

Total Knee Arthroplasty in a Low-Income Country

Short-Term Outcomes from a National Joint Registry

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Background: We describe our 10-year experience with total knee arthroplasty in patients who are included in the Malawi National Joint Registry.

Methods: A total of 127 patients underwent 153 total knee arthroplasties (TKAs) between 2005 and 2015. The mean duration of follow-up was 4 years and 3 months (range, 6 months to 10 years and 6 months). The study group included 98 women and 29 men with a mean age of 65.3 years (range, 24 to 84 years). Nine patients were human immunodeficiency virus (HIV)-positive.

Results: The primary indication for surgery was osteoarthritis (150 knees), and the mean preoperative and postoperative Oxford Knee Scores were 16.81 (range, 4 to 36) and 45.61 (range, 29 to 48), respectively. Four knees (2.6%) were revised because of early periprosthetic joint infection (1 knee), aseptic loosening (1 knee), and late periprosthetic joint infection (2 knees). There were no perioperative deaths. In the group of 9 patients who were HIV-positive, there were no early or late complications and the mean Oxford Knee Score was 47 (range, 42 to 48) at the time of the latest follow-up.

Conclusions: This study demonstrated good short-term results following 153 primary TKAs performed in a low-income country.

Level of Evidence: Therapeutic Level IV. See Instructions for Authors for a complete description of levels of evidence.

In a low-income-country setting, such as in sub-Saharan Africa, the numbers of total joint arthroplasties (TJAs) being performed are increasing. There are a number of reasons for this increase, including the wider availability of surgical resources and expertise and an increase in life expectancy in these settings^{1,2}. Additionally, there is a growing trend in the use of this form of orthopaedic surgery^{3,4}.

Our institute, Beit CURE International Hospital (BCIH), is an example of a health-care model in which the hospital provides a private elective hip and knee arthroplasty service that funds free health care for those most in need. The Malawi National Joint Registry (MNJR) was established to ensure that patients who had undergone a TJA in Malawi were followed and that their surgical and functional outcomes were accurately recorded for the purposes of both clinical governance and research⁴. All patients who have undergone TJA at our institute have been entered into the registry.

Very little is known about the long-term or short-term results of total knee arthroplasty (TKA) in low-income countries. Furthermore, it is not known how the results of TKA in low-income countries compare with those in high-income countries⁴. The key areas of interest are patient demographics, etiology, complications, patient-reported outcomes, and survivorship. We describe our experience with primary TKA in a low-income country over a 10-year period, with the aim of providing a benchmark against which other hospitals and registries can compare their outcomes.

Materials and Methods

All patients who had undergone TKA at our institution between December 2005 and January 2015 were identified through the MNJR and were included in the present study (Fig. 1). All data presented in the current study were derived from the MNJR. The registry was established in 2005,

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Fig. 1
Current patient flow protocol for the management of patients undergoing total knee replacement and entered into the Malawi National Joint Registry. TKR = total knee replacement, OKS = Oxford Knee Score, MDT = multi-disciplinary team, and TED = thromboembolism-deterrent.

with ethical approval from the Research Ethics Committee of the College of Medicine of the University of Malawi. At the time of the study, 177 primary TKAs in 151 patients (113 women and 38 men) had been performed at BCIH and entered into the registry. The mean age at the time of surgery was 66.2 years (range, 24 to 84 years). Twenty-six patients

(21 women and 5 men) underwent bilateral TKA with staged procedures.

In our review of the database, we identified 9 human immunodeficiency virus (HIV)-positive patients (5 men and 4 women) with a mean age of 60.8 years (range, 49 to 72 years) who had undergone primary unilateral TKA. The indication for TKA was osteoarthritis in 8 of these patients and rheumatoid arthropathy in 1. All but 1 of the patients were aware of their HIV status and had been taking highly active antiretroviral therapy (HAART) preoperatively.

The procedures were performed by 6 different surgeons, and all of the procedures were performed at BCIH. None of the hospital operating theaters had a laminar-flow system. The majority (174) of the TKA procedures were performed for the treatment of symptomatic osteoarthritis. Other indications included osteonecrosis (1 knee); rheumatoid arthritis (1 knee), and sickle-cell arthropathy (1 knee).

A PFC cruciate-retaining prosthesis (DePuy Orthopaedics) with a metal tray and polyethylene insert was used in 171 knees, a PFC cruciate-sacrificing prosthesis (DePuy Orthopaedics) was used in 2 knees, and an AGC prosthesis (Biomet) was used in 4 knees. None of the patients underwent patellar resurfacing. All of the implants were secured with use of Smartset GHV cement with gentamicin (DePuy), and the patients received a single dose of intravenous antibiotic at the start of surgery. The antibiotic that was used was either cefuroxime or, for patients with a penicillin allergy, gentamicin. The majority of procedures were performed with use of spinal anesthesia. The mean duration of hospitalization was 8.2 days (range, 5 to 20 days).

Thromboembolism-deterrent (TED) graduated compression stockings were used, along with low-dose aspirin, for a period of 6 weeks after each operation. All patients were mobilized on the first postoperative day.

After the operation, a senior research nurse, in partnership with a senior surgeon, evaluated all patients at 6 weeks, 3 and 6 months, and annually thereafter. The patients were assessed for pain, postoperative complications, and function with use of the Oxford Knee Score (OKS). In 2015, we introduced recording of the OKS during all of the preoperative and postoperative assessments of patients undergoing TKA. Therefore, in the present study, the postoperative scores were available for all patients but the preoperative scores were available for only some patients.

