

Outcomes and motives for not proceeding with the second stage bilateral knee replacement: a comparison of cancelled and completed bilateral total knee arthroplasty

Robert Longstaffe, MD
Kamran Shahid, MD
Angela Verrelli, MD
Lynda Loucks, BMR, PT, MSc
Eric Bohm, MSc, MD

Accepted Jan. 22, 2022

Correspondence to:

Robert Longstaffe
Pan Am Clinic
75 Poseidon Bay
Winnipeg MB R2M 3E4
rlongstaffe@panamclinic.com

Cite as: *Can J Surg* 2023 February 22; 65(X). doi: 10.1503/cjs.008621

Background: Staged bilateral total knee arthroplasty (TKA) is a common treatment option for patients with bilateral symptomatic knee osteoarthritis, yet some patients do not proceed with their second procedure. Our study aimed to identify the rate and reasons why patients did not proceed with their second procedure and compare their functional outcomes, satisfaction and complication rates with those of patients who had completed a staged bilateral TKA.

Methods: We determined the proportion of patients who underwent TKA but did not proceed with planned surgery for the second knee within 2 years, and compared their satisfaction with surgery, improvement in the Oxford Knee Score (OKS) and complications between groups.

Results: Our study included 268 patients: 220 patients who underwent staged bilateral TKA and 48 patients who cancelled their second procedure. The most common reason for not proceeding with the second procedure was a slow recovery after the first TKA (43.2%), followed by functional improvement in symptoms in the unoperated knee negating the need for surgery (27.3%), poor experience with the first surgery (22.7%), treatment of other comorbidities necessitating cancellation of their second procedure (4.6%) and employment reasons (2.3%). Patients who cancelled their second procedure were noted to have a worse postoperative OKS improvement ($p < 0.001$) and lower satisfaction rate ($p < 0.001$), than patients who underwent staged bilateral TKA.

Conclusion: About one-fifth of patients scheduled for staged bilateral TKA declined to proceed with the second knee surgery within 2 years showing a substantially decreased functional outcome and satisfaction rate. However, more than one-quarter (27.3%) of patients noted improvements in their contralateral (unoperated) knee, such that a second surgery was no longer felt to be necessary.

Contexte : L'arthroplastie totale du genou (ATG) bilatérale en séquence est une option courante pour l'arthrose du genou bilatérale symptomatique. Or, il arrive que la seconde intervention n'ait pas lieu. Notre étude a permis de déterminer le taux d'abstention de la seconde intervention et les motifs invoqués, et de comparer les résultats en termes de fonctionnement, de satisfaction et de complications selon qu'une seule ou les 2 interventions étaient effectuées.

Méthodes : Nous avons vérifié la proportion de cas où la seconde ATG n'a pas été effectuée dans les 2 ans suivant la première, et nous avons comparé les 2 groupes aux plans du degré de satisfaction vis-à-vis de la chirurgie, de l'amélioration des scores au questionnaire Oxford d'évaluation du genou (ou OKS, pour Oxford Knee Score) et des complications.

Résultats : Notre étude a inclus 268 patients : 220 qui ont subi l'ATG bilatérale en séquence et 48 qui ont décliné leur seconde intervention. Les motifs les plus souvent invoqués pour ne pas subir la seconde intervention étaient la lenteur du rétablissement suite à la première ATG (43,2 %), suivie de l'amélioration fonctionnelle des symptômes du genou non opéré rendant l'intervention superflue (27,3 %), l'expérience désagréable de la première intervention (22,7 %), un traitement pour des comorbidités qui a justifié l'annulation de la seconde intervention (4,6 %) et des raisons professionnelles (2,3 %). Les malades qui ont annulé leur seconde intervention ont eu une amélioration postopératoire moins bonne ($p < 0,001$) et un taux de satisfaction moins élevé ($p < 0,001$), que ceux qui ont subi l'ATG bilatérale en séquence.

