TOTAL DİZ PROTEZİ SONRASI İLK 90 GÜN PLANSIZ YENİDEN BAŞVURUNUN TEMEL RİSK FAKTÖRLERİNİN DEĞERLENDİRİLMESİ

Evaluation of Risk Factors For 90-Day Unplanned Readmissions After Total Knee Arthroplasty

Adem ÇÖBDEN[1], İsmet Yalkın ÇAMURCU[2], Hanifi ÜÇPUNAR[2], Hakan SOFU[2], Hüseyin DEMİREL[1], Utku DEMİR[1], Mehmet KIŞ[1]

[1]Sivas Numune Hospital, Department of Orthopaedics and Traumatology, Sivas

[2]Erzincan University Faculty of Medicine, Department of Orthopaedics and Traumatology, Erzincan, Turkey

Adem ÇÖBDEN, M.D
İsmet Yalkın ÇAMURCU, M.D
Hanifi ÜÇPUNAR, M.D
Hakan SOFU, M.D
Hüseyin DEMİREL, M.D
Utku DEMİR, M.D
Mehmet KIŞ, M.D

İletişim:
Adem ÇÖBDEN, M.D.
Yesilyurt Mah., Sivas Numune Hospital, Department of Orthopaedics and Traumatology, Sivas, Turkey
Tel: +90 506 7641870
e-mail:
dradem33k@gmail.com

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ÖZET

Amaç: Tek taraflı, eş zamanlı bilateral ya da aşamalı bilateral total diz protezi (TDP) uygulanan hastalarda ilk 90 gün plansız başvurunun temel belirleyici faktörlerini saptamaktır.
Yöntemler: 2011-2016 yılları arasında TDP uygulanan hastaların verileri tıbbi kayıtlarımızdan değerlendirildi. Hastalar, tek taraflı, aşamalı bilateral ve eş zamanlı bilateral TDP grupları olarak üç gruba ayrıldı. Yaş, cinsiyet, vücut kitle indeksi (VKİ), sistemik komorbid hastalıklar ve Amerikan Anesteziyoloji Derneği (ASA) skorları, anestezi tekniği, toplam ameliyat süresi, traneksamik asit uygulaması, transfüze edilen toplam kan ünitesi ve hastanede yatış süresi tıbbi kayıtlardan araştırıldı. İlk 90 gün plansız ve planlı başvurusu olan hastaların verileri, t-testi, Pearson Ki-Kare testi ve Fisher's exact test ile karşılaştırıldı. Son olarak, ilk 90 gün plansız başvurunun temel belirleyici faktörlerini belirlemek için çok değişkenli analiz yapıldı.
Bulgular: İlk 90 gün plansız başvurusu olan hastalarda toplam operasyon süresi, transfüze edilen toplam kan ünitesi ve hastanede yatış süresi anlamlı olarak daha yüksekti. İlk 90 gün plansız başvuru oranlarında TDP grupları arasında anlamlı bir fark gözlenmedi. Çok değişkenli lojistik regresyon analizine göre, hastanede kalış süresinin uzaması, 90 günlük plansız başvurunun ana belirleyicisi olarak belirlenmiştir.
Sonuç: Bizim sonuçlarımıza göre, ilk 90 gün plansız başvuruda tek taraflı, eş zamanlı bilateral ve aşamalı bilateral TKA grupları arasında anlamlı bir fark gözlenmedi. Artmış hastanede yatış süresi, 90 günlük plansız başvurunun ana belirleyicisi olarak bulunmuştur.

Anahtar Sözcükler: *Total diz artroplastisi; Tekrar başvuru; Yatış; Kan transfüzyonu; Postoperatif komplikasyon*

