# Better clinical outcome of total knee arthroplasty for rheumatoid arthritis with glucocorticoids and disease-modifying anti-rheumatic drugs after an average of 11.4-year follow-up

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May 14, 2020



**Abstract**

Objectives: This study investigated whether perioperative treatment with glucocorticoids (GC) and disease-modifying anti-rheumatic drugs (DMARDs) can improve clinical outcomes and reduce long-term complications for patients with rheumatoid arthritis (RA) undergoing total knee arthroplasty (TKA). Methods: Patients were allocated into three groups based on perioperative drug therapy: A. control group (no GC or DMARDs), B. DMARD group (DMARDs given without GC) and C. co-therapy group (DMARDs plus GC). The patients were followed and received questionnaires at the latest follow-up. Baseline characteristics, pre- and post-operative HSS knee score, laboratory parameters, and surgical complications were collected and analyzed. Results: 56 RA patients undergoing 91 TKAs were included in this study. The average follow-up duration was 11.4 years. Patients who received perioperative GC with DMARDs (group C) achieved better HSS score (C:84.04 vs A:78.96 vs B:76.50, p=.008), pain relief (VAS: C: 1.12 vs B: 1.73, p=0.02), higher functional assessment (C:16.17 vs B:13.23, p=0.03) and range of motion (C:132.15 vs A:112.57 vs B:112.51, p<0.001) compared the other treatment groups at time of latest follow-up. Aside from greater post-operative hemoglobin seen in group A compared to group B (P=0.04), no other differences were noted in laboratory tests, blood loss and transfusion, short-term or long-term complications between treatment groups. Conclusions: Perioperative treatment with GC combined DMARDs for RA patients is associated with improved HSS score, better function and range of motion, and reduced postoperative pain in the long term when compared to treatment with DMARDs alone or management without anti-rheumatic medication.

## Introduction

Rheumatoid arthritis (RA) is often characterized as an inflammatory autoimmune disease, causing cartilage and bone damage with progression to joint malformation and eventual loss of function. Joints typically involved in disease include the small joints of the hands and feet, as well as large joints of the hips, knees and ankle. Knee lesions are commonly seen in chronic RA patients, gradually impairing ambulatory capacity and subsequent quality of life [1-3]. Progressive pathophysiology of RA together with increase in global life expectancy warrants extensive attention in management and treatment of severe knee deterioration.

Fundamental approach to RA disease management attempts to accomplish inflammatory control, pain relief, and maintain function of affected joints through pharmaceutical and surgical interventions. Anti-inflammatory glucocorticoids (GC) are commonly used to reduce pain, stiffness and to slow progressive bone erosion [3-5]. Another cornerstone class of RA medication is disease-modifying anti-rheumatic drugs (DMARDs), consisting of conventional and biologic DMARDs, which slow disease progression by targeting

and resolving inflammatory disease pathophysiology. Co-therapy using GC with DMARDs provides additive benefit and is reported to reduce risk for joint replacement and radiographic disease progression compared to drug monotherapy [6,7,8]. However, despite improvements in joint function and quality of life using these drugs, rates of total knee arthroplasty (TKA) in end-stage disease have remained stable, with literature reporting close to 70% of joint replacement patients to have been treated with DMARDs in the past [7,9].

Conventional practice is often to take patients off medications prior to surgery for fear of infection or surgical complication, however it has been reported that medication cessation can lead to exacerbating RA symptoms. With some suggesting that continuation of drug therapy perioperatively helps control RA flares, improves postoperative rehabilitation, and reduces disease activity, pain and fatigue; benefits that can be weighed directly against infectious risk [7]. Long term effects and outcomes of perioperative drug therapy in TKA presently remain unclear and current guidelines are based largely on theory and clinician opinion, warranting formal clinical investigation. This study will evaluate short-term effects, long-term clinical outcome and complications associated with preoperative GC and DMARD use in RA patients undergoing TKA surgery.

Materials and Methods

This is a retrospective observational study designed in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines and was approved by the institutional review board [10] (IRB number: S-K1025). Informed written consent was obtained from patients for publication.