Conclusion : Environ le cinquième des cas planifiés d'ATG bilatérale en séquence ont refusé la deuxième intervention dans les 2 années suivant la première, cela s'est accompagné de résultats nettement moins favorables aux plans du fonctionnement et du taux de satisfaction. Toutefois, plus du quart (27,3 %) des cas ont noté des améliorations du genou non opéré, rendant la seconde chirurgie superflue.

Total knee arthroplasty (TKA) is a common and successful treatment for patients with end-stage osteoarthritis.¹ Patients can present with bilateral knee osteoarthritis that requires surgical intervention necessitating discussion between surgeon and patient as to whether to proceed with a simultaneous or staged bilateral TKA.

Advantages of simultaneous bilateral TKA include a single operation, anesthetic, hospital admission and recovery period. Potential benefits include a decreased overall length of hospital admission,^{2,3} lower costs^{4,5} and improved outcomes.⁶⁻⁸ However, several meta-analyses have noted simultaneous bilateral TKA was associated with increased medical complications such as pulmonary embolism,⁹⁻¹¹ cardiac complications,¹⁰ deep vein thrombosis⁹ and even death,⁹⁻¹³ although other reviews have noted no difference in pulmonary or cardiac complications.^{12,13} In addition, decreased infection and revision rates with simultaneous bilateral TKA have been noted in some reviews when compared with staged bilateral TKA.^{2,9,11,14}

A lack of well-designed level I studies adds to the challenges of comparing simultaneous to staged bilateral TKA. Most retrospective studies fail to account for patients who plan to undergo staged bilateral TKA, but decline to proceed with the second procedure; these patients are typically misclassified as having undergone unilateral TKA and excluded from analysis, thus biasing the findings.¹⁵ Deciding against proceeding with the second knee surgery is common, and in 1 study was found to occur in about one-third of patients.¹⁶ Functional recovery after the first surgery along with patient expectations can play a role in the willingness to proceed with the second procedure. The rate and factors that may contribute to cancellation of the second procedure have yet to be fully elucidated.

There is a paucity of literature on the differences in patient-reported outcomes (PROMs) between simultaneous and staged bilateral TKA. As emphasis on PROMs continues to increase within total joint arthroplasty, their use can provide valuable information for assessment and comparison of treatment modalities.^{17,18}

Our study aimed to identify the rate of cancellation and reasons why patients did not proceed with their second staged procedure and to compare their postoperative functional outcomes, satisfaction and complication rates with those of patients who had completed a staged bilateral TKA.

METHODS

We obtained approval from our institutional review board before the start of this study. A retrospective review of a prospectively collected arthroplasty database was performed to identify patients who had

undergone staged bilateral TKA or at least the first TKA of planned staged bilateral TKA. Because the database contained surgical booking information, it allowed for accurate identification of patients who had planned for staged bilateral TKA but declined to proceed with the second knee surgery. All surgeries occurred between Jan. 1, 2008, and Dec. 31, 2012, and were performed by 1 of 4 fellowship-trained arthroplasty surgeons at a single academic centre. Patients eligible for surgery included those with symptomatic bilateral knee osteoarthritis in whom nonoperative management was unsuccessful and were deemed good surgical candidates. Staged bilateral TKA was typically planned with the 2 stages occurring 3–6 months apart. For analysis, patients were stratified into 2 groups: those who underwent bilateral TKA within 2 years (staged group) and those who were scheduled for staged bilateral TKA but did not proceed with the second procedure within 2 years (cancelled group). We chose the time frame of 2 years to ensure an accurate collection of patients who had truly cancelled their second procedure rather than delaying the second procedure past the planned 3- to 6-month interval between procedures owing to slower recovery from their first operation.

