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Functional Evaluation of Patient with Osteoarthritis Genu Post High Tibial Osteotomy in Dr. Soetomo General Hospital and Husada Utama Hospital Surabaya

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Abstract— Osteoarthritis is the single most common cause of disability in older adults.A study reported that musculoskeletal disorders were much greater than previously thought and accounted for 6.8% of the factors contributing to decreased age productivity in patients worldwide. This study is a retrospective analytic observational study with a cross sectional approach to postoperative high tibial osteotomy (HTO) patients at Dr. Soetomogeneral hospital and HusadaUtamahospital in Surabaya. It was found that the most gender data were women with 20 patients (86.9), the most age was 51-60 years with 12 patients (52.1%), the most BMI was obese with 11 patients (61.1%),and the KOOS score of the pain, symptoms, activity daily living, sports, and quality of life components are 89.29, 92.51, 93.61, 56.96, and 82.61. Based on the FTA angle, the most patients were varus 4 and valgus 6. In addition, there were a significant difference between the mean FTA angle and between VAS average before and after surgery (p=0.000) and (p=0.000).There is an improvement in terms of clinical, radiological, and satisfactory KOOS score.

Keywords: Osteorarthritis Genu, High Tibial Osteotomy

1. Introduction

Osteoarthritis is the single most common cause of disability in older adults.A study of the global burden of disease reported that musculoskeletal disorders were much greater than previously thought and accounted for 6.8% of the factors contributing to decreased age aproductivity in patients (disability adjusted life year (DALY)) worldwide. It is estimated that 10% to 15% of all adults over the age of 60 have OA with varying degrees of OA, with a higher prevalence among women than men. According to the United Nations, by 2050 people over the age of 60 will make up more than 20% of the world's population. Of the 20%, treatment is conservative[1].

The results of long-term HTO surgery will be good, if the correct patient selection, surgical technique, rigid fixation, and a good postop protocol have been carried out.In patients with isolated medial OA with varus deformity and free ROM without ligamentous instability, HTO surgery is recommended[2]. An open wedge HTO on the medial side mounted with a TomoFix plate provides stability equivalent to the wedge lateral closure technique[3,4,5] The 10-year survival rate for near wedge osteotomy was reported to be 51% by Naudie et al and even up to 93.2% by Koshino et al. The favorable outcome of the study by Koshino was attributed to several postoperative factors including absence of flexion contractures, anatomic valgus angle of up to 10°, and concomitant patellofemoral decompression procedures when indicated. In general, HTO has a good success rate in the first ten years and deteriorates after 15years[2]

This study will conduct several evaluations regarding genu osteoarthritis patients who underwent high tibial osteotomy procedures. Some things that will be evaluated are the clinical, functional and radiological conditions retrospectively from high tibial osteotomy procedures in postoperative patients to see if high tibial osteotomy can meet patient expectations. This study also aims to determine the difference between the postoperative femorotibial angle (FTA) and 2 years postoperatively, the relationship between the KOOS score and changes in the femorotibial angle (FTA), and the relationship between changes in the visual

analogue scale (VAS) and changes in the femorotibial angle (FTA).

2. **Methods**

This study is a retrospective analytic observational study with a cross sectional approach to postoperative high tibial osteotomy (HTO) patients. The study population was patients who underwent HTO surgery from 2014 – 2018 at Dr. Soetomogeneral hospital and HusadaUtamahospital in Surabaya. Patients who met the inclusion criteria were collected and collected information through medical records from the Regional General Hospital dr. Soetomo Surabaya and HusadaUtama Hospital Surabaya from 2014 - 2018. Visited patients, for examination and interviews and filling out questionnaires from the KOOS score.Descriptive data is displayed in the form of tables and graphs. Data consist of gender, age, BMI and analyzed regarding the results of the HTO surgery from clinical, namely the degree of pain (VAS), radiological evaluation, namely femorotibial angle from x-ray genu, as well as data collection using the KOOS score questionnaire.This study had received Ethical CLEARANCE Information No. 0227/LOE/301.4.2/XI/2020 issued by the Research Commission of the Dr. Soetomo Hospital Surabaya.

3. Results

In this study, data obtained were 24 patients who underwent high tibial osteotomy surgery at the Dr. Soetomo General Hospital Surabaya during the period 2014-2018. Of the total 29 patients, only 23 patients met the inclusion criteria and 6 other patients did not meet the inclusion criteria because they were not willing to be examined.

