

# The relative safety of one-stage bilateral total knee arthroplasty

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**Abstract** Patients with osteoarthritis of the knee often require bilateral knee replacement before fulfilling their full ambulatory potential. Despite extensive research there is considerable debate about the risks of performing simultaneous bilateral knee replacements under the same anaesthetic. Our aim was to compare the relative short-term morbidity of one-stage bilateral with unilateral total knee arthroplasty in a retrospective, consecutive cohort of patients. Seventy-two bilateral knee replacements were case-matched for age and gender with 144 unilateral knees. One-stage bilateral arthroplasty was associated with increased morbidity with respect to wound (6.0 vs 0.7%;  $p=0.003$ ) and deep prosthetic (3.5% vs 0.7 %;  $p=0.02$ ) infections, cardiac complications (3.5% vs 0.7%;  $p=0.04$ ) and chest infections (7.0% vs 1.4%;  $p=0.04$ ). No differences were observed in the mortality rates ( $p=0.30$ ) and risk of thrombo-embolism ( $p=0.70$ ). We conclude that one-stage bilateral total knee arthroplasty is associated with increased morbidity compared with unilateral knee replacement.

**Résumé** Les patients ayant présenté une ostéoarthrite du genou nécessitent parfois une prothèse du genou bilatérale. Des travaux font état des risques survenant lors de la réalisation d'une prothèse totale unilatérale du genou, risques anesthésiques notamment. Le but de notre étude est de comparer la morbidité à court terme du remplacement du genou par prothèse unilatérale en un temps d'un côté ou des

deux côtés, ceci à propos de l'étude rétrospective d'une cohorte de patients. 72 prothèses totales du genou bilatérales en un temps ont été analysées en terme d'âge, de sexe en comparaison avec 144 prothèses du genou unilatérales. La prothèse totale du genou bilatérale en un temps est associée une augmentation de la morbidité (6.0 vs 0.7% ;  $p=0.003$ ) et à un taux d'infection profonde important (3.5% vs 0.7% ;  $p=0.02$ ), de même, en ce qui concerne les complications cardiaques (3.5% vs 0.7% ;  $p=0.04$ ), les complications pulmonaires (7.0% vs 1.4% ;  $p=0.04$ ). Nous n'avons pas observé de différence sur le plan de la mortalité ( $p=0.30$ ) de même en ce qui concerne les risques thromboemboliques ( $p=0.70$ ). Nous pouvons donc conclure que la prothèse totale du genou bilatérale en un seul temps entraîne une augmentation importante de la morbidité si on l'a compare à la prothèse totale du genou, unilatérale.

## Introduction

Osteoarthritis is estimated to affect as many as 80% of 65 year olds. About one-third of patients have bilateral symptoms on presentation to the surgeon. Many of these patients require surgery on both knees before achieving their full ambulatory potential. It is now well accepted that total knee arthroplasty is a good treatment for pain relief and restoration of function in patients with advanced degenerative disease [12]. The options for those patients requiring both knees replaced are either to have single anaesthetic simultaneous bilateral replacement or to have a staged procedure. In the latter procedure the second knee could be replaced at varying intervals following the original surgery. This may be within the same hospital admission, a week apart or at 3 months, 6 months or longer. The rationale behind one-stage bilateral knee replacement is the

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reduced hospitalisation, the reduction in cost and the need for only one anaesthetic. These benefits are in the best interest of the patient if the procedure is as safe as unilateral replacement. Several studies, mainly carried out in North America, including the studies published by Morrey et al., Ritter et al. and Soudry et al., have investigated the results of bilateral knee arthroplasty [18, 20, 23]. They have compared bilateral knee replacement with unilateral or staged procedures. The results from these studies show that the one stage procedure is functionally effective and safe. There appear to be some differences in the complication rates reported, with some studies finding a decrease in morbidity [17, 23], some similar [1, 8, 18, 20] and some a higher morbidity rate [7, 13]. Studies have shown financial savings ranging between 18% and 50% when performing bilateral rather than two unilateral replacements [4, 19]. This study was carried out to determine the relative risk of postoperative complications of bilateral same anaesthetic knee arthroplasty using single joint replacements as the control within a single dedicated orthopaedic unit in the United Kingdom.