Demographic data included age at time of surgery, body mass index (BMI) and sex. The reason(s) for cancellation of the second procedure were collected through chart review. We assessed functional outcome using the Oxford Knee Score (OKS).¹⁹ The OKS is a validated and reproducible 12-item PROM specifically designed to assess function and pain. It is reported on a scale of 12–60, with 12 representing the best possible score and 60 representing the worst possible score. Several reviews have shown OKS to be one of the more common and better performing outcome measures as it relates to lower-extremity joint arthroplasty.^{18,20,21} Patient satisfaction with the result of the knee replacement was assessed using a 5-point Likert scale from very satisfied to very unsatisfied,¹⁷ which was further dichotomized into satisfied (very satisfied or satisfied) and unsatisfied (neutral, unsatisfied or very unsatisfied). Preoperative OKS for each knee were collected in the preadmission clinic within 4 weeks of surgery. If these scores were not available, we used the OKS collected on the date when the patient was initially seen in consultation (typically 6–18 months preoperatively). We recorded postoperative improvement on the OKS and satisfaction rates yearly by way of mail-out or in clinic (the most recent score used in the analysis was obtained at a range of 1–4 yr). A minimum of 1 year was chosen as the majority of OKS improvement from preoperative levels occurs within the first 6–12 months.^{17,22,23}

Complications were stratified into those that occurred during a hospital stay and those that occurred after discharge. We compared the total number of complications

per patient between the staged and cancelled groups. Mortality was considered separately from complications, and we compared 90-day mortality between the groups.

Statistical analysis

Comparisons were drawn between the 2 groups using analysis of variance (ANOVA) or *t* test for continuous data and χ^2 test for dichotomous data. To simplify analysis and presentation of findings, we calculated an average OKS for each patient for each time point (pre- and postoperative) by taking the mean of the patient's right and left knee OKS. However, for the cancelled group, the OKS of only the operative side was used, as the OKS was not administered for the nonoperative knee postoperatively. The overall satisfaction with the result of TKA was set to the lowest non-missing, side-specific satisfaction rate. A *p* value of less than 0.05 was considered statistically significant.

RESULTS

Our study included 268 patients: 220 in the staged group and 48 in the cancelled group with baseline differences between the groups. We noted the cancelled group to be significantly older than the staged group, whereas the staged group had a significantly higher mean BMI than the cancelled group. There were significantly more female than male patients in both groups. (Table 1).

A total of 48 patients did not proceed with their planned second procedure within 2 years, representing an 18.3% cancellation rate. We noted an identifiable reason for cancellation in the charts of 44 patients (92.7%). The most common reason for not proceeding with the second procedure was slow recovery from the initial knee replacement necessitating further rehabilitation (43.2%), followed by functional improvement in symptoms in the unoperated knee such that surgery was felt to no longer be warranted (27.3%), poor experience with surgery and fear of a similar experience (22.7%), treatment of other comorbidities necessitating cancellation of the second procedure (4.6%) and cancellation owing to employment considerations (2.3%) (Table 2).

We found the mean preoperative baseline OKS scores to be similar in both groups. The cancelled group was noted to have a worse postoperative OKS improvement ($p < 0.001$) and lower satisfaction rate ($p < 0.001$), than the staged group (Table 3).

There were no differences in in-hospital complication rates between cancelled and staged bilateral TKA. However, the 1-year post-discharge complication rate was considerably higher in the cancelled group ($p = 0.0085$) (Table 4). There was only 1 postoperative death that occurred within 90 days postoperatively.

Table 1. Patient demographic characteristics

Characteristic	Staged group	Cancelled group	<i>p</i> value
Age, yr, mean \pm SD	64.63 \pm 10.24	68.71 \pm 11.04	0.003
BMI, kg/m ² , mean \pm SD	36.91 \pm 8.76	33.91 \pm 8.87	0.007
Proportion female, <i>n</i> (%)	141 (64.09)	32 (66.67)	0.9

BMI = body mass index, SD = standard deviation.

Table 2. Reasons for cancellation of second stage bilateral total knee arthroplasty

Reason	<i>n</i> (%)
Slow recovery with need to improve strength	19 (43.2)
Successful surgery with improved function that second surgery no longer required	12 (27.3)
Poor experience with first surgery with fear of similar experience	10 (22.7)
Treatment of other comorbidities	2 (4.6)
Postponed owing to work demands	1 (2.3)

Table 3. Patient reported outcome measure and satisfaction

Outcome	Staged group, %	Cancelled group, %	<i>p</i> value
Preoperative OKS, mean \pm SD	41.03 \pm 8.06	38.36 \pm 11.56	0.2
Postoperative OKS, mean \pm SD	20.30 \pm 7.26	30.33 \pm 11.29	0.0002
Improvement OKS, mean \pm SD	20.80 \pm 9.45	9.21 \pm 9.39	< 0.001
Satisfaction, mean \pm SD	336 \pm 89.84*	20 \pm 57.14*	< 0.001

OKS = Oxford Knee Score; SD = standard deviation.

