

Comparison of Posterior Tibial Slope and Outcomes of Pre and Post Total Knee Arthroplasty in Osteoarthritis Genu Patients at

H. Adam Malik General Hospital Medan

Murian Syahputra¹, Husnul Fuad Albar¹, Hidayat Siregar¹

¹muriansyahputra29@gmail.com

¹Departement of Orthopaedics and Traumatology, Faculty of Medicine, Sumatera Utara University, H. Adam Malik Hospital, Medan

Abstract

Introduction: Osteoarthritis (OA) is a chronic joint degeneration disease with a fairly high prevalence in the world population which is a leading source of disability for public health. Total Knee Arthroplasty (TKA) has been widely accepted as a definitive therapy for cases of knee OA that have failed nonoperative therapy. Posterior Tibial Slope (PTS) is a crucial factor influencing anteroposterior stability, range of motion, tension on knee ligaments, and the balance of flexion and extension gaps in knee arthroplasty. There is a potential role for PTS as an indicator of knee joint recovery and TKA success in osteoarthritis patients.

Objective: Examining the PTS in post-TKA osteoarthritis patients at H. Adam Malik Hospital, Medan.

Methods: This study used a retrospective cohort approach on OA patients who underwent TKA surgery at H. Adam Malik General Hospital, Medan in September 2021 – October 2022. All data in this research was taken from the patient's medical records. In subjects who met the inclusion criteria, visual analog scale (VAS), range of motion, and PTS were examined before and after the TKA procedure. The data obtained was analyzed statistically.

Results: There are differences in PTS and pre and post TKA surgical outcomes in genu osteoarthritis patients at H. Adam Malik General Hospital Medan, with PTS namely $t = 6.872 > t_{table} = 1.689$ and $p = 0.000 < 0.05$, flexion outcome namely $t = -4.794 > t_{table} = 1.689$ and $p = 0.000 < 0.05$, extension, namely $t_{count} = 4.896 > t_{table} = 1.689$ and $p = 0.000 < 0.05$, and VAS, namely $t_{count} = 9.788 > t_{table} = 1.689$ and $p = 0.000 < 0.05$.

Conclusion: After performing TKA in OA patients, there is an improvement in PTS, flexion outcome, extension, and VAS.

Keywords : Osteoarthritis ; Total Knee Arthroplasty ; Posterior Tibial Slope

1. Introduction

Osteoarthritis (OA) is a chronic joint degeneration disease with a fairly high prevalence in the world population which is a leading source of disability for public health. (Indonesian Rheumatology Association, 2014) In 2017, there were 303 million cases of osteoarthritis worldwide. (Kloppenborg and Berenbaum, 2020) In Indonesia, the prevalence of knee OA seen radiologically reaches 15.5% in men and 12.7% in women aged between 40-60 years. OA, especially in the knee joint, progressively causes joint inflammation and destruction, causing pain, limiting range of motion (ROM), and ultimately limiting functional ability and reducing the patient's quality of life (QoL). (Indonesian Rheumatology Association, 2014)

Total Knee Arthroplasty (TKA) has been widely accepted as a definitive therapy for cases of knee OA that have failed nonoperative therapy. TKA combined with post-operative care is known to reduce pain levels and improve patient function and QoL compared to non-operative therapy. (Mochizuki et al., 2018) However, the cost of TKA surgery is very expensive and tends to increase. (Ferket et al., 2017)

In daily practice, strict patient selection based on indications has been proven to have a major influence on the success of TKA in improving quality of life by restoring the function of the patient's knee joint as a weight-bearing joint, as well as playing an important role as a cost-effective justification for surgery. The importance of these aspects requires an indicator that can assess pre- and post-TKA knees. One important indicator that can be used as a reference is the Posterior Tibial Slope (PTS). (Pangaud et al., 2020)

PTS is a crucial factor influencing anteroposterior stability, range of motion, tension on knee ligaments, and the balance of flexion and extension gaps in knee arthroplasty. In addition, PTS plays a very important role in the kinematics and biomechanics of the knee joint. A study measuring normal PTS in Asian and Caucasian populations found mean PTS in global, medial, and lateral positions of 6.3, 6.2°, and 5.3°, respectively. (Pangaud et al., 2020) Another study that measured PTS in normal knees during normal load-bearing activities, such as standing, squatting, and walking found an increase in PTS of 1° with a maximum change of up to 10°. (Shelburne et al., 2011) In

degenerative joint disease, the slope changes due to the use of bones and joints with an average PTS of $13.1^\circ \pm 4.0$. (Meric et al., 2015) Based on the explanation above, researchers see the potential role of PTS as an indicator of knee joint recovery and TKA success in osteoarthritis patients, so this research aims to examine PTS in post-TKA osteoarthritis patients at H. Adam Malik General Hospital, Medan.