*Patient selection and management*

RA patients undergoing TKAs at our institute between January 2000 and December 2011 were included in this study, patients receiving operations for other joint diseases (i.e. osteoarthritis, ankylosing spondylosis, etc.) were excluded from research analysis. RA disease status was verified in all patients through history of rheumatologist diagnosis made according to standardized diagnostic criteria before admission. Information regarding GC and DMARD therapy was collected using our institutional arthroplasty database. Patients were organized into 3 treatment groups based on perioperative medication therapy:

A.Control group (no anti-rheumatic drugs used)

B.DMARD group (conventional or biologic DMARD use with no GC)

C.Co-therapy group (DMARD and GC use)

In order to be included in groups B and C, patients must have received consistent management with DMARDs and DMARDs plus GC respectively for a minimum of one year postoperatively. Follow-ups were then conducted through outpatient clinic questionnaires or via telephone. In cases of patient attrition due to death between the follow-up period, most recent health status was obtained in detail from close relatives.

In our study, no patients had been receiving GC monotherapy. Conventional DMARDs treatment was continued during surgery for groups B and C, however all biologic DMARDs were stopped 4 weeks prior to surgery and restarted at least one week postoperatively depending on medication and disease status. Non-steroid anti-inflammatory drugs (NSAIDs) were given in each group as needed to control acute pain.

*Data Collection*

Information on patient demographic including age, gender, body mass index (BMI), and whether unilateral or bilateral TKA was performed was recorded based on patient perioperative medication treatment group and used to assess possible discrepancy between groups (Table 1 & 2). Data was then collected for each treatment group evaluating pre- and post-operative metrics of joint function, surgical parameters, and bloodwork.

Preoperative

Preoperative knee status was determined using Hospital of Special Surgery (HSS) total knee score, a standardized 100-point approach to TKA assessment that includes joint range of motion (ROM), joint function, and pain. Pain was further assessed using a Visual Analog Scale (VAS). Baseline blood work was recorded

measuring white blood cells (WBC), hemoglobin (HGB), C reaction protein (CRP), erythrocyte sedimentation rate (ESR), and rheumatoid factor (RF). Additionally, choice of anesthesia was also recorded for each surgery.

Postoperative

HSS score, joint function, pain and VAS score were all assessed at time of latest follow-up. While ROM was measured twice, shortly postoperative prior to patient discharge and again during follow-up. Evaluation of postoperative management also included volume of wound drainage, postoperative temperature at days one and three (T pod 1 and 3), need for postoperative blood transfusion, volume of blood transfusion, and bloodwork measuring WBC, HGB and HGB drop during surgery (calculated by subtracting postoperative HGB from preoperative HGB). Patients were monitored for 3 months postoperatively for incidence of deep vein thrombosis (DVT) and short-term complications such as acute infection, delayed wound healing, need for blood transfusion, RA flare, etc., which were categorized into: systematic, wound, and surgical issues. Long term follow-up was performed approximately 10 years after TKA to document all complications that may have resulted from the operation, including periprosthetic joint infection (PJI), fracture, prosthesis loosening and need for surgical revision.

Of note, HSS score and ROM were evaluated separately for each knee in patients undergoing bilateral TKA, while other parameters such as pain were assessed jointly to better reflect overall patient disease status.

*Statistical Analysis*

Statistical analysis was preformed using IBM SPSS Statistics software version 25 (IBM Corporation, Armonk, US). Continuous data with normal distribution was reported as mean and SD, while non-normally distributed data was presented as median and interquartile range. Variance analysis (ANOVA) was used to compare quantitative data among the three treatment groups with subsequent Bonferrnoi pairwise comparisons. Chi-square test and Fisher's exact test were used to analyze qualitative variables. In Fisher's exact test, Bonferrnoi correction was used for adjusting significance limit to $P<0.017$, while significance was defined as $P<0.05$ for other tests.

## Results

*Demographic and disease features*

This study included 91 TKA operations performed on 56 RA patients in our hospital, with a mean patient age of 51.7 years. Average patient follow-up was 11.4 years (ranging from 7-16 years), during which 4 patients were lost to death attrition. The mean duration of RA medication treatment after surgery was approximately 8 years for both groups B and C. No other significant differences were observed between treatment groups in patient demographics (Table 1).

