

A Randomized Controlled Study on the Safety and Effectiveness of Total Knee Arthroplasty Operated At Different Times under ERASA.

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Abstract

Background Total knee replacement (TKA) is the most effective surgical method for end-stage knee joint disease. However, around 75%-92% of patients after TKA are not satisfied. In the earlier days, TKA done at different times had different outcomes. Till this date, Enhanced Recovery After TKA has upgraded to a higher level. However, its safety and effectiveness concerning time have been remained unclear. So this study, we design to compare the effectiveness and safety of TKA surgery operated at different times, under ERAS.

Material and method In this study, 80 patients were randomly included for primary unilateral TKA who fulfilled the study criteria, between May 1st, 2019, and November 31th, 2019 in the Department of Orthopedics, West China Hospital of Sichuan University. All patients operated and peri-operatively managed according to standard ERAS protocol. The measuring indicators include VAS score, Range of knee motion, PSQI sleep quality score, HSS knee score, operation duration, total hospital stay, anesthesia time, first urination time, hemoglobin level, hematocrit, blood loss, blood glucose, inflammatory indicators (CRP and IL-6), radiological evaluation, gastrointestinal complications, appetite, total hospitalization costs, and satisfaction.

Result Out of 80 patients, 40 were operated before 2 pm and 40 were operated after 2 pm. The VAS score for knee pain on day 1 after surgery in the group before 2 pm / after 2 pm, resting ($P= 0.831$); motion ($P = 0.877$). On discharge, resting VAS ($P= 0.681$); motion, ($P = 0.912$). At 21st days VAS Score at rest ($P= 0.679$), At motion ($P= 0.979$). Before 2 pm/after 2pm group ,Blood loss $P=0.328$, ROM at the 21st day after surgery ($p = 0.476$). PSQI at 21st days after surgery ($P = 0.188$), HSS knee score on the 21st day after surgery ($P = 0.762$), respectively.

Conclusion Under the standard ERAS protocol, total knee replacements at different times do not affect its safety and effectiveness.

Trial registration: ChiCTR, ChiCTR1900022256. Registered 2019/04/01

Introduction

Total knee replacement (TKA) is the most effective way to treat arthritis. Since the early 1970s, TKA began to develop in the United States and gradually spread to the world(1). Till this date, TKA has become a very common, low-cost, and efficient orthopedic surgery. TKA currently has up to 200,000 TKA operations per year in China(2). Considering the aging of the population and the extension of life expectancy, the number of TKA operations will increase dramatically in the future(3). Reasons are TKA improves the quality of life, relieves joint pain, and improves joint function. Moreover, the long-term effects of patients with end-stage knee joint disease are better(4). However, the satisfaction of patients after TKA is in the range of 75–92%. Low satisfaction directly affects the quality of life (5).

In the traditional rehabilitation model, surgery at different time points may affect the effectiveness of surgery. Muppavarapu et.al. Found that the outcome of TKA after Monday or Tuesday is better than Thursday or Friday (6). The results of the first operated patient and the last may be different on the same surgery day. A study on orthopedic surgery found that the mortality rate of patients who performed surgery in the morning was lower, while the mortality rate of cases performed at night was the highest(7). In the afternoon, the work efficiency of surgeons or surgical staff also declined. In two independent studies, Kelz et al. found an increased incidence of complications during general emergency surgery and vascular surgery after work (8, 9). The quality of care, such as fatigue of hospital staff, decreased qualifications in late shifts, and biological patient factors, such as longer fasting, lead to an increased risk of postoperative complications later in the day. Surgery at different time nodes, different duration of fasting, patients has different waiting times, worrying that the energy of the surgical team will decline, affecting the effectiveness and satisfaction of the surgery (9, 10).

Danish surgeon Kehlet proposed the concept of Enhanced Recovery After Surgery (ERAS) in the year 1997(11). According to the ERAS model, shortening the fasting time, proper patient counseling, strengthening preoperative nutrition, early diet pan after the operation, and exercising and mobilizing early. There is a lot of evidence that it is safe to fast for 6–8 hours for solid foods and 2–3 hours for carbohydrate beverages. Fasting too long before surgery will trigger metabolic reactions, which may increase the body's response to surgical wounds, resulting in increased insulin levels (12). The metabolic effects of prolonged fasting and surgery may impair the patient's postoperative recovery. Further, some surgical studies have shown that shortening preoperative fasting and it can reduce postoperative Length Of Stay LOS(13).