Table 1 Distribution of patients who underwent high tibial osteotomy surgery

		N	Percentage (%)	Mean
Gender	Female	20	86,9	
	Male	3	13,1	
Age	< 40 years	0	0	
	41 – 50 years	8	34,8	
	51 – 60 years	12	52,1	
	>60 years	3	13,1	
	Total	23	100	
BMI	Normal	6	26,1	
	Overweight	6	26,1	
	Obesitas	11	47,8	
	Total	23	100.0	
KOOS Score	Pain			89,29
	Symptoms			92,51
	Activity daily living			93,61
	Sports			56,96
	Quality of life			82,61

In the total subjects of this study, as many as 23 research subjects. Based on gender, the most data were female patients with 20 patients (86.9%) compared to 3 patients (13.1%).

In this study, the majority of the age group was 51-60 years, namely 12 patients (52.1%). Meanwhile, at the age of 41-50 years there were 8 patients (34.8%). At the age of over 60 years there were 3 patients (13.1%).

The results of the descriptive analysis showed that the majority of BMI in patients undergoing high tibial osteotomy surgery were obese, namely 11 patients (61.1%). At normal weight there were 2 patients (11.1%) and in the overweight category there were 5 patients (27.8%).

The KOOS score consists of five components. The five components of all samples were averaged and obtained: the KOOS score for the pain component was 89.29; the KOOS score for the complaint component is 92.51; the daily activity component KOOS score is 93.61; the KOOS score for the sports and recreation component is 56.96; and the KOOS score for the quality of life component is 82.61.

Table 2 Evaluation of the patient's femorotibial angle (FTA) on high tibial osteotomy (HTO)

Angle	Total patients
1. Before surgery	
Varus 2°	5
Varus 4°	10
Varus 6°	8
2. Post operation	
Valgus 4°	3
Valgus 6°	16
Valgus 8°	4
3. 2 years post operation	
Valgus 4°	3
Valgus 6°	16
Valgus 8°	4

Table3 Comparison of the femorotibial angle (FTA) in each group and wilcoxon test analysis

	Evaluation	N	Percentage	Mean	SD	Value p
FTA	Preoperation	23	100	175.83	1.47	0,000
	Post operation	23	100	186	1.2	
	Preoperation	23	100	186	1.2	0,100
	Post operation	23	100	186	1.2	

Comparison of the femorotibial angle (FTA) before surgery, postoperatively and 2 years postoperatively, an analytical test was performed using a paired T test with an alternative using the Wilcoxon test.

Meanwhile, the calculation of the distribution of the variable femrotibioal angle (FTA) using the non-parametric Shapiro-Wilk test in Table 8 shows an abnormal distribution for the FTA angle ($p < 0.05$) in the three preoperative, postoperative and 2 years postoperative periods. Therefore, a non-parametric Wilcoxon test was carried out to statistically analyze the differences from the point of view of FTA. Based on the Wilcoxon test analysis shown in Table 9, this study found a significant difference between the mean FTA angle before surgery and postoperatively ($p=0.000$). This shows that the postoperative FTA angle outcomes in OA patients have a significant difference.

Meanwhile, based on the Wilcoxon test analysis shown in Table10, this study found a non-significant difference between the mean postoperative FTA angle and 2 years postoperatively ($p=0.100$). This shows that the difference between the postoperative FTA angle and 2 years postoperatively in OA patients is not significantly different.

Table4 The value of each KOOS score and delta angle FTA

Score	N	Percentage	Mean	SD

Evaluation	KOOS Pain	23	100	89.29	7.84
	KOOS Symptoms	23	100	92.51	3.07
	KOOS Activity Daily Living	23	100	93.61	6.99
	KOOS Sports	23	100	56.96	17.17
	KOOS Quality of Life	23	100	82.61	14.5
	Delta FTA	23	100	10.17	1.59

Comparison of the changes in the femorotibial angle (FTA) before and after surgery (delta FTA) to the KOOS value, an analytical test was performed using the Pearson correlation test with the alternative using the Spearman correlation test.

Meanwhile, the calculation of the distribution of the KOOS score and delta FTA variables using the shapiro-wilk non-parametric test in Table 5.12 shows an abnormal distribution for the KOOS score and delta FTA ($p < 0.05$). Therefore, Spearman's non-parametric correlation test was performed to analyze statistically.