Of patients who received DMARD therapy in group B, conventional DMARDs were given to 6 patients (40.0%) as a single drug regimen, 7 (46.7%) were on a two-DMARD combination, and 2 patients (13.3%) were given a two-drug mix of conventional and biologic DMARD. All patents in group C consistently received one kind of GC plus DMARDs. Among them, 12 (57.1%) received conventional DMARD monotherapy, 6 (28.6%) received combination therapy with two conventional DMARDS, and 3 patients (14.3%) received a two-drug mix of biologic and conventional DMARD regimen. Additionally, NSAIDs were given to patients in all groups as needed to manage acute pain and no patients received GC intraarticular injections. (Table 2)

*Surgical related results*

No statistically significant differences were seen between any treatment groups in measures of preoperative or postoperative WBC, RF, HGB drop, CRP, volume of blood transfusion, wound drainage or temperature at POD1 (table 3). Preoperative ESR was found to be higher in group B than groups A or C ($P= 0.03$, 0.02 respectively) (table 1) and postoperative HGB was higher in group A than B ($P= 0.04$) (table 3).

*Clinical outcome*

Statistically significant improvements in HSS and VAS pain score were seen in all treatment groups postoperatively at time of last follow-up compared to preoperative measurements (P<0.01).

Follow-up assessment preformed at an average of 11.4 years postoperatively, showed patients receiving co-therapy in group C to have had superior improvement in both HSS score and VAS pain compared to group B patients given DMARDs alone (P= 0.01 and P = 0.04 respectively) (Table 3). HSS and VAS were statistically similar at follow-up between groups A and B. No differences were noted between any groups in joint ROM shortly after surgery prior to discharge. However long-term evaluation at latest follow-up demonstrated group C patients to have made the significantly greater postoperative improvement in ROM compared to both groups A and B (P=0.001 and P=0.002 respectively), while no follow-up ROM differences were observed between groups A and B (P=1.00) (Table 3).

*Postoperative complications*

Short term complications were monitored for 3 months postoperatively, during which time no cases of DVT were reported in group C patients, while one case was reported in group A and 4 in group B (Table 4). There is less ratio of DVT in group C compared to group B with no statistical significance after pairwise comparisons (P=0.03). Other short-term complications were further categorized as systematic, wound, or surgical issues. Group A control patients reported 4 complications (2 systematic, 1 wound and 1 surgical) which were 1 case of hemarthrosis (managed through puncture aspiration), 2 cases of nerve injury (one of which resulted from subcutaneous compression and resolved after release), and one case of blood transfusion related allergic shock. Four short-term complications were also noted in group C patients (3 systematic, 1 wound) which were one case of urinary tract infection, one herpes zoster infection, one thrombocytopenia, and one peroneal nerve palsy. No statistical differences were observed between any treatment groups in grouped short-term complications or when subdivided into systematic, wound or surgical problems (Table 4). Of note, no cases of RA flare/relapse or acute infection was reported in any group.

Long term complications assessed at latest follow up, an average of 11.4 years postoperatively, reported no incidents in groups A or B and one case of prosthetic joint infection (PJI) in group C which occurred 3 years following index surgery and required surgical revision. No aseptic loosening, instability or periprosthetic fracture was reported in our study.

## Discussion

Rheumatoid arthritis is an inflammatory autoimmune disease causing progressive articular destruction and malformation, damage to knee joints is particularly detrimental to patient mobility and quality of life, posing significant economic burden to patients, family and society [1,7,11]. Immunosuppressant medications including GC, conventional and biologic DMARDs, in monotherapy or co-therapy, are mainstays in RA management by reducing inflammatory pathophysiology and providing patients with greater joint mobility, symptomatic relief, and slowing disease progression [1,7-9,12,13]. However, TKA remains the definitive treatment in end-stage disease with severe malformation. Appropriate and timely surgical intervention can restore joint function [14,15], allow patients to reduce dosage of costly medications [8] and facilitate physical activities [16]. Although GC and DMARD management is routinely used to control chronic RA disease activity, long effects of their use perioperatively presently remains unclear. This study will provide a better understanding of the long-term clinical effects of perioperative anti-rheumatic medication use in TKA surgery, aiming to be a reference for future clinical rheumatology and orthopedic management of RA patients.

