



# Clinical outcomes of bilateral single-stage unicompartmental knee arthroplasty



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## ABSTRACT

**Background:** Deciding whether to treat patients with bilateral arthritis with two-stage or bilateral single-stage arthroplasties is a cause of considerable debate in orthopaedic surgery.

**Methods:** A total of 394 cemented Unicompartmental Knee Arthroplasties (UKA) were performed in this unit between 2006 and 2010. A retrospective review identified 38 patients (76 knees) who underwent bilateral Single-Stage Sequential UKA, performed by a single surgeon.

**Results:** The mean BMI was 29.8 and the majority of patients were ASA grade 2. The mean duration of follow-up was 30 months. The mean total tourniquet time was 83 min. The mean post-operative haemoglobin was 11.8 and no patient required blood transfusion. The mean time to mobilisation was 18 h and the average length of stay was 3.5 days. This compares favourably with an institutional average length of stay of two days for a single UKA.

There was a significant improvement in the mean pre- to post-operative OKS (from 14 to 34,  $p < 0.0001$ ). One patient required operative fixation of a tibial plateau fracture after sustaining a mechanical fall two months following surgery. There were no other major complications, including thrombo-embolic events or deep infections. Two patients required excision of a superficial suture granuloma.

**Conclusions:** Bilateral Single-Stage Sequential UKAs provide significant improvement in patient function and can be performed safely with a low complication rate. Patients can benefit from a single hospital admission and anaesthetic whilst the shorter total in-patient stay reduces costs incurred by the hospital.

**Level of evidence:** IV

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## 1. Introduction

Unicompartmental knee arthroplasty (UKA) has been shown to be effective in the treatment of antero-medial knee osteoarthritis and a suitable alternative to total knee arthroplasty (TKA) [1–3]. Deciding whether to treat patients with bilateral arthritis with two-stage or bilateral single-stage arthroplasties is a cause of some debate in knee surgery. Several studies have compared these two approaches with TKA, with conflicting outcomes with regards to complication rates [4–11].

There is considerable confusion within the literature with regards to the nomenclature regarding bilateral knee arthroplasty, and this warrants clarification.

- *Single-Stage Sequential* describes one knee arthroplasty being performed before proceeding directly under the same anaesthetic to the contralateral knee. Both knees can be prepped and draped at the beginning of surgery or alternatively, each knee can be treated as a separate surgical procedure [12].
- *Single-Stage Simultaneous* surgery relates to both knees being operated on at the same time by two different surgeons.

- *Two-stage* refers to surgery on one knee with the patient subsequently being rehabilitated and discharged. The patient is then readmitted at a later date for an operation on the contralateral knee under a second anaesthetic, with each operation as a separate entity.

*Single-Stage Sequential* and *Single-Stage Simultaneous* surgery have the advantage of a single anaesthetic, shorter total hospital stay, increased patient convenience, increased patient satisfaction and reduced hospital costs when compared with two-stage surgery [13,14].

In contrast to the large number of publications looking at TKA, there is a paucity of evidence regarding bilateral UKA, but a significant increase in major complications has been reported recently [15]. This study demonstrated more complications in the bilateral UKA group (a mixture of *Single-Stage Sequential* and *Single-Stage Simultaneous*) and it was advised that such surgery be undertaken with caution. However, chemical thrombo-prophylaxis was not used. A second study on bilateral UKA (*Single-Stage Simultaneous*) found that such patients had a shorter total operative time, shorter total length of hospital stay, and better functional outcomes without any difference in complication rates [16]. The authors did however note a bias towards performing bilateral surgery in younger and less obese patients.

UKA has many advantages over TKA with regards to the amount of bony resection, shorter surgical and anaesthetic times, less blood loss, lower morbidity due to the minimally invasive approach, low rate of

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thrombo-embolic disease, lower rate of infection, lower cost, a potentially greater range of post-operative movement, quicker recovery, decrease in the length of inpatient stay and ease of revision [17–22].