Objective of this study is to compare of outcomes among TKA candidates on the aspect of time, Under the ERAS model. The comparision parameters could be summarized as safety and effectiveness. Thus, study comapares safety and effectiveness of similar patients with same treatment methodology but different operating time among TKA candidates under ERAS.

Methods

This is a single-centered study and conducted in the Department of Orthopedic Surgery, West China Hospital, Sichuan University. The trial was registered in the Chinese Clinical Trials Registry(Reg. No.: ChiCTR1900022256)and was approved by the Ethics Committee and Institutional Review Board of West China Hospital, Sichuan University. The study was conducted from May 2019 to November 2019, with the sum of 84 patients who were suffering form end-stage osteoarthritis or rheumatoid arthrits. As this is observational study, verbal consent was obtained from all the participants and included on random manner with no selection bias, were scheduled for a primary unilateral TKA, no emergency patients, no neoplastic, traumatic diseases, infections, or revisions were included. exclusion criteria included Age 80 years and over, ASA grade 4, history of deep vein thrombosis or pulmonary embolism, serum albumin less than 35 g / L, acquired or congenital coagulopathy, history of cardiac bypass surgery or placement of arterial stent; high-risk medical comorbidities, patients with history, or who received anticoagulant

therapy (warfarin or heparin) in the previous weeks. In addition, patients with mental disorders or non-cooperation were also excluded. Patients who meet the admission criteria are admitted to the hospital. Otherwise, recommended patients manage to underline conditions, firstly.

Patients were randomly divided in to two groups. Patients who underwent surgery before 2 pm were in Group A, and those who performed surgery after 2 pm were in Group B ,according to a computerised random sequence generator. The sequence was concealed until the interventions were assigned by a sealed envelope method in the operating room. The observers collecting the data after the surgeries were uninvolved in the experimental operations and were unaware of the intervention assignments.

All patients were randomly taken to the operation room and received general anesthesia. All operations were performed by an experienced senior surgeon with three assistants. An anterior midline skin incision was made by the medial para-patellar approach, using intramedullary guides for the femur and extramedullary guides for the tibia and prosthesis fixed with bone cement. All patients neither used tourniquets nor postoperative drainage tubes. At the end of the operation, it was wrapped with an elastic bandage and the wound was covered with the ice pack. All patients were managed according to the same perioperative treatment plan. Patients are allowed to eat fat and solid food 8 hours before anesthesia, 6 hours can eat milk and semi-liquid diet, 4 hours can eat a semi-liquid diet without fat and milk, 2 hours can drink 5 ml / kg of fresh drinks, including water, sugar, electrolytes, coffee, and tea. Our department prepared nutrition supplement powder for all patients, each packet contains energy 193 kcal, CHO 48 g, Na 3 mg. 0 g protein, fat, dietary fiber, should take with 200 ml warm water 2 hours before surgery. All patients got written consent, counseling and patients education, watched the operation introduction video before the operation, and post-operative patients shared the surgical experience with other patients, friends and families, and postoperative exercise and precautions. All patients were managed according to the same perioperative treatment plan. Both groups of patients received the same pre-operative consultation, the same anesthesia, the same surgical procedures, and pre- and post-operative care. After the operation, mechanical thrombosis is prevented by intermittent inflation of lower limb pumps. Post-operative functional exercises include lower limb strength exercise, ankle back extension exercises, and knee joint flexion and extension exercises. Both groups of patients received the same thrombolytic drug, anti-infection, and analgesic regimens. The same senior professor supervised before, after, and during the follow-up.

Basic data were collected and compared the demographic characteristics of the two groups, the main indicators are the patient's height, weight, gender, sex, BMI, diagnosis, and ASA. BMI calculated based on height and weight. Pain evaluation is the main result of our research, assessed by a visual analog scale (VAS), where the lowest score is 0 and the highest score is 10. Motion and resting VAS were measured at the time of admission, the first day after surgery, the day of discharge, and the follow-up. The resting VAS was measured when the knee flexed at 45 degrees. Sleep quality was assessed by the Pittsburgh Sleep Quality Index (PSQI) at admission and the last follow-up. Knee function was evaluated by the Range Of Motion (ROM) and the HSS knee score, which were evaluated during admission, discharge, and follow-up. Hematocrit (Hct), hemoglobin (Hb), and blood glucose at admission and discharge were recorded.

Inflammation indicators (interleukin 6 and C-reactive protein) on admission, on the first day after surgery and upon discharge were recorded.