Unlike osteoarthritis, inflammatory control and suppression of RA disease activity is critical to TKA perioperative management, allowing patients symptomatic relief from pain and stiffness, avoiding ongoing mobility impairment, and facilitating postoperative rehabilitation [7,12,17,18]. HSS knee score, VAS pain and ROM were used as metrics to evaluate joint function and patient satisfaction with surgery. Our study showed that perioperative treatment with DMARDs and GC co-therapy resulted in significant long-term improvements

in all of these measures compared to patients managed with only DMARDs. Long-term ROM was additionally also significantly better in co-therapy patients than patients not given anti-rheumatics. This agrees with previous literature describing greater patient satisfaction and better prognosis post TKA in patients treated with GC and DMARD co-therapy [13,19]. Furthermore, GC is reported to provide analgesic effects and improve joint function, supporting why we found greater postoperative ROM in the co-therapy group compared to DMARD alone or no medication regimen [1,9,13,19]. Interestingly, no significant difference in HSS score, VAS pain or ROM was observed between patients given DMARD alone and the no medication control group. One possible explanation for this is that without rapid onset of GC analgesic effects, pain from other joints damaged by systemic RA may interfere with assessment of knee joints after TKA surgery which can decrease patient satisfaction with surgery [20, 21]. Moreover it should be noted that co-therapy patient ROM was statistically similar to the no drug control when measured shortly after surgery prior to patient discharge, but then significantly surpassed both DMARD and control groups by the long-term follow up. This might suggest a gradual improvement in joint mobility following TKA related to long-term steroid use. Overall, this study supports the use of perioperative DMARD and GC co-therapy to improve knee function, patient satisfaction, and decrease pain.

TKA is amongst the most common reasons for allogenic blood transfusion [22]. Avoidance of blood transfusion is ideal to avoid complications including hemolytic reaction, coagulopathy, and allergic reaction. Our study analysis did not indicate any increase in need for blood transfusion related to perioperative DMARD with GC use. Furthermore, anti-rheumatic medication use did not affect hemolytic markers such as WBC, and although DMARD patients had lower postoperative HGB than control, there were no significant differences between these groups when assessing net HGB change post-surgery. There was also one case of allergic shock related to blood transfusion observed in the control group, but it is difficult to draw conclusions from an isolated case and it was not statistically significant. In all, this study suggests no hematologic risk related to perioperative immunosuppressant use in RA patient TKA.

DVT is another complication frequently associated with TKA, however not all clots require intervention with some resolving spontaneously. This study reported no cases of DVT in the GC and DMARD co-therapy group, while one case was reported in the control and four in the DMARD therapy group. This means the co-therapy group actually had the lowest incidence of postoperative DVT, suggesting no increase in DVT risk associated with co-therapy use, which agrees with previous literature [23].

Although our study shows GC and DMARDs to improve joint function, mobility and patient satisfaction with limited complications, conventional practice often suggests discontinuation of immunosuppressants perioperatively for fear of infection, which RA patients are at particular risk for [4]. Prosthetic joint infection (PJI) occurs in about 0.5-2% of TKAs and is a disastrous surgical complication that compromises stability of prosthesis resulting in periprosthetic joint failure [7,24,25]. Literature meta-analysis describes increased risk for PJI up to three years postoperatively in patients using continuous GC therapy [24]. There is also correlation between intra-articular injection of GC and PJI after knee arthroplasty [26]. However, in this case like many, it's the dose that makes the poison and 2017 guidelines from the American College of Rheumatology directly balance fear infection against risk for inflammatory flare [7]. As perioperative inflammatory damage itself can potentially cause periarticular bone degradation and implant loosening [2,27,28]. Studies have also suggested that a standard dose of GC perioperatively can help with inflammation without drastically increasing infectious risk during the surgical period [29]. Only one case of PJI requiring surgical revision at three years following TKA was reported in our entire study, and although it occurred in the GC and DMARD co-therapy group, it is very difficult to draw any definitive conclusions based on this isolated incident. Especially since pharmacotherapy did not appear to affect perioperative hemolytic measures of inflammation and disease activity including WBC, HGB, CRP, and RF in our study.

Limitations are inevitable in all studies including this one. First, the study cohort was relatively small, as all patient profiles were acquired from the database of a single medical center. Although we were able to draw confident conclusion from our study and patients were selected over an 11-year period covering the breadth of conventional RA presentations, a larger population might have provided greater statistical power and

may have allowed for more thorough analytical analysis of surgical complications. Second, many different types of conventional and biologic DMARDs were analyzed combinedly which potentially may mask specific medication affects. However, more detailed categorizing and analysis of patient drug regimens would have required a much larger study population and combined analysis of DMARDs allow our study results to better reflect and apply to a heterogeneous general RA population. Finally, our long-term analysis period with an average 11.4-year follow-up period inevitably contributed to cohort attrition due to death or an inability or refusal to follow-up, which further limited our study size and required that we obtain medical information from close relatives which is rarely as accurate as patient self-reported history.