ABSTRACT

Purpose: To determine the major predictive factors for 90-day unplanned readmission (UR) in patients who underwent unilateral, simultaneous bilateral or staged bilateral total knee arthroplasty (TKA).
Methods: The data of patients who underwent elective TKA between 2011 and 2016 were evaluated from our medical records. Patients were divided into three groups according to the type of TKA procedure as unilateral, staged bilateral and simultaneous bilateral TKA groups. Age, gender, body mass index (BMI), systemic comorbid diseases, and American Society of Anesthesiologists (ASA) scores, anesthesia technique, total operation time, presence of tranexamic acid administration, total number of blood unit transfused ,and total length of hospital stay were investigated through medical records. The data of patients with 90-day UR and no 90-day UR were compared by student t-test, Pearson Chi-Square test, and Fisher's exact test. Finally, multivariate analysis was performed to determine the major predictive factors of 90-day UR.
Results: Total operative time, total amount of blood unit transfused, and total length of hospital stay were significantly higher in patients who had 90-day UR. No significant difference was observed among TKA groups in 90-day UR rates. According to multivariate logistic regression analysis, increased total length of hospital stay was determined as the only major predictor of 90-day UR.
Conclusion: According to our results, no significant difference was observed among unilateral, simultaneous bilateral and staged bilateral TKA groups in 90-day UR. The increased length of hospital stay was found as the major predictor of 90-day UR.

Keywords: *Total knee arthroplasty; Hospital readmission; Hospital stay; Blood transfusion; Postoperative complication*

INTRODUCTION

Total knee arthroplasty (TKA) is the main stay of treatment to relieve pain and restore function in patients with end-stage osteoarthritis of the knee joint. Patients who have bilateral knee osteoarthritis are potential candidates for bilateral simultaneous or staged TKA procedure, which have high patient satisfaction rates (1). Both patient and surgeon must decide whether to treat bilateral knee osteoarthritis with simultaneous bilateral or staged bilateral TKA with a certain time interval between the two procedures. However, the decision for choosing the appropriate TKA procedure is still controversial with different complication rates reported in the literature (2-5). In the other hand, the most painful knee is usually operated on first in staged bilateral TKA and a considerable proportion of patients do not undergo the second TKA in the contralateral knee (6).

Unplanned readmissions (URs) due to either orthopedic or medical complications during early postoperative period may lead to additional burden on healthcare providers, which were widely investigated in the literature (7-10). In most studies investigating readmission rates after TKA, bilateral simultaneous TKA was compared to staged procedure, or the term unilateral TKA denoted staged bilateral TKA. It may be difficult to compare bilateral simultaneous and staged TKA due to various intervals varies days to year, which was reported in the literature. Therefore, various results may be obtained as predictors of readmissions when comparing staged and bilateral TKA procedures. In addition to that, healthcare registry studies with large populations have already reported the determinants of URs and major complications. However, an institutional analysis is more valuable to interpret the data more accurately and guide orthopedic surgeons to predict the factors related to unplanned readmissions by comparing both three TKA procedures. Therefore, the main purpose of this single center study was to determine the major factors of 90-day UR in patients who underwent unilateral, simultaneous bilateral or staged bilateral TKA.