Table5 Spearman correlation test between Delta FTA and KOOS Score

	Score	N	Percentage	Value p
Delta FTA	KOOS Pain	23	100	0,557
	KOOS Symptoms	23	100	0,699
	KOOS Activity Daily Living	23	100	0,194
	KOOS Sports	23	100	0,201
	KOOS Quality of Life	23	100	0,875

Based on the analysis of the Spearmann correlation test shown in Table 5.13, this study found an insignificant correlation between delta FTA and each KOOS score ($p>0.05$). This shows that there is a non-significant difference between the FTA angle delta and each KOOS score.

Table6 Comparison of VAS values in each group

	Evaluation	N	Percentage	Mean	SD
VAS	Preoperation	23	100	7.39	1.11
	Post operation	23	100	1.09	0.42

Comparison of the VAS values before and after surgery, an analytical test was performed using a paired T test with an alternative using the Wilcoxon test.

Meanwhile, the calculation of the distribution of the VAS value variable using the Shapiro-Wilk non-parametric test in Table 5.15 shows an abnormal distribution for the VAS value ($p < 0.05$) before and after surgery. Therefore, a non-parametric Wilcoxon test was performed to statistically analyze the differences in the VAS values.

Table7 Wilcoxon test analysis od VAS value before and after surgery

	Evaluation	N	Percentage	Mean	SD	Value p
VAS	Pre operation	23	100	7.39	1.11	0,000
	Postoperation	23	100	1.09	0.42	

Based on the Wilcoxon test analysis shown in Table 5.16, in this study, there was a significant difference between the mean VAS values before surgery and after surgery ($p = 0.000$). This shows that the outcome of postoperative VAS values in OA patients has a significant difference.

Table 8 Value of each delta VAS Score and delta FTA Angle

	Score	N	Percentage	Mean	SD
Evaluation	Delta VAS	23	100	6.3	1.29
	Delta FTA	23	100	10.17	1.59

Comparison of changes in the femorotibial angle (FTA) before and after surgery (delta FTA) to the value of VAS before and after surgery (delta VAS) an analytical test was performed using the Pearson correlation test with the alternative using the Spearman correlation test.
Meanwhile, the distribution calculation on the deltas VAS and FTA using the non-parametric Shapiro-Wilk test in Table 5.18 shows that the distribution is not normal for the delta VAS and deltas FTA ($p < 0.05$). Therefore, Spearman's non-parametric correlation test was performed to analyze statistically.

Table 9 Spearmen correlation test between Delta FTA and Delta VAS

		N	Percentage	Value p
Delta FTA	Delta VAS	23	100	0,780

Based on the analysis of the Spearmann correlation test shown in Table 5.19, this study found an insignificant correlation between the delta FTA and the delta VAS ($p>0.05$). This shows that the correlation between the magnitude of the delta FTA angle and delta the VAS value is not significantly different.

4. Discussion

The results of this study obtained data that patients who underwent HTO based on gender were mostly female patients with 20 patients (86.9%) compared to 3 patients (13.1%). The results in accordance with previous study, which states that of 1,418 research subjects regarding OA, 831 of them are women [6]. This is in accordance with a study conducted by Ganvir which stated that epidemiologically, knee OA patients were more common in women than in men in the United States and Egypt. This is related to reduced levels of estrogen and progestin at menopause age which is a risk factor for OA [7]. At menopause there is estrogen deficiency which has a role in systemic predisposition to OA [8]. Hormonal factors can influence the progression and formation of the disease. Disparity can also be related to differences in bone and ligament structure that cause changes in alignment, laxity, or decreased cartilage volume in women compared to men [9].

In this study, it was found that the majority of the age group who underwent HTO were 51-60 years, namely 12 patients (52.1%) based on the collected data. This is supported by previous research which states that increasing age increases the prevalence of OA [6]. The proportion of patients with knee OA increases with age in the population in both women and men. The increasing prevalence and incidence of OA in older people is thought to be the result of the accumulation of exposure to various risk factors and biological changes that occur in the aging process such as cartilage thinning, decreased muscle strength, decreased proprioception and oxidative damage [10].