In conclusion, this study suggests that perioperative co-pharmacotherapy with GC and conventional or biologic DMARDs can result in improved long-term TKA clinical outcomes and patient satisfaction measured through HSS knee score, joint ROM, and VAS pain when compared to management with DMARDs alone or no anti-rheumatic drug treatment, without significant increase of the surgical related complications. Further investigation is warranted with a larger cohort size to better understand more specific medication affects.

**Disclosure**

The authors declare no competing financial interest about the work.

**Acknowledgement**

This research work received grants and was financially supported by the National Nature Science Foundation in China (No.81871740)

**Author contributions**

YR and QY performed research, collected, analyzed and interpreted data and drafted and wrote the manuscript; JL, JJ and WQ performed the surgery and supervised data collection and critically reviewed the paper; BF and TL revised the manuscript; XW and BF designed research, supervised data collection.

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Table 1 Patient demographics

| | Group A | Group B | Group C | P value |
|---|---|---|---|---|
| Number of patients (n) | 20 | 15 | 21 | / |
| Number of knees (n) | 30 | 26 | 35 | / |
| Number of operated knees (unilateral/bilateral) (n) | 11/9 | 4/11 | 6/15 | |
| Age (years) | 53.91±11.02 | 53.51±11.11 | 48.21±11.94 | 0.88 |
| BMI ($kg/m^2$) | 23.42±2.86 | 22.52±3.84 | 22.12±4.24 | 0.40 |
| SEX(female/male)(n) | 14/6 | 13/2 | 18/3 | 0.35 |
| general anesthesia/non general anesthesia(n) | 12/8 | 12/3 | 13/8 | 0.31 |
| Duration of medication treatment after surgery(years) | N/A | 8.13±2.42 | 8.33±2.63 | 0.80 |
| Pre-op HSS | 43.61±16.32 | 42.02±14.32 | 42.01±17.73 | 0.91 |
| Pre-op ROM (°) | 78.51±34.79 | 78.73±30.82 | 89.81±28.22 | 0.25 |
| Pre-op Pain | 4.81±3.61 | 4.03±2.82 | 4.02±3.46 | 0.56 |
| Pre-op Function | 18.28±7.11 | 18.85±7.79 | 18.00±9.09 | 0.92 |
| Pre-op VAS | 6.00±2.03 | 6.65±1.35 | 6.49±1.91 | 0.38 |
| Pre-op WBC ($*10^9/L$) | 6.75±1.81 | 7±1.92 | 7.05±2.58 | 0.88 |
| Pre-op HGB (g/L) | 119.12±17.09 | 111.21±14.22 | 116.22±18.21 | 0.34 |
| Pre-op CRP (mg/L) | 11.08±14.86 | 29.59±43.42 | 21.17±28.11 | 0.15 |
| Pre-op ESR (mm/h) | 39.43±32.87 | 59.53±28.21 | 43.81±30.00 | 0.04 + |
| Pre-op RF (U/ml) | 75.15±87.71 | 113.74±108.68 | 69.37±78.17 | 0.28 |

n, case number; TKA, total knee arthroplasty; BMI, body mass index; Pre-op, preoperative; HSS, Hospital for Special Surgery score; ROM, range of motion; VAS, visual analog scale; WBC, white blood cell; HGB, hemoglobin; CRP, C-reaction protein; ESR, erythrocyte sedimentation rate; RF, rheumatoid factor; N/A, not applicable.

+ ESR in group B is significantly higher than group A (P= 0.03) and group C (P= 0.02).

Table 2 Perioperative medications in Group B and C

| | No. of cases | median dosage | median treatment duration |
|---|---|---|---|
| Group B | | | |

| | No. of cases | median dosage | median treatment duration |
|---|---|---|---|
| LEF | 5 | 15mg daily | 8 years |
| MTX | 9 | 12.5mg weekly | 10 years |
| TGP | 1 | 1200mg daily | 0.5 years |
| TG | 7 | 40mg daily | 14 years |
| SASP | 1 | 2000mg daily | 5 years |
| ETN | 2 | 25mg biweekly | 0.5 years |
| Group C | | | |
| DMARDs | | | |
| IGU | 2 | 50mg daily | 1 years |
| MTX | 18 | 12.5mg weekly | 12 years |
| PA | 1 | 1000mg daily | 6 years |
| TG | 13 | 60mg daily | 8 years |
| SASP | 1 | 2000mg daily | 4 years |
| ETN | 3 | 25mg biweekly | 0.5 years |
| GC | | | |
| PRDL | 4 | 7.5mg daily | 11.5 years |
| PRED | 16 | 10mg daily | 12 years |
| MPS | 1 | 8mg bi-daily | 21 years |