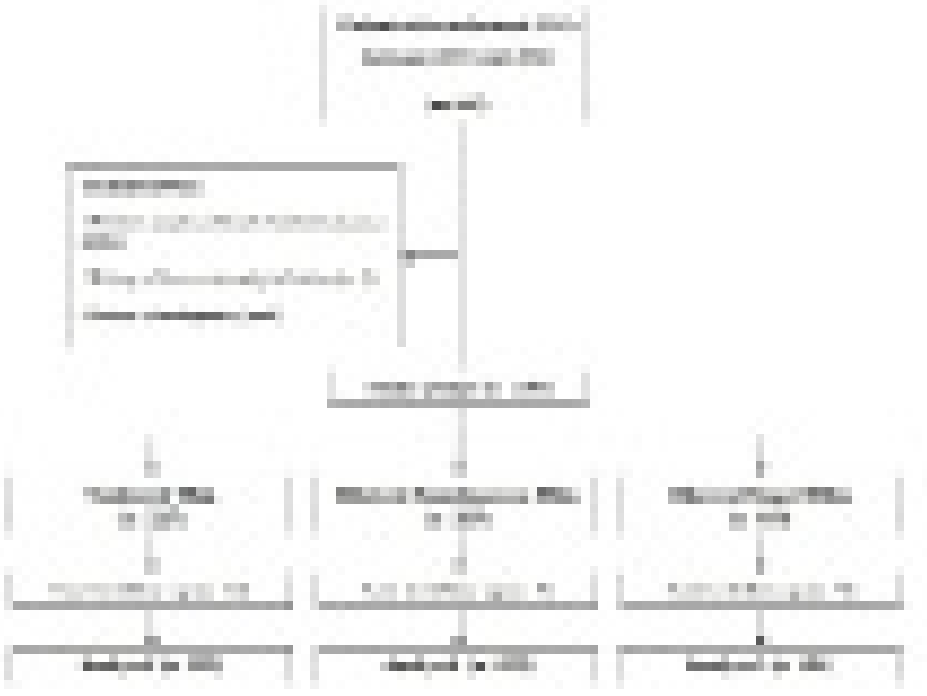

Figure 1. Flowchart diagram of the study. n: number of patients, TKA: total knee arthroplasty.

MATERIALS AND METHODS

This retrospective study was performed after the approval of our institution's ethical review board. The data of 559 patients who underwent elective TKA between 2011 and 2016 were evaluated from our medical records. Patients with the history of infection, trauma, or malignancy from the indexed knee (which may affect readmission), and who were lost to follow-up and were excluded. Patients were divided into three groups according to the type of TKA procedure as unilateral, staged bilateral and simultaneous bilateral TKA groups (Figure 1).

Table 1. Comparison of demographics, preoperative health status, operative data and postoperative data of three TKA groups.

	Unilateral TKA (n=209)	**Simultaneous Bilateral TKA (n=198)**	**Staged Bilateral TKA (n=101)**	**P value**
Demographics				
Gender (female / male)				0.017*
Female	173 (83%)	180 (91%)	81 (80%)	
Male	36 (17%)	18 (9%)	20 (20%)	
Age (years)	69.7 ± 7.8 (50-89)	68.8 ± 7.3 (51-89)	69.8 ± 7.5 (49-85)	n.s.*
BMI (kg/m2)	28.9 ± 4.1 (22-35)	27.5 ± 4 (22-35)	27.9 ± 4.4 (22-34)	n.s.**
Preoperative Health Status				
Comorbid systemic disease				
Hypertension	89 (43%)	101 (51%)	47 (47%)	n.s.*
Diabetes Mellitus	48 (23%)	40 (20%)	17 (17%)	n.s.*
Chronic Obstructive Pulmonary Disease	18 (9%)	17 (9%)	10 (10%)	n.s.*
Coronary Artery Disease	25 (12%)	25 (13%)	5 (5%)	n.s.*
Cerebrovascular Disease	5 (2%)	1 (1%)	5 (5%)	0.042*
ASA score (%)				n.s.*
ASA I	9 (9%)	14 (7%)	11 (11%)	
ASA II	138 (66%)	123 (62%)	67 (66%)	
ASA III	41 (20%)	50 (25%)	21 (20%)	
ASA IV	11 (5%)	11 (6%)	2 (2%)	
Operative Data				
Anesthesia Technique (general / regional)	3 / 206	11 / 187	8 / 93	n.s.*
Total Operation Time (minutes)	74.9 ± 26.4 (25-315)	125.3 ± 31.1 (60-300)	158 ± 33.8 (90-250)	<0.001**
IV TXA administration (+ / -)	97 /112	45 / 153	62 / 39	<0.001*
Postoperative Data	1.4 ± 0.8 (0-5)	3.4 ± 1 (0-7)	3.5 ± 1 (0-6)	<0.001**
Number of blood unit transfused (units)	1.4 ± 0.8 (0-5)	3.4 ± 1 (0-7)	3.5 ± 1 (0-6)	<0.001**
Length of Hospital Stay (days)	8 ± 2.4 (4-17)	9.7 ± 3.7 (4-33)	16.3 ± 4.7 (6-35)	<0.001**

* P value according to Pearson Chi-Square test
** P value according to one-way ANOVA test
n.s.: not significant (p<0.05)
TKA: total knee arthroplasty, n: number, BMI: body mass index, ASA: American Society of Anesthesiologists, TXA: tranexamic acid

Simultaneous bilateral TKA denoted bilateral TKAs performed sequentially by one surgeon under a single anesthetic procedure. Staged bilateral TKA denoted two staged TKAs with an interval of 0- 6 months between two stages. The decision for staged or simultaneous TKA procedure was made by the patient and the surgeon after brief information was given by the surgeon. Unilateral TKA group consisted of patients who did not have second stage or choose to undergo single unilateral TKA from the most painful side.