Blood Loss Formula, according to Gross et. al(14) and Nadler et.al(15).

$$\text{TBL(mL)} = \text{PBV} \times (\text{Hctpre} - \text{Hctpost}) / \text{Hctave}$$

$$\text{PBV(mL)} = k_1 \times \text{height (m)} + k_2 \times \text{weight (kg)} + k_3$$

Among them, total blood loss (TBL), patient's blood volume (Patient's blood volume, PBV), initial hematocrit level before Hct pre operation, minimum hematocrit level after Hctpost operation, Hct before and after Hctave operation The average of the sum of Hct. $k_1 = 0.3669$, Male $k_2 = 0.3219$, $k_3 = 0.6041$; Female $k_1 = 0.3561$, $k_2 = 0.3308$, $k_3 = 0.1833$

Furthermore, Comparison was made between the group on total anesthesia time, total operation time, total hospital stay, urine output for the first time after surgery, gastrointestinal adverse effect, appetite, and total cost. Gastrointestinal complaints mainly focus on postoperative diarrhea, constipation, dry mouth, nausea/vomiting. Appetite conditions classified by not good, normal, good, and very good. patient Satisfaction where satisfaction classified as very satisfied, satisfied, normal, and not satisfied. X-ray films of two groups of patients were taken for imaging evaluation. The comparison made between prosthesis loosening, light transmission where light transmission line > 2 mm counted as positive for transmission. The evaluation of the lower limb force line used the femoral tibial mechanical axis angle (MFT), which is the angle of the tibial mechanical axis.

Statistical analysis for quantitative data expressed as mean and standard deviation (SD); categorical variables are expressed as proportions. According to the distribution characteristics of the data, the *t*-test or Mann-Whitney *U* test was used to evaluate the difference of continuous variables between groups. A Chi-square test or Fisher's exact probability test is used to compare categorical Variables. $P < 0.05$ was considered statistically significant and used SPSS 19.0 to complete the statistical analysis.

Results

1. Candidates flow and baseline data

84 patients meet the inclusive and exclusive criteria among then 2 were unwilling to participate and 2 were lost during follow up, 80 patients remained until the study over. 40 patients were operated morning and remaining 40 were operated at evening. patients flow chart is shown in table1. There are 40 patients on both groups and no statistical difference in the ages of groups A and B ($p=0.421$). The mean height of both groups are similar and no statistical significance between the groups ($p=0.874$). The mean weight of both groups also similar and no statistical difference between the groups ($p=0.917$). BMI between the two groups shows no significant difference between the groups ($P = 0.460$). Group A contains only 3 males, while group B contains 4 males and shows no significant difference ($p=1.000$). Similarly, 1 RA patient in group A, 2 RA patients in group B, and the rest were OA and was no statistical difference between the two groups ($P= 1.000$). There was 1 patient in group A of ASA grade 1 and 2 patients in group B. There were

18 cases in ASA grade 2 group A and 15 cases in group B. There were 22 cases in ASA grade 3 group A and 23 cases in group B. There were no ASA grade 4 patients in both groups. American Society of Anesthesiologists (ASA) were collected preoperatively, with no statistical difference ($p > 0.05$).

2. Pre-operative data

As shown in Table 2: Two knee VAS scores were measured before surgery, at rest and motion. Compared with group A, the average knee pain VAS score during rest and motion is similar in group B, but there is no statistical difference between the two groups ($P = 0.602$), ($P = 0.689$) respectively. Similarly, there is no statistical difference in preoperative ROM between the two groups ($P = 0.646$). In terms of the HSS score, there is no statistical difference between group A and group B ($P = 0.505$). In the sleep score, there is no statistical difference between the two groups ($P = 0.385$). There is no statistical difference in HCT content between the two groups ($P = 0.456$). In terms of hemoglobin level, there is no statistical difference between the two groups ($P = 0.203$). There were no significant differences in blood glucose levels between the groups ($P = 0.203$), CRP, and IL-6 between groups A and B ($P > 0.05$). In summary, there was no statistical difference in baseline data between the two groups pre-operatively.

3. Post-operative data

3.1 pain score

As shown in Table 3, resting VAS and motion VAS were measured three times after surgery and compared between groups. The resting VAS on the first postoperative day: no significant difference between the groups ($P = 0.831$); Motion VAS: no significant difference between the groups ($P = 0.877$). Resting VAS at discharge: no significant difference between the groups ($P = 0.681$); Motion VAS: no significant difference between the groups ($P = 0.912$). Resting VAS at follow-up, the resting no significant difference between the groups ($P = 0.679$); Motion VAS: no significant difference between the groups ($P = 0.979$). From the above data, it can be seen that there is no statistical difference in the VAS score between the two groups during the perioperative period and the follow-up period.