## Patients and methods

We compared the morbidity and mortality associated with 72 consecutive bilateral same anaesthetic simultaneous knee replacements (BSATKR) and 144 unilateral knee replacements that were case matched for age, gender and year of operation. The data were collected by retrospective review of patient notes. All patients had a preoperative diagnosis of osteoarthritis and were under the care of one surgeon. All patients received a standard preoperative assessment. Unless contraindicated they were all given cefuroxime antibiotic on induction and had aspirin and thromboembolic deterrent (TED) stockings for deep vein thrombosis (DVT) prophylaxis. The operations were performed in a clean air theatre. The AGC (Biomet, Europe) total knee replacement was used in all patients. In the case of the bilateral procedures both knees were prepared at the beginning. A tourniquet was routinely used. The same instruments were used for both sides. Postoperatively most patients had Stryker reinfusion drains. They were started on continuous passive motion (CPM) on the same day as surgery, and they all had early physiotherapy commencing on the second postoperative day with quadriceps and flexion exercises. Patients were discharged when knee flexion approached 90 degrees with safe mobilisation and the wound was dry. All patients were followed up for a minimum of 6 months. Fisher's exact test was used to compare the results of the unilateral and bilateral procedure. A P-value of less than 0.05 was considered statistically significant.

**Table 1** Demographic data. TKR: total knee replacement, ASA: American Society of Anaesthesiologist

Gender	Bilateral TKR	Unilateral TKR	Total Patients
Male	34	68	102
Female	38	76	114
<b>ASA</b>			
1	23	16	
2	43	109	
3	6	19	

## Results

The mean age for all patients was 71 years, ranging from 48 to 94. The median age for all patients was 72. Thirty-four of the bilateral knee replacements were male and 38 were female. As the groups were matched for gender there were 68 males and 76 females having unilateral procedures (Table 1). The ASA scoring for each patient was determined from the notes; these can be seen in Table 1.

Recorded complications were divided into local and systemic. The local complications were calculated per knee and the systemic complications were recorded per patient. For a diagnosis of superficial and deep infection to be recorded there had to be clinical signs and positive microbiology. The results are presented in Table 2. Thromboembolic complications include deep vein thrombosis (DVT) diagnosed clinically and confirmed by Doppler. Pulmonary emboli were suspected clinically and confirmed using radioisotope scanning. Both DVT and pulmonary embolism (PE) were treated with heparin and warfarin. Chest infections were diagnosed if clinically suspected and showed positive microbiology. Cardiac complications included myocardial infarction, acute rhythm changes and acute episodes of heart failure. Systemic complications and mortality are recorded in Table 2. In the bilateral group there were two myocardial infarctions, one self limiting supra-ventricular tachycardia (SVT) and one episode of heart failure. Three of these patients were ASA group 3. There was one mortality in the bilateral group, which was

**Table 2** Morbidity and mortality

Complication	Bilateral TKR	Unilateral TKR	P-value	
Chest or cardiac	9 (12.5%)	3 (2%)	0.003	
Thromboembolic	1 (1.4%)	4 (2%)	0.7	
Chest infection	5 (7%)	2 (1.4%)	0.04	
Cardiac	4 (5.6%)	1 (0.7%)	0.04	
<b>Mortality</b>	1 (0.7%)	0	0.3	
<b>Complication per knee</b>				<b>Total</b>
Wound infection	9 (6%)	1 (0.7%)	0.0003	10 (3.5%)
Deep infection	5 (3.5%)	1 (0.7%)	0.02	6 (2%)

an old lady with an ASA score 3 who died following a combination of a myocardial infarction and pneumonia. The mean hospital stay in the bilateral group was 15.3 days with a median of 13 days, and in the unilateral group the mean was 11.6 days, with a median of 10 days.

## Discussion

We set out to compare the postoperative surgical and medical complications of patients undergoing BSATKR with those undergoing unilateral joint replacement. The results indicate differences in both local and systemic complications between the two groups.

There was a significant difference in the rate of cardiopulmonary complications between the two groups. The incidence of cardiac complications in the bilateral group was 5.6% compared to 0.7% in the unilateral group. This difference is even more significant when it is considered that there were proportionally higher ASA scores, and thus higher risk patients in the unilateral group. The rate of complication in the unilateral group was favourable when compared to the literature, but the rates for the bilateral group were slightly higher. It is generally accepted that there is the potential for higher numbers of cardiac complications in the bilateral group, but most studies have documented no greater risks [21].