Age, gender, body mass index (BMI), systemic comorbid diseases, and American Society of Anesthesiologists (ASA) scores of the patients were investigated through our medical record database. Anesthesia technique (general or regional), total operation time, and presence of tranexamic acid (TXA) administration were investigated through operation records. Total amount of allogenic blood unit transfused and total length of hospital stay were also noted for each patient.

Staged bilateral TKAs were performed by the same surgeon who performed the index operation with the same anesthesia technique, in the same manner of TXA administration. The measurement of total operative time, total blood unit transfusion, and total length of hospital stay in the staged bilateral TKA group was performed by summing the values of two intermittent stages. Postoperative treatment protocol was same for all patients. All patients received prophylactic first generation cephalosporin 30 minutes prior to the procedure. Postoperative intravenous antibiotics were continued for 72 hours. All patients received low-molecular-weight heparin for thromboembolic prophylaxis until the end of postoperative 4th week.
Postoperative 90-day URs was defined as patients' URs related to orthopedic or medical complications. Pain, stiffness, swelling, hematoma, superficial wound infection, deep wound infection, deep venous thrombosis, periprosthetic fracture, and re-operation were defined as orthopaedic complications. Pulmonary embolus, cerebrovascular accident, myocardial infarction, and other pathologies were defined as medical complications.

Statistical analysis

Statistical analysis was performed by using SPSS 20.0 (SPSS Inc., IBM, NY, USA). Numeric variables were given as means and standard deviations, categorical variables were given as frequencies and percent. The comparison of three TKA groups was performed by one-way ANOVA test and Pearson Chi-Square test. Factors related to 90-day UR were compared by student t-test and Fisher exact test or Pearson Chi-Square test. Then, multivariate logistic regression analysis was performed to determine the major predictive factors for 90-day UR.

RESULTS

Five hundred and eight patients with the mean age of 69.4 years were included in the current study. The comparison of demographics and clinical characteristics of three TKA groups were demonstrated in Table 1. The percent of male patient was significantly higher in staged bilateral TKA group (p=0.017). Preoperatively, presence of cerebrovascular disease was also significantly higher in the staged bilateral TKA group (p=0.042). Total operation time, presence of IV TXA administration, number of blood units transfused, and length of hospital stay were also higher in staged bilateral TKA group (Table 1).

The main reasons for 90-day unplanned readmissions were demonstrated in Table 2. Total operative time, total amount of blood unit transfused, and total length of hospital stay were significantly higher in patients who had 90-day UR (Table 3). No significant difference was observed among three TKA groups in 90-day UR rates. According to multivariate logistic regression analysis, increased total length of hospital stay was determined as the major predictor of 90-day UR (Table 4).

Table 2. The main reasons for 90-day unplanned readmissions.

	Unilateral TKA (n=209)	Simultaneous Bilateral TKA (n=198)	Staged Bilateral TKA (n=101)
Orthopedic Problems			
Pain	3	5	2
Stiffness	1	2	0
Swelling	0	2	1
Hematoma	2	2	2
Superficial wound infection	2	2	3
Deep wound infection	0	1	1
Deep venous thrombosis	0	0	0
Periprosthetic fracture	0	0	1
Re-operation	1	1	1
Medical Problems			
Pulmonary embolus	0	2	0
Cerebrovascular accident	2	1	0
Myocardial infarction	0	1	0
Other	1	2	0
Total			