*Reported in observations not patients to account for 2 joints.

Table 4. In-hospital and 1-year postoperative complication rates

Complication	Staged group, no. (%)	Cancelled group, no. (%)	<i>p</i> value
In-hospital	58 (13.2)*	9 (18)*	0.4
One-year postoperative	5 (1.15)*	4 (8)*	0.0085

*Reported in observations not patients to account for 2 joints.

DISCUSSION

In our cohort of 263 patients with bilateral knee arthritis who had planned to undergo staged bilateral knee replacement, close to one-fifth of patients scheduled for a staged bilateral TKA did not proceed with the second knee replacement within 2 years. When examining reasons for the cancellation of the second procedure, many patients reported a slow recovery or poor experience with the first surgery. Only 57.1% of the cancelled group reported being satisfied with the first surgery, which was substantially lower than the staged group, and considerably lower than well-documented

satisfaction rates of about 80% in many large series studies.^{24–27} However, some authors have found that patient satisfaction does not always correlate with physical functioning.²⁸ Patient expectations can play an important role in satisfaction and expectations can change between staged replacements.²⁹ Noble and colleagues³⁰ found in their series of TKA that satisfaction was primarily determined by patient expectations and not their absolute level of function.

To our knowledge, only 2 studies have examined reasons for deferral of the second procedure in staged bilateral TKA.^{16,31} Alesh and colleagues³¹ noted in their series of patients undergoing staged bilateral TKA 1 week apart that initially, 18.6% of their cohort did not proceed with their second procedure at 1 week postoperatively and 13.8% continued to defer their second procedure at 1 year. The most common reason was pain, followed by family circumstances, work demands or fear of long rehabilitation. Similar to the findings in our study, patients who cancelled their second procedure were considerably older and had a higher complication rate. Sesen and colleagues¹⁶ noted an even higher refusal rate of 36.9% in a series of 111 patients undergoing staged bilateral TKA. Again, age was found to be a determinant, as patients older than 70 years were less likely to proceed with the second procedure. Using a post-visit questionnaire of patient expectations, the authors found the process of health care followed by treatment outcome were most influential on the likelihood of proceeding with the second procedure.¹⁶ Poultsides and colleagues²⁹ in their series of patients undergoing either a staged TKA or total hip replacement noted that for most patients, expectations changed between surgeries and change was not uniform. Within their cohort of patients undergoing staged bilateral TKA, more than 70% of patients showed either higher or lower expectations after the first procedure.

Perhaps the most interesting and unique finding in our study was that in 27% of the cancelled group, pain and function improved in their contralateral knee to the point that it was deemed to no longer require surgical intervention. Clement and colleagues³² found in a retrospective cohort of 3718 patients who underwent primary TKAs that moderate or severe pain in their contralateral nonoperative limb had a clinically notable improvement in the functional component of their Western Ontario and McMaster Universities Osteoarthritis Index score. Smith and colleagues³³ found in a cohort of 772 patients undergoing unilateral TKA an improvement in pain in both the index and contralateral knee, but this declined after 3 months postoperatively. In the subset of patients in our study in whom pain had improved, this improvement was maintained for about 2 years postoperatively. Parsi and colleagues³⁴ found a small, but measurable, improvement in the mechanical axis plumbline in the

contralateral leg after primary TKA. They suggested the index procedure may have a splinting effect with an improved mechanical axis on the contralateral knee. It is known that increasing varus malalignment will increase the contact loading and contribute to increasing varus osteoarthritis.^{35–38} Furthermore, limb realignment surgery has been shown to substantially improve biomechanical risk factors and load distribution during walking.³⁹ Further work is needed to examine if improvements in mechanical axis of either the index or contralateral knee lead to improvement in pain and function in the contralateral nonoperated knee.