3.2 Function Scale

HSS knee score: during follow-up no significant difference between the groups ($P = 0.762$). ROM: at discharge; during discharge no significant difference between the groups ($P = 0.546$) and at follow-up no significant difference between the groups ($P = 0.476$). There was no significant difference in the HSS knee score and ROM score between the two groups during the perioperative period and follow-up.

3.3 Sleep Quality

The PSQI comparison of sleep scores between the two groups is ($P = 0.188$). There was no statistical difference between the two groups in preoperative and postoperative sleep scores.

3.4 Blood Index

At discharge, HCT (%): no statistical difference between the groups ($P = 0.987$). At discharge, HGB no statistical difference between the groups ($P = 0.545$). At discharge blood sugar no statistical difference between the groups ($P = 0.564$). first day after surgery and discharge CRP no statistical difference between the groups ($P = 0.968$), ($P = 0.108$) respectively. Interleukin – 6 during the first day after surgery and discharge, no statistical difference between the groups ($P=0.153$), ($P=0.280$) respectively.

4. Time Differences, Total Blood Loss and Radiological Assessment

As shown in Table 4, total hospital stay (days) ($P = 0.988$). The first postoperative urine output (hours) ($P = 0.890$), Operation time (minutes); ($P = 0.882$). Anesthesia time (minutes): ($P = 0.772$), Blood loss (ml) ; ($P = 0.328$) where data shows no significant different the groups. The prostheses of both groups were in place, and there was no loosening, no light transmission line > 2mm. The evaluation of the lower limb force line used the femoral tibial mechanical axis angle (MFT), which is the angle of the tibial mechanical axis. There were 35 cases (87.5%) within 3 ° of MFT in group A and 36 cases (90%) in group B. There was no statistical difference between the two groups.

5. Appetite, gastrointestinal complications, Total Hospital Cost and Satisfaction

As shown in Table 5, A and B groups have 8 cases and 7 cases of "Bad", 15 cases and 16 cases of "Normal", 16 cases and 15 cases of "Good", "Very Good" for 1 case, 2 cases respectively. There was no statistical difference between the two groups ($P = 0.837$). Gastrointestinal complications: Constipation: 12 cases (30%) in group A, 15 cases (37.5%) in group B ($P = 0.478$); 2 cases (5%) in group A with dry mouth, and 3 cases (7.5%) in group B ($P = 1.000$); diarrhea group 3 cases (7.5%), group B 4 cases (10%) ($P = 1.000$), nausea / vomiting group 4 cases (10%), group B 4 cases (10%) ($P = 1.000$), there is no statistical difference between the two groups of gastrointestinal complications. The total cost is calculated in RMB, including the cost of the prosthesis, there was no statistical difference between the total cost of the two groups ($P = 0.808$). Comparing the satisfaction rate, 27 cases (67.5%) were "very satisfied" in group A, 24 cases (60%) in group B; 13 cases (32.5%) in "satisfied" group A and 16 cases (40%) in group B; No "general" and "unsatisfactory". There was no statistical difference between the two groups ($P = 0.489$).

Discussion

In the earlier days, surgery at different time points may affect the effectiveness of surgery. Muppavarapu et. al found that TKA performed on Monday or Tuesday was better than Thursday or Friday(6). Halvachizaden et. al. found that night surgery is less effective than day surgery and morning is better than an afternoon(16). But Montaigne et al found that in cardiac surgery, afternoon surgery is more effective(7). In two independent studies, Kelz et al. Found(7–9). Early day's surgical model, fasting is usually required overnight before surgery. Fasting too long before surgery will trigger metabolic reactions, which may increase the body's response to surgery, resulting in increased insulin resistance and the surgical wound may impair the patient's postoperative recovery (12, 13).

The ERAS model focus on reducing surgical wound through the use of minimally invasive surgical procedures, thereby reducing postoperative complications, saving costs, shortening the length of hospital stay (LOS), improving patient satisfaction and promoting faster recovery(17). The nutrition mode under the ERAS model requires shortening the fasting time, strengthening preoperative nutrition, early postoperative food supplements, exercising, and mobilizing early (18). The Society of Anesthesiology recommends fasting for 2–3 hours before surgery (19). Some studies have shown that shortening preoperative fasting can reduce postoperative LOS(13). Preoperative education helps to increase patient confidence, improve patient Preoperative education has a modest beneficial effect on perioperative anxiety (9).