n: number, TKA: total knee arthroplasty

DISCUSSION

Understanding the major predictive factors related to unplanned readmission is important for orthopedic surgeons to decrease additional burden and costs as well as to increase the quality of treatment. The aim of our single-center study was to determine the major predictive factors related to 90-day UR by performing an institutional analysis. The most important finding of our study was increased length of hospital stay was the main predictive factor for 90-day UR. In the literature, results of the clinical studies that reported the safety and cost-effectiveness of TKA by comparing simultaneous and staged bilateral TKA are still controversial (11, 12). In the other hand, most studies were designed to compare bilateral TKA and staged bilateral TKA. Therefore, limited studies exist in the literature which compare both unilateral, simultaneous bilateral, and staged bilateral TKAs. In their study, which compared three TKA procedures, Stefansdottir et al reported higher 30-day mortality rates after simultaneous bilateral TKAs (3). As a result, authors mentioned that it is safer to operate one knee at a time (3). Memtsouidis et al compared unilateral, simultaneous bilateral and staged bilateral TKAs and reported increased perioperative and in-hospital mortality after bilateral simultaneous TKA (13). However, Bini and Seol et al found no significant difference in major postoperative complications between simultaneous bilateral and staged bilateral TKA groups (9, 14). According to our results, we observed no significant differences among groups in UR rates. However, major medical problems such as myocardial infarction and pulmonary embolus were more common in patients who underwent bilateral simultaneous TKA, although no significant difference was observed in systemic comorbid diseases and ASA scores. In our study, 2 patient had pulmonary embolus in bilateral simultaneous TKA group where as none was observed in staged bilateral and unilateral TKA groups. In their systematic review, Fu et al also reported higher 30-day mortality rates and pulmonary embolism after simultaneous bilateral TKAs when compared to staged bilateral TKAs (15).

Table 3. Evaluation of factors related to 90-day unplanned readmissions (UR).

	UR group (n=44)	**No UR group (n=464)**	**P values***
TKA procedure			n.s.*
Unilateral TKA	12 (5.7%)	197 (94.3%)	
Simutaltaneous bilateral TKA	21 (10.6%)	177 (89.4%)	
Staged bilateral TKA	11 (10.9%)	90 (89.1%)	
Demographics			
Gender (female / male)	40 / 4	394 / 40	n.s.*
Age (years)	68.7 ± 7.8	69.4 ± 7.5	n.s.**
BMI (kg/m2)	27.5 ± 4.0	27.5 ± 4.2	n.s.**
Preoperative Health Status			
Comorbid systemic disease			
Hypertension	23 (52%)	214 (46%)	n.s.*
Diabetes Mellitus	8 (18%)	97 (21%)	n.s.*
Chronic Obstructive Pulmonary Disease	5 (11%)	40 (9%)	n.s.*
Coronary Artery Disease	4 (9%)	51 (9%)	n.s.*
Cerebrovascular Disease	2 (5%)	9 (2%)	n.s.*
ASA score (%)			n.s.*
ASA I	2 (5%)	42 (9%)	
ASA II	28 (63%)	300 (65%)	
ASA III	12 (27%)	100 (22%)	
ASA IV	2 (5%)	22 (4%)	
Operative Data			
Anesthesia Technique (general / regional)	2 / 42	20 / 444	n.s.*
Total Operation Time (minutes)	128.5 ± 53.2	109.4 ± 42.8	0.006**
IV TXA administration (+ / -)	21 / 23	183 / 281	n.s.*
Postoperative Data			
Number of blood unit transfused (units)	3.2 ± 1.3	2.5 ± 1.3	0.002**
Length of Hospital Stay (days)	12.5 ± 5.7	10.1 ± 4.5	0.001**

* P value according to Pearson Chi Square test or Fisher's exact test
** P value according to student t-test
n.s.: not significant (p<0.05)
TKA: total knee arthroplasty, n: number, BMI: body mass index, ASA: American Society of Anesthesiologists, TXA: tranexamic acid

Table 4. Major predictors of unplanned readmissions after TKA.

	Multivariate analysis (logistic regression)	
Variable	Odds Ratio (95% Confidence Interval)	P
Total Operation Time (minutes)	1.00 (0.99 - 1.01)	0.699
Number of blood unit transfused (units)	1.28 (0.97 - 1.68)	0.074
Length of hospital stay (days)	1.06 (1.00 - 1.13)	0.039
TKA: total knee arthroplasty		