It is our opinion that patients with bilateral disease necessitating arthroplasty will achieve a quicker return to function with Single-Stage Sequential UKA than with staged surgery. Two-stage surgery necessitates patients mobilising on a painful arthritic knee whilst awaiting their second operation with a longer overall period before they can be free of pain and achieve maximal function.

The aim of this study was to determine the safety, functional outcomes and complications of Single-Stage Sequential UKA.

## 2. Patients and methods

A retrospective review of clinical records between January 2006 and March 2010 identified all patients undergoing UKA in this unit. Over this period, 394 Oxford UKA were performed (316 patients, 394 knees) of which 38 patients (76 knees) underwent single-stage sequential bilateral Oxford UKA (Biomet, Swindon, United Kingdom) through a minimally invasive approach [23]. All patients with bilateral antero-medial compartment knee osteoarthritis requiring arthroplasty were offered Single-Stage Sequential UKA, irrespective of Body Mass Index (BMI). The only mandatory criterion was an ASA grade of 3 or below.

All surgery was performed within a laminar airflow theatre by the senior author (DHB) or trainees operating under his supervision. During each operation, one knee was operated on and then that tourniquet deflated and the wound closed by an assistant whilst the contralateral tourniquet was then inflated and surgery on the other leg commenced. This second tourniquet was then deflated prior to closing the wound so as to ensure haemostasis. Wounds were irrigated with pulsatile lavage systems using normal saline. No drains were used and all patients were encouraged to fully weight bear immediately. All patients received post-operative chemical and mechanical thrombo-prophylaxis. Daily injections of subcutaneous enoxaparin were given whilst in-patients until discharge, followed by 2 weeks of oral rivaroxaban (Bayer UK Ltd, Newbury, United Kingdom) on discharge. All patients wore above knee compression stockings for 6 weeks.

All patients followed a Rapid Recovery Programme (Biomet, Swindon, United Kingdom) supervised by physiotherapists and were seen in the outpatient clinic at 6 weeks, 6 months and 1 year following surgery [24].

Review of the medical records, clinic evaluations and telephone consultations identified patient age, gender, total tourniquet time, time to mobilisation, length of stay, length of follow up, all complications and pre- and post-operative Oxford Knee Score (OKS).

The OKS was designed to minimise surgical bias by focussing on patient-reported outcomes only [25]. This was initially designed to give a score between 12 and 60, with 12 being the best outcome. This has been modified with use over the subsequent years to a final score of 0 to 48, with 48 being the best outcome [26]. This modified OKS has been used in this study.

## 3. Statistical analysis

The results were analysed by an independent statistician.

Binomial linear modelling was used to assess relationships within the data, within the open source statistical program "R". An alpha of 0.05 was regarded as significant. Graphs were generated using "ggplot".

## 4. Results

Of the 38 patients, 16 were male and 22 were female, with a mean age of 64. The mean BMI was 29.8 and the majority of patients were ASA grade 2. The mean haemoglobin (Hb) was 13.6 pre-operatively and 11.8 post-operatively. The mean haematocrit was 0.39 pre-operatively and 0.35 post-operatively. The lowest post-operative Hb was 9.1 and no patient required blood transfusion (Table 1).