The main goal of postoperative analgesic treatment is to reduce pain, reduce the need for opioids and reduce the adverse reactions associated with opioids, and accelerate patient recovery. This directly affects patient satisfaction, postoperative care level, financial burden, and anxiety(20, 21). Changes in the degree of pain can be assessed by VAS. Karlsen et al. conducted a meta-analysis of pain management after TKA and found that there is no best strategy for pain management after TKA, in the literature(22). In our study, the improvement of patients' postoperative pain in this study is similar to that of Wang et. al. (23). As can be seen from the results of this study, the pain during the follow-up period has been greatly reduced compared with before the operation. Patients may suffer from sleep disorders due to pain, socioeconomic burden, and even mental disorders before receiving TKA, and sleep disorders are also prone to occur after TKA (24). Research conducted by Brien suggests that lack of sleep (4 hours or less) may result in decreased daily performance and persistent inattention. Also, in healthy adults, poor sleep quality directly affects the quality of life and mental state, which is even worse in perioperative patients who need more sleep (25, 26). But there seems to be a vicious circle: pain-poor sleep quality-increased pain-poor sleep quality. Studies have shown that there is a statistically significant correlation between pain intensity and sleep quality. Besides, nighttime pain is significantly associated with joint swelling, elevated ESR, and CRP, all of which are consistent with the characteristics of local and systemic reactions in TKA surgery (24–26). Our result shows there is no significant difference between the groups on the above indicators and found improved after surgery.

HSS and ROM represent the patient's knee function. Miao et al found that 6 weeks after TKA, the joint function of patients has exceeded that of pre-operation(27). Canovas and others found that TKA can greatly improve the quality of life scores. They found that pain and / or stiffness during exercise is associated with the patient's quality of life and patient satisfaction(5). In addition, Zhou et al found at 6 weeks after surgery, the patient showed significant improvement in walking and bending activities(28). Our study found that 3 weeks after surgery, ROM and HSS scores were significantly. improved compared with before surgery, and the results of the two groups were not statistically different. Compared with patients guided by surgeons and anesthesiologists for perioperative care, patients with TKA through ERAS have significantly lower LOS(29, 30). Urinary retention after TKA has greatly hindered early discharge(31). Stowers et. al. found no significant difference in LOS between ERAS and non-ERAS(32).LOS is not only affected by a single independent factor, it is the result of a combination of

various factors. In this study, LOS, time of urination after surgery is shorter and there was no statistical difference between the two groups.

Various factors will affect TKA post-operative outcomes, Shortening of anesthesia time is directly related to early postoperative rehabilitation (32). Soffin et.al. Found that the prolongation of general anesthesia time was significantly associated with postoperative nausea and vomiting(33). In our study, the anesthesia time and the operation time of the two groups of patients were the same, found to be no statistical difference in the anesthetic time and proportion of postoperative gastrointestinal complications between the two groups. It is estimated that by 2030, the global prevalence of Diabetes Mellitus(DM)disease will increase from 6.4% in 2010 to 7.7%(34). According to reports, compared with patients without DM, TKA patients with DM have more perioperative complications (35). Also, DM can impair the healing of wounds by delaying collagen synthesis and adversely affect the musculoskeletal system (34). Therefore, the blood glucose level before and after controlling TKA is very important (34, 36). Due to the use of advanced technology to minimize the risk of DM-related adverse effects, the success rate of TKA continues to increase(37). In our study, there was no statistical difference in blood glucose between the two groups, suggesting that surgery at different surgical time has no significant effect on blood glucose changes.

After a major surgery, patients often suffer from loss of appetite, but no literature has specifically studied the relationship between TKA patients, loss of appetite, and its relation to the surgery start time. Prodger et al found that after TKA, patients usually suffer from loss of appetite and disappear within 6 weeks(38). Besides, patients with gastrointestinal disease (GI) are at risk of osteopenia or osteoporosis, such as post-gastrectomy status, inflammatory bowel disease (IBD), and abdominal disease, which may cause fractures around the prosthesis and require revision(39). Because most TKA patients are elderly osteoporosis patients, the incidence of fractures around the prosthesis is higher (39). Other causes of gastrointestinal symptoms include *C. difficile* and pseudomembranous colitis (40, 41). It is important to observe gastrointestinal symptoms closely, especially intestinal dysfunction caused by analgesic. This study explored the relationship between different surgical start times and postoperative gastrointestinal reactions and appetite. Postoperative gastrointestinal reactions were not statistically different between the two groups, and appetite was not statistically different. It is suggested that under the ERAS, surgery at different time points does not affect appetite and does not increase the risk of gastrointestinal complications.