The risk of cardiac complications in the literature ranges from zero, 3.2%, 3.5%, to 10% [5, 13, 15]. The reasons for higher complications in the bilateral group may be related to the longer operative and anaesthetic time, the larger surgical insult, the associated increase in blood loss for the second knee [3] or the exaggerated haemodynamic instability on release of the second tourniquet [9]. These phenomena are potentially dangerous especially for patients with pre-existing ischaemic heart disease and limited cardiac reserve. The difference between our figures and the published data with lower cardiac morbidity figures may simply be that in other studies, patients with medical problems such as cardiovascular disease, respiratory disease, diabetes and obesity were excluded [7, 23]. Ivory et al. argues that these patients with preoperative co-morbidities are the ones to benefit most from a single anaesthetic [11]. Interestingly, three of the patients with cardiac complications were of ASA score 3. Thus in our study half of those patients with an ASA grade of 3 suffered complications related to their cardiac system, and therefore our findings do not support Ivory's argument. Leonard et al., however, found that patients with pre-existing cardio-respiratory conditions were at a greater risk of developing complications [14].

Chest infections also occurred more frequently in the bilateral procedure most likely related to longer periods of

anaesthesia. Our study found no increase in the thromboembolic risk between the unilateral and bilateral groups. There has been much concern over the possible increased risks of thrombotic and fat emboli [7]. Barrett et al. found that the adjusted risk of pulmonary embolism is about 80% higher in the 3 months after a simultaneous procedure than in the 3 months after a single procedure [2]. We found no statistical difference in the mortality rate although the one death in the study followed a bilateral knee replacement. Other studies have shown no statistical difference in mortality rates between bilateral and unilateral disease although there do appear to be more deaths in the bilateral groups in some of the studies [11, 13]. A recent large scale study derived from the Scottish Arthroplasty Project found no difference in the 90-day mortality between unilateral TKR, staged TKR or BSATKR [25]. We would advocate that patients need to be carefully selected, and those patients with pre-existing cardio-respiratory disease are carefully assessed pre-operatively to ensure they are fit for a bilateral procedure. Furthermore, patients should be informed of the potential risks and benefits and therefore guide treatment.

We also found an increase in both superficial infection (6%) and deep infection (3.5%) in the bilateral group as compared to the unilateral group. The superficial infection rates for unilateral replacement were very acceptable, 0.7%, being less than much of the published data. The deep infection also at 0.7% is also comparable with the literature. The bilateral results are statistically higher than the unilateral group. Previously concern has been raised about the potential for both knees to become infected in a one sitting procedure. In our study we have not had any patient so far who has developed infection in both joint replacements. It is difficult to explain this statistically higher rate of infection between the two groups, but it may be related to prolonged operation time, increased number of assistants, not redraping, rescrubbing and changing instruments. In some centres separate instrument trays for each knee are advocated. Gradillas found a high superficial infection rate of 9.7% in his bilateral group, four times his results for the unilateral group, which was considered attributable to the high number of rheumatoid patients in his study [7]. In contrast to our findings, Ritter et al. published a higher rate of superficial infection in the unilateral group [20]. Deep infection rates in bilateral replacement range from zero to 3.6% [5, 7, 13]. A recent large Finnish study found that bilateral operations were not an independent risk factor for deep surgical site infection (SSI) with no difference in mortality between bi and unilateral total knee replacements. Furthermore, they found that following bilateral operations: four deep SSIs were detected, all from bilateral procedures, three of which were on the second operative side [10].

As in many previous studies we found little difference in the number of hospital days for the bilateral and unilateral procedure despite the increased complications in the bilateral group.

Other studies have shown that BSATKR decreases total time spent in hospital, is cheaper and the patients achieve similar or better functional results [24]. In our study, simultaneous bilateral total knee arthroplasty appears to carry a higher postoperative morbidity, but a similar mortality to a unilateral procedure. It appears that it would be safer medically to have bilateral procedures separated by a period of time. Some studies have advocated this staged approach for elderly patients [16], and other groups have recommended a staggered approach with a 1-week interval during a single hospital admission [6, 22].

Importantly from our study, those with significant pre-operative medical problems are more at risk of post-operative problems with both knees replaced with the same anaesthetic. We would recommend that fit candidates with bilateral arthritis undergo BSATKR, with its proven good functional results, symmetric knee rehabilitation and possible cost savings. However, high risk patients should have a unilateral procedure.