LEF, leflunomide; MTX, methotrexate; TGP, total glucosides of paeony; TG, tripterysium glycosides; SASP, salicylazosulfapyridine; ETN, eternacept; IGU, iguratimod; PA, penicillamine; PRDL, prednisolone; PRED, prednisone; MPS, methylprednisolone; DMARD, disease-modifying anti-rheumatic drug; GC, glucocorticoid

Table 3 Postoperative clinical outcomes and clinical outcomes at the latest follow-up

| | Group A | Group B | Group C | P | A vs B | A vs C | B vs C |
|---|---|---|---|---|---|---|---|
| drainage (ml) | 530.01±279.12 | 559.08±361.83 | 566.94±399.92 | 0.93 | 0.99 | 0.99 | 0.99 |
| blood transfusion(ml) | 368.97±313.79 | 507.69±340.50 | 550.00±364.50 | 0.10 | 0.41 | 0.11 | 0.99 |
| Post-op WBC (*$10^9$/L) | 10.63±3.72 | 11.87±3.81 | 11.91±32 | 0.34 | 0.68 | 0.60 | 0.99 |
| Post-op HGB (g/L) | 107.41±14.12 | 96.29±13.12 | 98.72±13.32 | 0.03 | 0.04* | 0.10 | 0.99 |
| HGB drop (g/L) | 17.83±14.51 | 14.91±11.16 | 24.39±18.23 | 0.13 | 0.99 | 0.44 | 0.17 |
| T pod 1 () | 37.94±0.39 | 37.82±0.64 | 37.59±0.72 | 0.20 | 0.99 | 0.23 | 0.99 |
| T pod 3 () | 37.52±0.29 | 37.21±0.63 | 37.09±0.51 | 0.03 | 0.48 | 0.02** | 0.85 |
| Post-op ROM before discharge(°) | 100.00±18.71 | 107.50±14.84 | 110.42±13.17 | 0.03 | 0.26 | 0.09 | 0.99 |
| ROM at follow-up(°) | 112.57±29.21 | 112.51±18.32 | 132.15±14.73 | 0.001 | 1.00 | 0.001** | 0.002*** |
| HSS at follow-up | 78.96±10.61 | 76.50±9.31 | 84.04±8.22 | 0.008 | 0.95 | 0.13 | 0.01*** |
| Post-op Pain | 25.73±3.71 | 24.63±4.71 | 26.69±3.22 | 0.11 | 0.90 | 0.92 | 0.12 |
| Post-op Function | 14.52±5.12 | 13.23±4.23 | 16.17±4.82 | 0.07 | 0.96 | 0.60 | 0.07 |
| VAS at follow-up | 0.97±0.89 | 1.73±1.51 | 1.12±1.19 | 0.003 | 0.22 | 0.99 | 0.04*** |

* Difference between Group A and B is significant.

** Difference between Group A and C is significant.

*** Difference between Group B and C is significant.

Post-op, postoperative; HSS, Hospital for Special Surgery; ROM, range of motion; VAS, visual analog scale; WBC, white blood cell; HGB, hemoglobin; T pod 1/T pod 3, temperature in postoperative day 1 and 3

Table 4 Complications during follow-up

| | Group A | Group B | Group C | P | A vs B | A vs C | B vs C |
|---|---|---|---|---|---|---|---|
| Deep venous thrombosis (cases) | 1 | 4 | 0 | 0.03 | 0.14 | 1.00 | 0.03 |
| Number of other short-term complications§ | 4+ | 0 | 4 ++ | 0.15 | / | / | / |
| Systematic | 2 | 0 | 3 | 0.36 | / | / | / |
| Wound | 1 | 0 | 0 | 0.99 | / | / | / |
| Surgical | 1 | 0 | 1 | 0.99 | / | / | / |
| Long-term | 0 | 0 | 1 | 0.63 | | | |

+ included: allergic shock after blood transfusion; hemarthrosis; subcutaneous adiponecrosis and common peroneal nerve compression; sciatic nerve injury

++ included: urinary infection; herpes zoster; compromised sensory function of planta pedis and plantar flexion ability of the first toe; thrombocytopenia

§ Short-term complications are defined as those no more than 3 months after surgery.