The total cost of hospitalization and patient satisfaction are other evaluation indicators of TKA's success. Despite the continuous improvement, TKA satisfaction should be higher. It has been reported in the literature that about 20% of TKA patients are dissatisfied after the operation and their functional score is not high (20, 21, 42, 43). However, this study shows that postoperative satisfaction is higher, which may be due to the different psychosocial behavior of patients in different places. The higher satisfaction rate may be due to the psychosocial behavior of the patients. There was no significant difference in hospitalization costs between the two groups,in this study.

In this study, the VAS pain score, joint function score, joint mobility, blood inflammatory indicators, blood loss, hemoglobin level, blood sugar, gastrointestinal complications, PSQI sleep score, operation duration, anesthesia duration, first postoperative urine output, Patient satisfaction, radiological evaluation, total hospitalization costs, and differences between the two groups were not statistically significant. Every parameter of the two groups of patients was better than those before the operation, suggesting that TKA significantly improved the patient's condition which is safe and effective. In summary, under the ERAS model, TKA patients' personalized dietary management and full communication and pre-operation before surgery eliminate concerns, and different time nodes have no difference in the safety and effect of TKA surgery.

This study also has some limitations. The study was conducted at West China Hospital of Sichuan University and is a single-center prospective study. The research study sample size is small, and the preoperative diagnosis is limited to OA and RA patients, the follow-up time is short, and the methods used to measure various outcome indicators are relatively limited. In the future, a multi-center large sample long follow-up study may be needed to further depth of the study.

Conclusion

This prospective study aimed to compare the difference between the results of TKA before and after 2 pm under ERAS. We found that there was significantly safe and effective of the procedure until three weeks follow up. Furthermore, there was no statistically significant difference between the two groups on postoperative, discharge, and 3 weeks of postoperative follow-up. In the ERAS, TKA patient-oriented diet management, patient education, and counseling before surgery success made no difference in the impact of different time on the aspect of safety and effectiveness.

Abbreviations

TKA; Total Knee Arthroplasty, TKR; Total Knee Replacement, BMI; Body Mass Index, OA; Osteoarthritis, RA; Rheumatoid Arthritis, HSS; Hospital for Special Surgery, ROM; Range of Motion, ASA; American Society of Anesthesiologists, SD; Standard Deviation, PBV; Patients Blood Volume, HCT; Hematocrit, HGB; Hemoglobin, IL-6; Interleukin-6, CRP; C - reactive protein, PSQI; Pittsburgh Sleep Quality Index, VAS; Visual Analogue Score, LOS; Length of Hospital Stay, UFT; Urination for First Time, ERAS; Enhanced Recovery after Surgery.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee and Institutional Review Board of West China Hospital, Sichuan University (Registration: ChiCTR1900022256). This is observational study, only verbal consent was obtained from all individual participants included in the study.

Consent to participate

Verbal consent was obtained from all the participate in this study.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on a reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

SD is a major contributed in writing and revising the manuscript and Participate in the design of the study. RX and MCY equally contributed as SD to design to this article. ZYL performed the statistical analysis. HS contributed to the data Interpretation. QFT and ZKZ participated in the design of the study. All authors reviewed the final manuscript. All authors agree to be accountable for all aspects of the work.

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Tables

Table 1
Baseline data

Variables	Group A	Group B	<i>P</i>
Age	66.70 ± 9.63	65.2 ± 7.3	0.421
Height	154.48 ± 15.59	157.60 ± 6.42	0.874
Weight	62.08 ± 10.9	67.64 ± 6.76	0.917
BMI	3.81 ± 0.56	3.65 ± 0.53	0.460
M/F	3/37	4/36	1.000
RA/OA	1/39	2/38	1.000
ASA			0.820
1	1	2	
2	18	15	
3	22	23	
4	0	0	
<p>The data is shown as mean ± standard deviation. Body mass index (BMI) is equal to the weight in kilograms divided by the square of the height in meters, M stands for male/F stands for female. (OA) osteoarthritis, (RA) rheumatoid arthritis and (ASA) American Society of Anesthesiologists.</p>			