The true correlation between age and prevalence of OA is not clear. There are several theories suggesting that changes in normal joint structure, the number of chondrocytes and the extracellular matrix can decrease the capacity of the joint to adapt to chemical and mechanical disturbances. Chondrocytes have a limit to the number of replications throughout life (about 30-40 divisions) called the "hayflick limit". This phenomenon will be the final basis of the cell cycle progression. The aging process can cause a significant decrease in the number of articular cartilage chondrocytes and will undergo apoptosis which is directly correlated with the degree of cartilage damage. The chondroprotective agent of the articular cartilage is represented by a mucinous glycoprotein product (PRGP 4) gene named lubricant or superficial zone protein

(SZP). Lubricants have a role in determining the onset and progression of the disease. This glycoprotein has a role in cartilage tissue such as lubrication of the cartilage surface, prevention of cartilage wear and synovial cell adhesion. Data from various studies show that recombinant lubricants administered to animal models of OA have shown to protect cartilage and prevent disease progression [9].

The majority of BMI in patients undergoing high tibial osteotomy surgery were obese, namely 11 patients (47.8%). Obesity will increase the mechanical load on the body and will also reduce the level of muscle tone which causes greater joint work. Fat cells will also secrete cytokines that degrade the matrix in the joints which will later cause OA [11]. In people who are obese it will be easier to lose weight, according to Roddriguez, as much as 5 kg will reduce the risk of OA by 50%. Weight loss can also reduce pain and disability in people with OA [11].

Knee injury and osteoarthritis outcome score (KOOS) is one of the assessments that is often done to evaluate therapy in knee OA. There are five symptom subscales related to knee, pain, exercise and recreation, activities of daily living (ADL), and quality of life (QOL). The KOOS score consists of five components [12]. In this study, in patients who had HTO the five components of all samples calculated the KOOS score and obtained: the KOOS score for the pain component was 89.29; the KOOS score for the complaint component is 92.51; the daily activity component KOOS score is 93.61; the KOOS score for the sports and recreation component is 56.96; and the KOOS score for the quality of life component is 82.61. On each subscale, 100 points equals no problem, while 0 points equals extreme problem. An increase of 10 points in the subscale was considered clinically significant. According to Collins who conducted a comparative study on various scoring systems, the KOOS score was considered to meet the criteria to be used as an assessment tool for both clinical and research purposes [13].

The purpose of performing HTO is to move the mechanical axis from the medial to slightly lateral from the knee midline to reduce the knee load that can delay the occurrence of osteoarthritis (OA). Therefore, it is necessary to evaluate the FTA to see the success of the HTO operation. However, the goal of OA treatment is to reduce the complaints of these patients. In this study, the KOOS score was used to evaluate OA complaints of post-HTO patients. Thus, the researchers compared the number of angles that changed with the KOOS score in patients undergoing HTO. In this study, no significant results were obtained. This is in accordance with research conducted by Nakajima, which shows that the value of the FTA angle has no effect on the KOOS value in general [14].

In this study, the VAS scores on preoperative and postoperative results were significant. This is, in accordance with research conducted by Kim which showed the results of VAS values before surgery and postoperatively obtained significant results [15]. In a study conducted by Bode also showed the same thing, it was found that the VAS value decreased in patients who received HTO therapy for preoperative and postoperative. This shows that the goal of HTO is achieved to reduce pain complaints based on scores (Bode et al., 2015). Therefore, the researcher compared the difference between the preoperative and postoperative FTA angles based on the VAS values to show the correlation of the FTA angles with the VAS values. In this study, the results were not significant. In Kim's study, there was no significant change in VAS based on the difference between the preoperative and postoperative FTA angles [15]. Pain is the main complaint felt by patients with OA. OA treatment itself aims to reduce pain in patients so that they can perform daily activities optimally [11]. In this study, it was found that postoperative HTO experienced significant pain. However, there is no significant correlation between the number of FTA angles and the VAS number, so further research is needed in this regard.

There are several limitations, the first is the short distance between the evaluation period. Second, the number of samples is small. The suggestion in this study is that the follow-up evaluation distance can be

divided into medium and long in order to better describe the effect of HTO surgery, especially in the long term. The second suggestion is that the study should have a larger sample size to better describe the effect of HTO on a larger sample.

5. Conclusion

Patients with osteoarthritis (OA) genu post high tibial osteotomy (HTO) obtained improvements in clinical terms based on the VAS score, and radiologically based on the femorotibial angle (FTA), and the evaluation value of the KOOS score was satisfactory. However, there was no significant change in the evaluation of the femorotibial angle (FTA), the change in the FTA angle on the KOOS score, and the change in the FTA angle on the VAS value. For future research, it is possible to conduct further studies with a larger number of samples and a longer time, so that the survival rate of high tibial osteotomy (HTO) in patients with osteoarthritis (OA) genu can be determined.

6. References

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