Ideally, a PROM should be responsive to clinical change by being valid, reliable and easily administered. Multiple studies have reported these qualities for OKS.^{19,40–42} In our study, the mean improvement in OKS from pre- to postoperative among the cancelled group was significantly lower than in the staged group. Similarly, Sesson and colleagues¹⁶ found the mean Knee Society Score to be significantly worse within their cancelled group, further highlighting the potential value of PROMs in the assessment of whether patients will proceed with the second procedure.

The cancelled group in our study experienced a significantly higher complication rate within the first year postoperatively. This is similar to the findings of Alesh and colleagues³¹ and likely contributes to a patients' unwillingness to proceed with the second procedure. This highlights a potential benefit of staged bilateral TKA as the time interval between surgeries can help to identify patients who may not be medically fit for a second procedure; conversely, not proceeding with the second procedure may result in residual pain and loss of function arising from the unoperated knee. This is similar to the previous systematic review by Hussain and colleagues,¹³ but contrary to other large series reviews that noted simultaneous bilateral TKA to carry a higher risk of postoperative complications.^{10,12} The discrepancies between multiple reviews could be partially attributable to the poor quality of some included studies within these systematic reviews, and the selection bias that occurs if patients who decline to proceed with the second procedure are not adequately identified in administrative datasets and therefore excluded from the analysis.¹⁵

Limitations

Our study had several limitations that need to be considered. Although demographics such as age and BMI were captured, specific assessment of medical comorbidities was not performed. To simplify analysis and presentation of findings, an average OKS for each patient was calculated for each time point (pre- and postoperative) by taking the mean of the patient's right and left knee OKS; however, this has not been validated and should be

taken into consideration when analyzing our results. This study was carried out at a single academic institution, and results may not be generalizable. Finally, the cancelled bilateral TKA group was small, and conclusions about these results need to be made with caution. Despite these limitations, this study is 1 of only a few to examine rates and reasons for deferment of the second stage of bilateral TKA while incorporating PROMs.

CONCLUSION

About one-fifth of patients scheduled for a staged bilateral TKA did not proceed with the second procedure. They showed a substantial decrease in functional outcomes and satisfaction rates along with increased complication rates. However, more than one-quarter (27%) of patients in this group noted improvements in their contralateral (unoperated) knee, such that a second procedure was no longer felt to be necessary. Further investigations should include well powered, prospective randomized controlled trials that track not only functional outcomes and complications, but also include outcomes that may be of broader relevance to patients, such as time off work and improvement of symptoms in the unoperated knee.

Affiliations: Concordia Hip and Knee Institute (Longstaffe, Shahid, Verrelli, Loucks, Bohm); Department of Surgery (Longstaffe, Bohm), University of Manitoba; Pan Am Clinic (Longstaffe), Winnipeg, Man; Practice Plus Group Hospital (Shahid), Shepton Mallet, UK.

Competing interests: None declared.

Contributors: E. Bohm designed the study, A. Verrelli acquired the data, which L. Loucks then analyzed and interpreted. R. Longstaffe, M.K. Shahid and A. Verrelli wrote the article, which E. Bohm and L. Loucks reviewed. All authors approve the final version for publication.

Content licence: This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY-NC-ND 4.0) licence, which permits use, distribution and reproduction in any medium, provided that the original publication is properly cited, the use is noncommercial (i.e., research or educational use) and no modifications or adaptations are made. See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>