Table 2
preoperative data

Variables	Group A	Group B	P-value
Rest VAS	1.12 ± 0.75	1.17 ± 0.747	0.602
Motion VAS	4.07 ± 1.02	4.67 ± 1.14	0.689
ROM	97.87 ± 11.97	97.02 ± 9.23	0.646
HSS	57 ± 8.31	56 ± 9.95	0.505
PSQI	6.25 ± 1.54	6.85 ± 1.35	0.385
HCT	0.39 ± 0.04	0.39 ± 0.49	0.456
HGB	129.45 ± 16.23	132.93 ± 13.05	0.498
Glucose	6.248 ± 1.70	6.0052 ± 1.31	0.203
CRP	3.99 ± 1.026	4.66 ± 0.912	0.46
Il-6	4.51 ± 1.46	4.417 ± 1.66	0.846

Data shown as mean ± standard deviation include visual analog score VAS, activity ROM, HSS knee score, and Pittsburgh sleep quality score PSQI. Hematocrit HCT is measured in%, hemoglobin HGB is measured in g / L, blood glucose mmol / L is measured in L, C-reactive protein CRP, unit mg / L, interleukin-6 IL-6 pg / dL.

Table 3
post-operative and follow up data

Variables	Group A	Group B	P-value	
VAS				
	D1-rest	1.15 ± 0.53	1.27 ± 0.59	0.831
	D1 - motion	4.25 ± 0.80	4.12 ± 0.82	0.877
	Discharge - rest	1.075 ± 0.69	1.22 ± 0.65	0.681
	Discharge- motion	3.12 ± 0.95	3.05 ± 0.93	0.912
	F/U - rest	0.25 ± 0.48	0.27 ± 0.45	0.679
	F/U - motion	1.77 ± 0.66	1.82 ± 0.975	0.979
PSQI	F/U	7.32 ± 1.22	7.775 ± 1.27	0.188
HSS	F/U	67.55 ± 6.44	65.425 ± 5.02	0.762
HCT	Discharge	0.344 ± 0.037	0.35 ± 0.51	0.987
HGB	Discharge	112.9 ± 14.017	114 ± 12.74	0.545
Glucose	Discharge	8.767 ± 1.98	8.26 ± 1.52	0.564
CRP	D1	42.08 ± 12.34	43.73 ± 13.454	0.968
	Discharge	58.03 ± 18.9	59.4375 ± 17.51	0.108
IL-6	D1	54.73 ± 14.81	51.68 ± 12.65	0.153
	Discharge	43.89 ± 10.22	44.73 ± 9.36	0.028
ROM	Discharge	104.6 ± 5.5	105.5 ± 5.37	0.546
	F/U	110 ± 6.61	109 ± 5.94	0.476

The data are shown as mean ± standard deviation: visual analog score-VAS, first day-D1, discharge-Discharge, follow-up-F / U, Pittsburgh sleep quality score PSQI. Hematocrit-HCT (%). Hemoglobin-HGB (g / L), Glucose Mmol/L, C-reactive protein CRP (mg / L), interleukin-6 IL-6 (pg / dL), ROM (°),

Table 4
Different Time, Total Blood Loss and Radiological Assessment

Variable	Group A	Group B	P-Value
LOS	5.075 ± 0.85	4.97 ± 0.91	0.988
UFT	2.44 ± 0.847	2.63 ± 0.91	0.890
Surgery Duration	83.05 ± 12.32	86.47 ± 16.64	0.882
Anesthetic Duration	128.90 ± 25.06	121.68 ± 29.26	0.772
Blood Loss	440 ± 145	430 ± 155	0.328
Prosthesis loosen	0	0	-
Light Transmission	0	0	-
MFT 3°less	35(87.5%)	36(90%)	1.000

The data are shown as mean ± standard deviation LOS hospitalization days (in days) UFT first micturition time (in hours), operation time and anesthesia time in minutes, blood loss in ml, MFT femoral tibial mechanical axis angle.

Table 5
showing total cost, satisfaction, Appetite condition, and complication.

	Group A	Group B	Pvalue
Total Cost	57170.21 ± 3883.35	56774.80 ± 4036.4	0.808
Satisfaction			0.489
Very Satisfied	27(67.5%)	24(60%)	
Satisfied	13(32.5%)	16(40%)	
Normal	0	0	
Not Satisfied	0	0	
Appetite			0.837
Not good	8	7	
Normal	15	16	
Good	16	15	
Very good	1	2	
Complication			
Constipation	12(30%)	15(37.5%)	0.478
Dry Mouth	2(5%)	3(7.5%)	1.000
Diarrhea	3(7.5%)	4(10%)	1.000
Nausea/ Vomiting	4(10%)	4(10%)	1.000

The total cost data are expressed as mean ± standard deviation, percentage and the satisfaction is divided into four categories. Gastrointestinal complication; Constipation, Dry mouth, Diarrhea, Nausea/Vomiting where appetite includes Not good, Normal, Good, Very Good.