2. Methods

2.1 Research Design and Subjects

This study used a retrospective cohort approach. This research was conducted in the Orthopedics and Traumatology Department, H. Adam Malik Hospital, Medan in September 2021 – October 2022. The sample for this study was all OA patients who underwent TKA surgery at H. Adam Malik Hospital Medan who met the criteria inclusion and exclusion. Inclusion criteria were patients who underwent primary TKA in cases of primary osteoarthritis, aged 55-75 years, had a BMI < 100, and a preoperative ROM score > 1000. Exclusion criteria were patients suffering from rheumatoid arthritis and patients with a history of TKA surgery on the same joint. The sampling technique was carried out by consecutive sampling.

2.2 Research Procedure

All data in this research was taken from patient medical records. In patients admitted to the Orthopedics and Traumatology Polyclinic, H. Adam Malik Hospital, Medan, an anamnesis, physical examination and radiological examination of the knee are carried out. In subjects who met the inclusion criteria, VAS, range of motion, and PTS were examined. The patient then underwent a TKA surgical procedure, and a radiological evaluation of the knee was carried out. Re-evaluation was carried out on VAS, range of motion, and PTS. The data obtained was analyzed statistically.

2.3 Statistic Analysis

Nominal data is presented using a presentation while numerical data is presented using the mean and standard deviation. Data normality was tested using the Shapiro-Wilk test where a p-value <0.05 was assessed as an abnormal data distribution and vice versa. The main assessments in this study were PTS, range of motion, and VAS before and after TKA surgery. Paired t-test was used to test statistical differences in the main assessments (VAS, range of motion, and PTS) before and after surgery. In this study, SPSS software for Windows version 25 was used to carry out data analysis.

3. Result

3.1 Characteristics of Research Subjects

The research was conducted on 35 research subjects who met the inclusion criteria with the characteristics shown in table 1. Based on this table, the age of the research subjects was between 51 years and 81 years, while the average age (mean) was 63.7 years. Most people aged ≤ 63.7 years, namely 20 people (57.1%), female, namely 27 people (77.1%), work as housewives, namely 24 people (68.4%).

Table 1. Frequency Distribution of Research Subject Characteristics

| Characteristics | Total (f) | Percentage (%) |
|------------------------------------|-----------|----------------|
| Age (mean: 63.7, min: 51, max: 81) | | |
| 1. ≤ 63.7 years | 20 | 57.1 |
| 2. > 63.7 years | 15 | 42.9 |
| Total | 35 | 100.0 |
| Gender: | | |
| 1. Male | 8 | 22.9 |
| 2. Female | 27 | 77.1 |
| Total | 35 | 100.0 |
| Job: | | |
| 1. Housewife (IRT) | 24 | 68.4 |

| Characteristics | Total (f) | Percentage (%) |
|-------------------------|-----------|----------------|
| 2. Self-employed | 7 | 20.0 |
| 3. Teacher | 1 | 2.9 |
| 4. Pastor | 1 | 2.9 |
| 5. Farmer | 1 | 2.9 |
| 6. Government employees | 1 | 2.9 |
| Total | 35 | 100.0 |

3.2 Descriptive Data

Table 2 describes descriptively the PTS, flexion, extension and VAS outcomes of genu osteoarthritis patients who sought treatment at H. Adam Malik General Hospital Medan (pre-op and post-op). For PTS, the mean \pm SD for pre-op was 8.97 ± 4.926 while post-op was 4.94 ± 3.589 . The minimum and maximum values for pre-op are 2° and 16° , while for post-op they are 0° and 10° . For flexion outcomes, the mean \pm SD for pre-op was 124.94 ± 13.565 while post-op was 132.77 ± 8.678 . The minimum and maximum values for pre-op are 90° and 145° , while for post-op they are 100° and 145° . For extension, the mean \pm SD for pre-op was 3.17 ± 3.577 while post-op was 1.20 ± 2.273 . The minimum and maximum values for pre-op are 0° and 15° , while for post-op they are 0° and 10° . For VAS, the mean \pm SD for pre-op was 3.00 ± 0.804 while post-op was 0.51 ± 0.887 . The minimum and maximum values for pre-op are 2 and 4, while for post-op they are 0 and 2.