The rates and risk factors of URs after TKA were widely investigated in the literature. Hart el al compared simultaneous bilateral TKA with unilateral TKA, and found no significant difference in 30-day readmission rate between the groups (16). Authors reported that male gender, presence of chronic obstructive pulmonary disease, and chronic steroid use were the major predictors of 30-day readmission (16). Ricciardi et al reported that increased tourniquet time, length of hospital stay <3 days, and preoperative depression were associated with increased 30-day readmission rate after TKA (8). Kurtz et al analyzed the factors associated with 30-day and 90-day readmission after TKA, they reported a 9.6 % 90-day readmission rate and found that use of transfusion and >5 day length of hospital stay were more associated with increased readmissions (10). Williams et al found 6.1% 90-day readmission rate and mentioned that total length of hospital stay more than four days was a significant risk factor for increased UR within 90 days after total joint arthroplasty (17). Otero et al reported increased complication and readmission rates in patients with increased length of stay after total joint arthroplasty (18). Duchman et al mentioned that increased operation time over 120 minutes was associated with increased mortality and morbidity (19). In our study, we also found significant association of increased operative time, transfusion, and length of hospital stay with 90-day UR. Due to social factors affected by the region of our hospital, the length of hospital stay was longer compared to literature with a mean of ten days. However, we determined the increased length of hospital stay as the major predictive of 90-day UR. Overall rate of 90-day readmission was 8.6% in our study, which was lowest in unilateral TKA with 5.6%. In their review Ramkumar et al reported that the overall rate of 90-day readmission was 9.7% after TKA (20). In their nationwide study, Kurtz et al reported that 90-day readmission varies from 0% to 32% with a median of 8.6% (10). Kurtz et al also emphasized the effect of geographic region and hospital location as a factor affecting UR after TKA (10).

Rapid discharge of the patient after total joint arthroplasty has become popular in recent years. Increased length of hospital stay and UR may lead to additional burden on healthcare providers and increase costs. In the other hand, longer length of hospital stay may indicate a medical problem. However, the systemic comorbidities and ASA scores of the patients did not differ between UR group and no UR group. In addition to that, we have already had a longer length of hospital stay apart from literature. According to the results acquired from our study; if we could control factors which are connected to each other such as operative time, blood transfusion, and length of hospital stay, we will achieve less unplanned readmissions and postoperative complications. Dwyer et al and Pennington et al also emphasized increased length of hospital stay and readmission after developmental practice in perioperative care (21,22).

We note two limitations of the current study. Firstly, it was a retrospective evaluation of prospectively followed patient group. Secondly, our study population was smaller when compared to large population-based health registry studies. However, we evaluated a detailed data of a single instution in which the same treatment protocol was performed for each patient. Besides, the statistical power of our study in the aspect of determining the major predictive factors was 0.99 with an alpha value of 0.05. The main strength of this study was being the first study comparing three TKA procedures from an institutional point of view in order to determine the factors related to 90-day UR. The reason for choosing 90-day for evaluating readmission was to better understanding of postoperative orthopedic complications rather than 30-day. Chen et al also reported that postoperative 90-day time frame was superior to 30-day in capturing surgery related readmissions after total joint arthroplasty (23).

CONCLUSION

According to our results, no significant difference was observed among unilateral, simultaneous bilateral and staged bilateral TKA groups in 90-day UR. The increased length of hospital stay was found as the major predictor of 90-day UR.

REFERENCES

1. Tamaki T, Oinuma K, Miura Y, Higashi H, Kaneyama R, Shiratsu-chi H. Perioperative complication rate of one-stage bilateral total