Figures

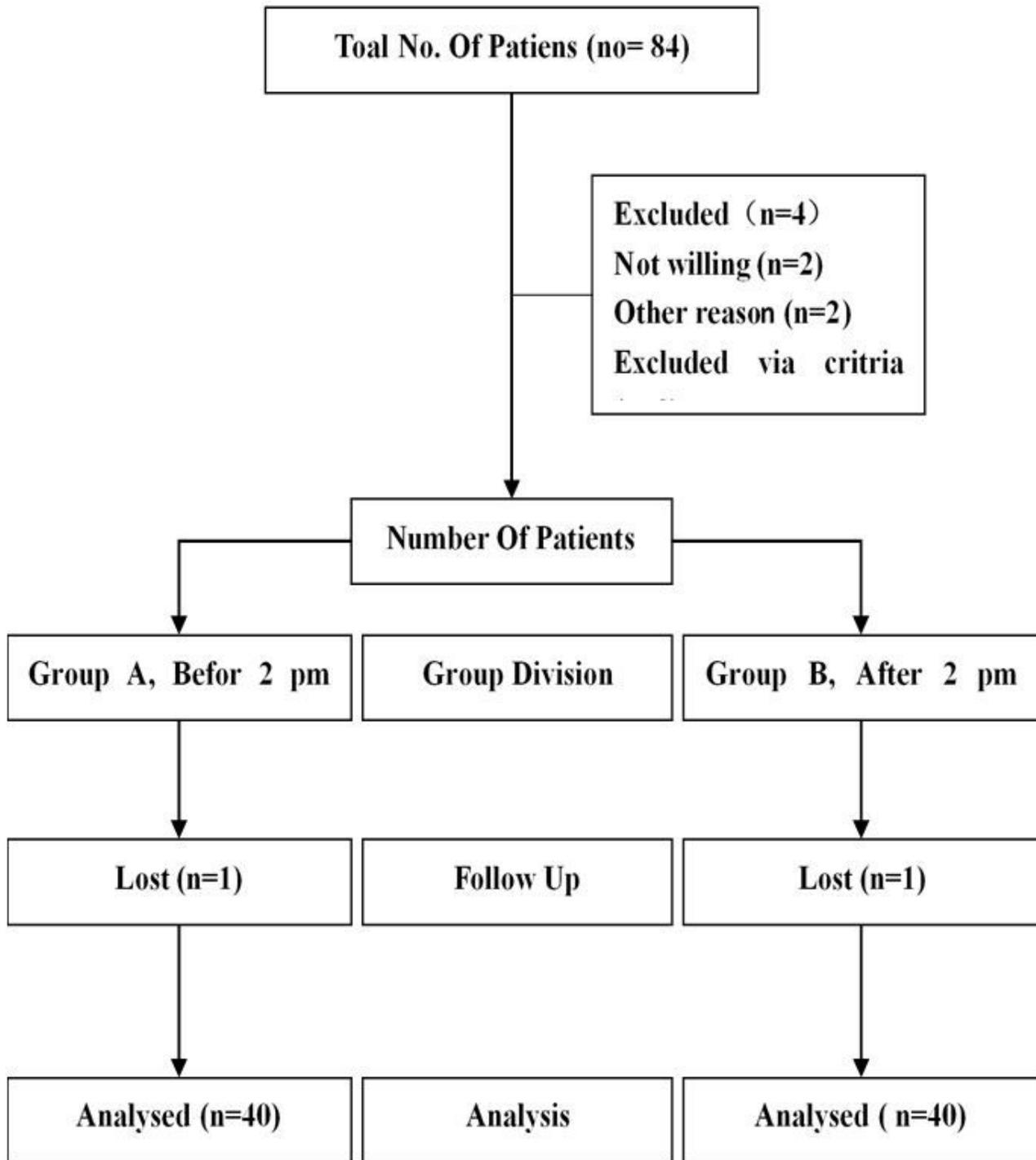


Figure 1

Chart 1 showing flow chart of patient selection and process.