## References

1. Alemparte J, Johnson GV, Worland RL et al (2002) Results of simultaneous bilateral total knee replacement: a study of 1,208 knees in 604 patients. *J South Orthop Assoc* 11:153–156
2. Barrett J, Baron JA, Losina E et al (2006) Bilateral total knee replacement: staging and pulmonary embolism. *J Bone Joint Surg* 88:2146–2151
3. Bould M, Freeman BJ, Pullyblank A, Newman JH (1998) Blood loss in sequential bilateral total knee arthroplasty. *J Arthroplasty* 13:77–79
4. Brotherton SL, Roberson JR, de Andrade JR, Fleming LL (1986) Staged versus simultaneous bilateral total knee replacement. *J Arthroplasty* 1:221–228
5. Cohen RG, Forrest CJ, Benjamin JB (1997) Safety and efficacy of bilateral total knee arthroplasty. *J Arthroplasty* 12:497–502
6. Forster MC, Bauze AJ, Bailie AG et al (2006) A retrospective comparative study of bilateral total knee replacement staged at a one-week interval. *J Bone Joint Surg* 88:1006–1010
7. Gradillas EL, Volz RG (1979) Bilateral total knee replacement under one anesthetic. *Clin Ortho Relat Res* 153–158
8. Hardaker WT Jr, Ogden WS, Musgrave RE, Goldner JL (1978) Simultaneous and staged bilateral total knee arthroplasty. *J Bone Joint Surg* 60:247–250
9. Huang CH, Wang MJ, Chen TL et al (1996) Blood and central venous pressure responses after serial tourniquet deflation during bilateral total knee replacement. *J Formos Med Assoc* 95:496–499
10. Huotari K, Lyytikainen O, Seitsalo S (2007) Patient outcomes after simultaneous bilateral total hip and knee joint replacements. *J Hosp Infect* 65:219–225
11. Ivory JP, Simpson AH, Toogood GJ et al (1993) Bilateral knee replacements: simultaneous or staged? *J R Coll Surg Edinb* 38:105–107
12. Kolettis GT, Wixson RL, Peruzzi WT et al (1994) Safety of 1-stage bilateral total knee arthroplasty. *Clin Ortho Relat Res* 102–109
13. Lane GJ, Hozack WJ, Shah S et al (1997) Simultaneous bilateral versus unilateral total knee arthroplasty. Outcomes analysis. *Clin Ortho Relat Res* 106–112
14. Leonard L, Williamson DM, Ivory JP, Jennison C (2003) An evaluation of the safety and efficacy of simultaneous bilateral total knee arthroplasty. *J Arthroplasty* 18:972–978
15. Liu TK, Chen SH (1998) Simultaneous bilateral total knee arthroplasty in a single procedure. *Int Orthop* 22:390–393
16. Mangaleshkar SR, Prasad PS, Chugh S, Thomas AP (2001) Staged bilateral total knee replacement—a safer approach in older patients. *Knee* 8:207–211
17. McLaughlin TP, Fisher RL (1985) Bilateral total knee arthroplasties. Comparison of simultaneous (two-team), sequential, and staged knee replacements. *Clin Ortho Relat Res* 220–225
18. Morrey BF, Adams RA, Ilstrup DM, Bryan RS (1987) Complications and mortality associated with bilateral or unilateral total knee arthroplasty. *J Bone Joint Surg* 69:484–488
19. Reuben JD, Meyers SJ, Cox DD et al (1998) Cost comparison between bilateral simultaneous, staged, and unilateral total joint arthroplasty. *J Arthroplasty* 13:172–179
20. Ritter M, Mamlin LA, Melfi CA et al (1997) Outcome implications for the timing of bilateral total knee arthroplasties. *Clin Ortho Relat Res* 99–105
21. Ritter MA, Harty LD (2004) Debate: simultaneous bilateral knee replacements: the outcomes justify its use. *Clin Ortho Relat Res* 84–86
22. Sliva CD, Callaghan JJ, Goetz DD, Taylor SG (2005) Staggered bilateral total knee arthroplasty performed four to seven days apart during a single hospitalization. *J Bone Joint Surg* 87:508–513
23. Soudry M, Binazzi R, Insall JN et al (1985) Successive bilateral total knee replacement. *J Bone Joint Surg* 67:573–576
24. Stubbs G, Pryke SE, Tewari S et al (2005) Safety and cost benefits of bilateral total knee replacement in an acute hospital. *ANZ J Surg* 75:739–746
25. Walmsley P, Murray A, Brenkel IJ (2006) The practice of bilateral, simultaneous total knee replacement in Scotland over the last decade. Data from the Scottish Arthroplasty Project. *Knee* 13:102–105