hip arthroplasty using the direct anterior approach. J Orthop Sci 2016;21(5):658-61.
2. Bohm ER, Molodianovitsh K, Dragan A, et al. Outcomes of unilateral and bilateral total knee arthroplasty in 238,373 patients. Acta Orthop 2016;87 Suppl 1:24-30.
3. Stefánsdóttir A, Lidgren L, Robertsson O. Higher early mortality with simultaneous rather than staged bilateral TKAs: results from the Swedish Knee Arthroplasty Register. Clin Orthop Relat Res 2008;466(12):3066-70.
4. Jain S, Wasnik S, Mittal A, Sohoni S, Kasture S. Simultaneous bilateral total knee replacement: a prospective study of 150 patients. J Orthop Surg (Hong Kong) 2013;21(1):19-22.
5. Hu J, Liu Y, Lv Z, et al. Mortality and morbidity associated with simultaneous bilateral or staged bilateral total knee arthroplasty: a meta-analysis. Arch Orthop Trauma Surg 2011;131(9):1291-8.
6. Thiam D, Teh DJ, Bin Abd Razak HR, Tan AH. Improvement in health-related quality of life after unilateral total knee arthroplasty in patients with bilateral knee osteoarthritis. J Orthop Surg (Hong Kong) 2016;24(3):294-297.
7. Cherian JJ, Issa K, Robinson K, et al. Differences in readmission rates for two total knee arthroplasty prostheses. J Knee Surg 2015;28(3):201-6.
8. Ricciardi BF, Oi KK, Daines SB, et al. Patient and Perioperative Variables Affecting 30-Day Readmission for Surgical Complications After Hip and Knee Arthroplasties: A Matched Cohort Study. J Arthroplasty 2017;32(4):1074-1079.
9. Bini SA, Khatod M, Inacio MC, Paxton EW. Same-day versus staged bilateral total knee arthroplasty poses no increase in complications in 6672 primary procedures. J Arthroplasty 2014;29(4):694-7.
10. Kurtz SM, Lau EC, Ong KL, et al. Which Hospital and Clinical Factors Drive 30- and 90-Day Readmission After TKA? J Arthroplasty 2016;31(10):2099-107.
11. Odum SM, Troyer JL, Kelly MP, et al. A cost-utility analysis comparing the cost-effectiveness of simultaneous and staged bilateral total knee arthroplasty. J Bone Joint Surg Am 2013;95(16):1441-9.
12. Vulcano E, Memtsoudis S, Della Valle AG. Bilateral total knee arthroplasty guidelines: are we there yet? J Knee Surg 2013;26(4):273-9.
13. Memtsoudis SG, Ma Y, González Della Valle A, Mazumdar M, Gaber-Baylis LK, MacKenzie CR, Sculco TP. Perioperative outcomes after unilateral and bilateral total knee arthroplasty. Anesthesiology 2009;111(6):1206-16.
14. Seol JH, Seon JK, Song EK. Comparison of postoperative complications and clinical outcomes between simultaneous and staged bilateral total knee arthroplasty. J Orthop Sci 2016;21(6):766-769.
15. Fu D, Li G, Chen K, Zeng H, Zhang X, Cai Z. Comparison of clinical outcome between simultaneous-bilateral and staged-bilateral total knee arthroplasty: a systematic review of retrospective studies. J Arthroplasty 2013; 28(7):1141-7.Review.
16. Hart A, Antoniou J, Brin YS, et al. Simultaneous Bilateral Versus Unilateral Total Knee Arthroplasty: A Comparison of 30-Day Readmission Rates and Major Complications. J Arthroplasty 2016;31(1):31-5.
17. Williams J, Kester BS, Bosco JA, et al. The Association Between Hospital Length of Stay and 90-Day Readmission Risk Within a Total Joint Arthroplasty Bundled Payment Initiative. J Arthroplasty 2017;32(3):714-718.
18. Otero JE, Gholson JJ, Pugely AJ, et al. Length of Hospitalization After Joint Arthroplasty: Does Early Discharge Affect Complications and Readmission Rates? J Arthroplasty 2016;31(12):2714-2725.
19. Duchman KR, Pugely AJ, Martin CT, et al. Operative Time Affects Short-Term Complications in Total Joint Arthroplasty. J Arthroplasty 2017;32(4):1285-1291.
20. Ramkumar PN, Chu CT, Harris JD, Athiviraham A, Harrington MA, White DL, Berger DH, Naik AD, Li LT. Causes and Rates of Unplanned Readmissions After Elective Primary Total Joint Arthroplasty: A Systematic Review and Meta-Analysis. Am J Orthop (Belle Mead NJ) 2015;44(9):397-405. Review.
21. Dwyer AJ, Thomas W, Humphry S, Porter P. Enhanced recovery programme for total knee replacement to reduce the length of hospital stay. J Orthop Surg (Hong Kong) 2014;22(2):150-4.
22. Pennington JM, Jones DP, McIntyre S. Clinical pathways in total knee arthroplasty: a New Zealand experience. J Orthop Surg (Hong Kong) 2003;11(2):166-73.
23. Chen BP, Dobransky J, Poitras S, Forster A, Beaulé PE. Impact of Definition and Timeframe on Capturing Surgery-Related Readmissions After Primary Joint Arthroplasty. J Arthroplasty 2017;32(12):3563-3567.