References

1. NIH Consensus Statement on total knee replacement. *NIH Consensus State Sci Statements* 2003;20:1-34.
2. Bohm ER, Molodianovitch 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. Lindberg-Larsen M, Jørgensen CC, Husted H, et al. Early morbidity after simultaneous and staged bilateral total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc* 2015;23:831-7.
4. 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;95:1441-9.
5. Lin AC-C, Chao E, Yang C-M, et al. Costs of staged versus simultaneous bilateral total knee arthroplasty: a population-based study of the Taiwanese National Health Insurance Database. *J Orthop Surg Res* 2014;9:59.
6. Ritter MA, Harty LD, Davis KE, et al. Simultaneous bilateral, staged bilateral, and unilateral total knee arthroplasty. A survival analysis. *J Bone Joint Surg Am* 2003;85:1532-7.
7. Husted H, Troelsen A, Otte KS, et al. Fast-track surgery for bilateral total knee replacement. *J Bone Joint Surg Br* 2011;93:351-6.
8. Bagsby D, Pierson JL. Functional outcomes of simultaneous bilateral versus unilateral total knee arthroplasty. *Orthopedics* 2015;38:e43-7.
9. Liu L, Liu H, Zhang H, et al. Bilateral total knee arthroplasty: simultaneous or staged? A systematic review and meta-analysis. *Medicine (Baltimore)* 2019;98:e15931.
10. Restrepo C, Parvizi J, Dietrich T, et al. Safety of simultaneous bilateral total knee arthroplasty: a meta-analysis. *J Bone Joint Surg Am* 2007;89:1220-6.
11. Fu D, Li G, Chen K, et al. Comparison of clinical outcome between simultaneous-bilateral and staged-bilateral total knee arthroplasty: a systematic review of retrospective studies. *J Arthroplasty* 2013;28:1141-7.
12. 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;131:1291-8.
13. Hussain N, Chien T, Hussain F, et al. Simultaneous versus staged bilateral total knee arthroplasty: a meta-analysis evaluating mortality, peri-operative complications and infection rates. *HSS J* 2013;9:50-9.
14. Meehan JP, Danielsen B, Tancredi DJ, et al. A population-based comparison of the incidence of adverse outcomes after simultaneous-bilateral and staged-bilateral total knee arthroplasty. *J Bone Joint Surg Am* 2011;93:2203-13.
15. Kim S, Meehan JP, White R. Operative risk of staged bilateral knee arthroplasty is underestimated in retrospective studies. *J Arthroplasty* 2011;26:1198-204.
16. Sesen H, Demirkale I, Karaduman M, et al. Why two-thirds of patients accepted the second session in staged bilateral total knee arthroplasty: a prospective analysis of 111 patients. *Knee Surg Sports Traumatol Arthrosc* 2015;23:3585-90.
17. Rolfson O, Bohm E, Franklin P, et al.; Patient-Reported Outcome Measures Working Group of the International Society of Arthroplasty Registries. Patient-reported outcome measures in arthroplasty registries Report of the Patient-Reported Outcome Measures Working Group of the International Society of Arthroplasty Registries Part II. Recommendations for selection, administration, and analysis. *Acta Orthop* 2016;87(Suppl 1):9-23.
18. Siljander MP, McQuivey KS, Fahs AM, et al. Current trends in patient-reported outcome measures in total joint arthroplasty: a study of 4 major orthopaedic journals. *J Arthroplasty* 2018;33:3416-21.
19. Dawson J, Fitzpatrick R, Murray D, et al. Questionnaire on the perceptions of patients about total knee replacement. *J Bone Joint Surg Br* 1998;80:63-9.
20. Harris K, Dawson J, Gibbons E, et al. Systematic review of measurement properties of patient-reported outcome measures used in patients undergoing hip and knee arthroplasty. *Patient Relat Outcome Meas* 2016;7:101-8.
21. Alviar MJ, Olver J, Brand C, et al. Do patient-reported outcome measures in hip and knee arthroplasty rehabilitation have robust measurement attributes? A systematic review. *J Rehabil Med* 2011;43:572-83.
22. Williams DP, Blakey CM, Hadfield SG, et al. Long-term trends in the Oxford knee score following total knee replacement. *Bone Joint J* 2013;95-B:45-51.
23. Browne JP, Bastaki H, Dawson J. What is the optimal time point to assess patient-reported recovery after hip and knee replacement? A systematic review and analysis of routinely reported outcome data from the English patient-reported outcome measures programme. *Health Qual Life Outcomes* 2013;11:128.

