.8^{\circ}$ and significantly related to postoperative tibial slope.^{3,4} He concluded from his study that maximal flexion angle of the knee after PCL-sacrificing TKA was significantly related to the postoperative tibial slope. But in Hoffman study In 33 total knee arthroplasties (TKAs) using instrumentation designed to cut the tibia with 0° posterior slope, ten tibial components demonstrated at least 2 mm of tibial component subsidence. These subsided components were implanted onto tibiae with an average of 8 degrees +/- 2 degrees difference between the preoperative, anatomic posterior slope and their postoperative posterior slope. The remaining 23 components, without subsidence, were implanted onto tibiae cut within 2 degrees +/- 2 degrees of their anatomic slope. To help understand these clinical observations, a laboratory study was performed to compare the load carrying capacity and the stiffness of tibial subchondral bone following two types of tibial cuts: one made perpendicular to the long axis of the tibia and the other made parallel to the articular surface of the tibia and it was found that tibia cut parallel to the surface exhibited 40% greater load carrying capacity and 70% greater stiffness than the paired tibiae cut perpendicular to the long axis.

Therefore, an exclusive increase of tibial slope is not desirable after some degrees although it improves the maximum flexion achieved. From our prospective randomized controlled study we can conclude that as posterior tibial slope increases upto 7° , achieved post op range of movement is increasing and is statistically significant.

Conclusion:

From our prospective non randomized controlled study we conclude that, as posterior tibial slope increases upto 7° , post op range of movement increases significantly. A further increase in Posterior Tibial Slope beyond 7° does not appear to influence the post-op ROM as it does not increase statistically.

References:

1. De Boer JJ, Blankevoort L, Kingma I, Vorster W. In vitro study of inter- individual variation in posterior slope in the knee joint. Clin Biomech (Bristol, Avon). 2009 Jul; 24(6):488-92.
2. Hofmann AA, Bachus KN, Wyatt RW. Effect of the tibial cut on subsidence following total knee arthroplasty. Clin Orthop Relat Res.1991Aug; 269:63-9.
3. Jojima H, Whiteside LA, Ogata K. Effect of tibial slope or posterior cruciate ligament release on knee kinematics. Clin Orthop Relat Res. 2004 Sep; 426:194-8.
4. Akagi M, Ueo T, Matsusue Y, Akiyama H, Nakamura T. Improved range of flexion after total knee arthroplasty. Bull Hosp Jt Dis 1997;56:225–232
5. Banks S, Bellemans J, Nozaki H, Whiteside L, Harman M, Hodge A. Knee motions during maximum flexion in fixed and mobile bearing arthroplasties. Clin Orthop Relat Res.2003 May ;(410):131-8.
6. Bellemans J, Robijns F, Duerinckx J, Banks S, Vandenuecker H. The influence of tibial slope on maximal flexion after total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc.2005 Apr; 13(3):193-6.
7. Catani F, Fantozzi S, Ensini A, Leardini A, Moschella D, Giannini S. Influence of tibial component posterior slope on in vivo knee kinematics in fixed-bearing total knee arthroplasty. J Orthop Res.2006; 24:581–587.

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