Table 2. PTS, Flexion, Extension and VAS Outcomes of Osteoarthritis Genu Patients at H. Adam Malik General Hospital Medan (Pre-op and Post-op)

| Parameter | Pre-op | Post-op |
|-------------------------------|---------|---------|
| Posterior Tibial Slope | | |
| Mean | 8.97 | 4.94 |
| Median | 6.00 | 4.00 |
| Mode | 6 | 2 |
| Std. Deviation | 4,926 | 3,589 |
| Variance | 24,264 | 12,879 |
| Range | 14 | 10 |
| Minimum | 2 | 0 |
| Maximum | 16 | 10 |
| Flexion Outcome | | |
| Mean | 124.94 | 132.77 |
| Median | 130.00 | 135.00 |
| Mode | 130 | 135 |
| Std. Deviation | 13,565 | 8,678 |
| Variance | 183,997 | 75,299 |
| Range | 55 | 45 |
| Minimum | 90 | 100 |
| Maximum | 145 | 145 |
| Extension | | |
| Mean | 3.17 | 1.20 |
| Median | 3.00 | .00 |
| Mode | 0 | 0 |
| Std. Deviation | 3,577 | 2,273 |
| Variance | 12,793 | 5,165 |
| Range | 15 | 10 |
| Minimum | 0 | 0 |
| Maximum | 15 | 10 |
| Visual Analog Scale | | |
| Mean | 3.00 | .51 |
| Median | 3.00 | .00 |

| Parameter | Pre-op | Post-op |
|----------------|--------|---------|
| Mode | 3 | 0 |
| Std. Deviation | ,804 | ,887 |
| Variance | ,647 | ,787 |
| Range | 2 | 2 |
| Minimum | 2 | 0 |
| Maximum | 4 | 2 |

3.3 Differences in Mean PTS, Flexion Outcome, Extension, and VAS Pre-op and Post-op

Difference in mean scores PTS, flexion, extension and VAS outcome in genu osteoarthritis patients before and after TKA are shown in table 3.

Table 3. Differences in Mean PTS, Flexion, Extension, and VAS Pre-op and Post-op Total Knee Arthroplasty at H. Adam Malik Hospital Medan

| Variable | Mean ± SD | Mean Difference | Significance Test | |
|----------------------------|-----------------|-----------------|-------------------|-------|
| | | | t | p |
| PTS (pre-op) | 8.97±4.926 | 4.03 | 6,872 | 0,000 |
| PTS (post-op) | 4.94 ± 3.589 | | | |
| Flexion Outcome (pre-op) | 124.94 ± 13.565 | 7.83 | -4,794 | 0,000 |
| External Flexion (post-op) | 132.77±8.678 | | | |
| Extension (pre-op) | 3.17±3.577 | 1.97 | 4,896 | 0,000 |
| Extension (post-op) | 1.20 ± 2.273 | | | |
| VAS (pre-op) | 3.00 ± 0.804 | 2.49 | 9,788 | 0,000 |
| VAS (post-op) | 0.51 ± 0.887 | | | |

The average value and standard deviation of PTS (pre-op) is 8.97 ± 4.926 , and PTS (post-op) is 4.94 ± 3.589 , with a mean difference of 4.03. This means that there is a decrease in the degree of PTS before and after TKA. There is a significant difference in the decrease in the mean degree of PTS score in Osteoarthritis Genu patients before (Pre-op) and after (Post-op) TKA obtained a calculated $t_{\text{value}} = 6.872 > t_{\text{table}} = 1.689$ or statistically significant $p\text{-value} = 0.000 < 0.05$, meaning that TKA influences PTS in osteoarthritis genu patients at H. Adam Malik General Hospital, Medan.

The average value and standard deviation of flexion outcome (pre-op) was 124.94 ± 13.565 , and post-op was 132.77 ± 8.678 , with a mean difference of 7.83. This means that there is an increase in the degree of flexion outcome before and after TKA. There is a significant difference in the increase in the average degree of score flexion outcome in osteoarthritis genu patients before (Pre-op) and after (Post-op) TKA obtained a calculated $t_{\text{value}} = 4.794 > t_{\text{table}} = 1.689$ or statistically significant $p\text{-value} = 0.000 < 0.05$, meaning that TKA has an effect to flexion outcome in osteoarthritis genu patients at H. Adam Malik General Hospital, Medan.