24. Dunbar MJ, Richardson G, Robertsson O. I can't get no satisfaction after my total knee replacement: rhymes and reasons. *Bone Joint J* 2013;95-B(Suppl A):148-52.
25. Bourne RB, Chesworth BM, Davis AM, et al. Patient satisfaction after total knee arthroplasty: who is satisfied and who is not? *Clin Orthop Relat Res* 2010;468:57-63.
26. Baker PN, van der Meulen JH, Lewsey J, et al.; National Joint Registry for England and Wales. The role of pain and function in determining patient satisfaction after total knee replacement. Data from the National Joint Registry for England and Wales. *J Bone Joint Surg Br* 2007;89:893-900.
27. Robertsson O, Dunbar M, Pehrsson T, et al. Patient satisfaction after knee arthroplasty: a report on 27,372 knees operated on between 1981 and 1995 in Sweden. *Acta Orthop Scand* 2000;71:262-7.
28. Haanstra TM, van den Berg T, Ostelo RW, et al. Systematic review: do patient expectations influence treatment outcomes in total knee and total hip arthroplasty? *Health Qual Life Outcomes* 2012;10:152.
29. Poultsides LA, Ghomrawi HMK, Lyman S, et al. Change in pre-operative expectations in patients undergoing staged bilateral primary total knee or total hip arthroplasty. *J Arthroplasty* 2012;27:1609-15.e1.
30. Noble PC, Conditt MA, Cook KF, et al. The John Insall Award: patient expectations affect satisfaction with total knee arthroplasty. *Clin Orthop Relat Res* 2006;(452):35-43.
31. Alosch H, Shah RP, Courtney PM, et al. One-week staged bilateral total knee arthroplasty protocol: a safety comparison of intended and completed surgeries. *J Arthroplasty* 2014;29:1176-80.
32. Clement ND, Weir DJ, Holland J, et al. Contralateral knee pain reduces the rate of patient satisfaction but does not clinically impair the change in WOMAC score after total knee arthroplasty. *Bone Joint J* 2020;102-B:125-31.
33. Smith HK, Wylde V, Lingard EA, et al. The effect of pain after total knee arthroplasty on the contralateral, nonreplaced knee. *J Bone Joint Surg Am* 2013;95:315-22.
34. Parisi TJ, Levy DL, Dennis DA, et al. Radiographic changes in nonoperative contralateral knee after unilateral total knee arthroplasty. *J Arthroplasty* 2018;33:S116-20.
35. Vandekerckhove P-JTK, Matlovich N, Teeter MG, et al. The relationship between constitutional alignment and varus osteoarthritis of the knee. *Knee Surg Sports Traumatol Arthrosc* 2017;25:2873-9.
36. Moyer RF, Birmingham TB, Chesworth BM, et al. Alignment, body mass and their interaction on dynamic knee joint load in patients with knee osteoarthritis. *Osteoarthritis Cartilage* 2010;18:888-93.
37. Kumar D, Manal KT, Rudolph KS. Knee joint loading during gait in healthy controls and individuals with knee osteoarthritis. *Osteoarthritis Cartilage* 2013;21:298-305.
38. Bennell KL, Bowles K-A, Wang Y, et al. Higher dynamic medial knee load predicts greater cartilage loss over 12 months in medial knee osteoarthritis. *Ann Rheum Dis* 2011;70:1770-4.
39. Birmingham TB, Moyer R, Leitch K, et al. Changes in biomechanical risk factors for knee osteoarthritis and their association with 5-year clinically important improvement after limb realignment surgery. *Osteoarthritis Cartilage* 2017;25:1999-2006.
40. Ko Y, Lo N-N, Yeo S-J, et al. Comparison of the responsiveness of the SF-36, the Oxford Knee Score, and the Knee Society Clinical Rating System in patients undergoing total knee replacement. *Qual Life Res* 2013;22:2455-9.
41. Garratt AM, Brealey S, Gillespie WJ; DAMASK Trial Team. Patient-assessed health instruments for the knee: a structured review. *Rheumatology (Oxford)* 2004;43:1414-23.
42. Theodoulou A, Bramwell DC, Spiteri AC, et al. The use of scoring systems in knee arthroplasty: a systematic review of the literature. *J Arthroplasty* 2016;31:2364-70.e8.