**Table 1**  
Patient demographics and haematology results.

#	Age	Sex	BMI	ASA	Pre-op Hb	Post-op Hb	Pre-op Hct	Post-op Hct
1	65	F	22.0	2	13.6	11.40	0.39	0.38
2	75	F	17.0	2	12.5	9.10	0.36	0.34
3	55	M	24.0	3	13.0	9.90	0.40	0.35
4	73	F	28.2	2	12.6	9.60	0.37	0.28
5	61	F	28.0	1	12.6	9.30	0.39	0.37
6	69	F	36.0	1	11.8	10.40	0.35	0.30
7	76	M	27.3	2	15.4	13.90	0.42	0.39
8	59	M	28.4	1	14.1	13.50	0.38	0.35
9	78	M	33.8	3	14.5	13.80	0.35	0.31
10	67	F	36.3	2	14.0	11.20	0.35	0.33
11	58	F	28.0	2	12.8	10.00	0.34	0.30
12	56	F	48.2	2	14.6	12.60	0.40	0.37
13	77	M	25.7	2	13.7	10.60	0.40	0.32
14	50	F	35.0	3	13.9	13.20	0.38	0.35
15	58	F	31.0	2	13.2	12.90	0.38	0.36
16	64	M	31.0	3	14.6	13.80	0.39	0.35
17	53	M	28.0	2	13.5	12.20	0.42	0.37
18	72	M	30.0	2	14.0	12.40	0.42	0.36
19	43	F	33.5	1	12.9	11.80	0.38	0.35
20	54	F	30.0	3	13.0	11.00	0.40	0.33
21	72	F	32.0	2	14.3	13.00	0.39	0.34
22	75	F	30.0	3	12.5	11.20	0.41	0.37
23	62	F	30.5	2	13.9	11.20	0.40	0.34
24	68	F	28.0	1	13.0	12.30	0.39	0.37
25	80	M	34.0	2	14.4	12.90	0.42	0.36
26	55	M	32.4	3	13.1	11.60	0.38	0.34
27	66	F	22.0	2	12.6	10.00	0.34	0.30
28	58	F	34.0	1	12.9	11.10	0.39	0.33
29	53	F	26.2	2	13.2	12.20	0.36	0.33
30	56	M	35.5	2	14.8	14.30	0.44	0.43
31	52	F	34.0	1	13.1	11.10	0.35	0.34
32	69	M	33.3	2	13.4	12.00	0.40	0.36
33	76	F	25.1	2	15.2	13.20	0.44	0.39
34	63	M	30.0	2	13.1	11.30	0.42	0.36
35	60	F	22.6	1	15.0	14.10	0.44	0.41
36	78	M	29.8	1	14.4	12.00	0.41	0.36
37	66	M	22.2	2	14.1	13.40	0.40	0.38
38	51	M	29.0	1	13.2	10.40	0.41	0.35

The mean length of follow up was 30 months. The mean total tourniquet time (both knees) was 83 min. The mean time to mobilisation was 18 h and the average length of stay was 3.5 days. This compares favourably with an institutional average length of stay of two days for a single UKA (Table 2).

There was a significant increase ( $p < 0.0001$ ) in the mean pre to post-operative OKS from 14 to 34. There were 3 complications giving an overall complication rate was 3.9%. There were no thrombo-embolic events or deep infections. One patient required operative fixation of a tibial plateau fracture after sustaining a mechanical fall two months following surgery and two patients each required excision of a superficial suture granuloma with no further intervention necessary.

Linear regression demonstrated that there was no link between OKS and age, gender, total surgical time, time to mobilisation or length of stay (Figs. 1–3).

## 5. Discussion

The number of bilateral TKAs performed in the United States over the past two decades has more than doubled, and almost tripled among the female population [27]. The majority of the work on bilateral knee arthroplasty has focussed on TKA with conflicting evidence within the literature with regards to the risks involved with bilateral surgery. Single-Stage bilateral surgery in patients over the age of 70 has been shown to demonstrate no difference with regards to peri-operative complications and better functional outcomes at 6 months and 1 year [28]. Further studies have demonstrated Single-Stage bilateral surgery to be safe with good clinical results and no increase in complications [5,7,29,30]. Patient satisfaction and their post-operative function scoring have been shown to be high following both Single and Two-Stage bilateral knee surgery with no difference found between the two [31]. Single-Stage Sequential surgery offers the benefits of a single anaesthetic, reduced total anaesthetic time, shorter total hospital stay, shorter total recovery time, convenience to the patient and reduced costs,

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