The average value and standard deviation of extension (pre-op) is 3.17 ± 3.577 , and extension (post-op) is 1.20 ± 2.273 , with a mean difference of 1.97. This means that there is a decrease in the degree of extension before and after TKA. There is a significant difference in the decrease in the average degree of score extension in osteoarthritis genu patients before (Pre-op) and after (Post-op) TKA obtained a calculated $t_{\text{value}} = 4.896 > t_{\text{table}} = 1.689$ or statistically significant $p\text{-value} = 0.000 < 0.05$, meaning that TKA influences extension in osteoarthritis genu patients at H. Adam Malik General Hospital, Medan.

The average value and standard deviation of VAS (pre-op) is 3.00 ± 0.804 , and VAS (post-op) is 0.51 ± 0.887 , with a mean difference of 2.49. This means that there is a decrease in the degree of VAS before and after TKA. There was a significant difference with a decrease in the mean VAS score in patients with osteoarthritis genu before (Pre-op) and after (Post-op) TKA obtained a calculated $t_{\text{value}} = 9.788 > t_{\text{table}} = 1.689$ or statistically significant $p\text{-value} = 0.000 < 0.05$, meaning that TKA influences VAS in patients with osteoarthritis genu at H. Adam Malik General Hospital, Medan.

4. DISCUSSION

4.1 Difference between Posterior Tibial Slope (PTS) Pre-op and Post-op

The results of the study showed that there was a significant difference in the decrease in the average degree of PTS in genu osteoarthritis patients before and after TKA. This research is in line with the results of research conducted by Seo et al. (2013) who assessed the degree of PTS score of patients with osteoarthritis genu on 801 knees belonging to 768 patients who underwent TKA from 2003-2009. The results of this study showed a statistical decrease in the mean degree of PTS score with a p-value <0.001. However, the study examined the average PTS values of 4 patient groups based on the patient's pre-op ROM. In contrast to the research conducted by Seo, this study did not average the patients based on the patient's ROM before surgery. (Seo et al., 2013)

4.2 Differences in Flexion Outcome Pre-op and Post-op

The results of the study showed that there was a significant difference in the increase in the mean score level flexion outcome in genu osteoarthritis patients before and after TKA. The results of this research are in accordance with research conducted by Farahini et al. (2012), where TKA was performed on patients with osteoarthritis genu and pre-op and post-op outcomes were assessed. In accordance with the expectations of performing TKA, an increase in the mean degree of flexion outcome score was obtained in this study with the average value and standard deviation of flexion outcome in this study being $101.6 \pm 14.3^\circ$ for pre-op and $106.3 \pm 11.1^\circ$ for post-op with p-value <0.001. (Meier et al., 2021)

4.3 Differences in Extension Pre-op and Post-op

The results of the study showed that there was a significant difference in the decrease in the average degree of score extension in genu osteoarthritis patients before and after TKA. The same thing was also found in the research of Farahini et al. (2012) who found a decrease in the mean degree of extension score in similar patients. This study obtained a mean value and standard deviation of extension of $5.7 \pm 4.8^\circ$ for pre-op and $1.4 \pm 3.1^\circ$ for post-op with a p-value <0.001, which means there is a statistically significant difference in OA genu patients who underwent TKA related to the degree of extension. (Meier et al., 2021)

4.3 Differences in VAS Pre-op and Post-op

The results of the study showed that there was a significant difference with a decrease in the mean VAS score in osteoarthritis genu patients before and after TKA. The results of this study are also in line with research conducted by Lee et al. (2023). The study examined 164 knees in 107 patients with genu osteoarthritis treated with TKA. Pre-op and post-op pain assessment was assessed from the patient's VAS which showed a decrease in the mean value. The mean value and standard deviation of the VAS in this study were 7.6 ± 1.8 for pre-op and 1.4 ± 2.0 for post-op with a p-value <0.001. In line with this research, Lee et al. obtained statistically significant results regarding the reduction of post-op TKA pain in OA genu patients. (Lee et al., 2023)

5. Conclusion

After performing TKA on osteoarthritis genu patients, there was improvement in the PTS, flexion outcome, extension, and VAS. Further studies with larger samples and more detailed variations in patient groups are needed to gain a more comprehensive understanding of the impact of TKA on PTS, flexion outcome, extension, and pain reduction in patients with osteoarthritis genu. Research is also needed to examine the relationship between changes in PTS with surgical outcomes and the incidence of post-TKA complications.

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