The surgical wounds and/or scars were inspected and assessed with use of the ASEPSIS wound-scoring system⁵, which assigns a total possible score of 70 on the basis of the appearance of the wound as well as additional treatments required. For the purposes of the present study, a score of >10 was considered to be indicative of an infection, a system that has been approved by National Institute for Health and Clinical Excellence (NICE) in the United Kingdom (U.K.)⁶.

Anteroposterior and lateral radiographs of the knee were made at each follow-up appointment. At the most

TABLE I Demographic Data on Patients in Malawi National Joint Registry

Entered into the Registry*	Lost to Follow-up*	Followed in Registry*	HIV-Positive*	Indication for Surgery†	Type of Implant†
151 (177)	24 (24)	127 (153)	9 (9)	Osteoarthritis (174), osteonecrosis (1), rheumatoid arthritis (1), sickle-cell arthropathy (1)	PFC cruciate-retaining prosthesis (171), PFC cruciate-sacrificing prosthesis (2), Biomet AGC prosthesis (4)

*The values are given as the number of patients undergoing TKA, with the number of knees in parentheses. †The number of knees is given in parentheses.

recent follow-up, the radiographs were reviewed by the first author (S.M.G.), who had not been involved in the surgical procedures and who assessed the images for signs of loosening. For all HIV-positive patients, the CD4 count was rechecked annually.

Malawi has a national policy (established in 2005) of using oral co-trimoxazole (trimethoprim-sulfamethoxazole), at a dose of 960 mg daily, as a prophylactic antibiotic for all HIV-positive patients. No information on compliance with this national policy was available for the present study⁷.

Results

Of the 151 patients (177 knees) who underwent primary TKA, 24 patients (24 knees) were unavailable at the most recent follow-up and were excluded from the analysis (Table I). All 24 patients were seen at 6 months postoperatively, but no further follow-up was available. All 24 patients had undergone unilateral TKA. Of these 24 patients, 16 (11 from Malawi and 5 from Zimbabwe), representing 11% of the original group, died before the latest follow-up, and the remaining 8 (2 from Malawi and 6 from Zimbabwe), representing 5% of the original group, were lost to follow-up. None of the patients died within 6 months after surgery. No revision procedures were performed in any of the patients who were lost to follow-up. None of the patients who were lost to follow-up had HIV. Therefore, 127 patients (98 women and 29 men) with a mean age of 65.3 years (range, 24 to 84 years) who had undergone a total of 153 primary TKAs were included in the final analysis. Of these, 26 patients had had staged bilateral TKA. The mean duration of follow-up was 4 years and 3 months (range, 6 months to 10 years and 6 months).

One patient developed an early postoperative peri-prosthetic joint infection within 6 weeks postoperatively and was successfully managed with early irrigation, debridement, and antibiotic therapy. Methicillin-sensitive *Staphylococcus aureus* infection was identified on the basis of microbiological sampling. One patient developed tibial aseptic loosening at 2 years and underwent successful revision surgery at our institute. Two patients developed late periprosthetic joint infections at 1 year and 3 years postoperatively. One of these patients was managed with implant removal and insertion of a permanent antibiotic cement

spacer at our institute. The other patient underwent revision surgery abroad and subsequently developed an infection at the site of the revision implant. No further revision procedures were performed in any of the patients. Thus, the overall revision rate was 2.6% (4 of 153).

There were no other early complications (≤ 6 weeks postoperatively) or late complications (> 6 weeks postoperatively) such as aseptic loosening, dislocation, symptomatic deep-vein thrombosis, or pulmonary embolism. No other patients had any symptoms consistent with aseptic loosening, such as pain, dislocation, or alteration in the level of postoperative mobility. Furthermore, radiographs demonstrated no evidence of aseptic loosening in any patient at the time of the latest follow-up. The rates of inpatient mortality and overall mortality at 6 weeks and 12 months postoperatively were all 0%. To our knowledge, none of the 16 deaths that occurred later were related to the arthroplasty.

The mean preoperative OKS was 16.81 (range, 4 to 36) for the 48 patients who had available data. The mean postoperative OKS was 45.61 (range, 29 to 48) after a mean duration of follow-up of 4 years and 3 months (range, 6 months to 10 years 6 months). The 4 patients who had > 10 years of follow-up had a mean OKS of 46 (range, 45 to 48), and the 18 patients with ≥ 5 years of follow-up had a mean OKS of 47 (range, 45 to 48).

Of the patients who were HIV-positive, none had any early or late complications and none had died at the time of the latest follow-up. The mean OKS for these patients was 47 (range, 42 to 48), and no patient had symptoms of aseptic loosening at the time of the latest follow-up. All HIV-positive patients were taking HAART at the time of the latest follow-up.

Discussion

The present study demonstrated good short-term results following primary TKA in 127 patients (153 knees) in a low-income country. To our knowledge, this study is the largest such study to date and is the first to evaluate outcomes, complications, and infection rates associated with TKA in a low-income country. The study demonstrated a 0% perioperative mortality rate at 6 months and a 2.6% overall revision rate at a

TABLE II Summary of Studies*

Study	Date	Country	No. of TKAs	Age† (yr)	Sex (no. of patients)	Indication (No. of Knees)	HIV-Positive (no. of patients)
Current study	December 2005 to January 2016	Malawi	153 (101 unilateral, 52 bilateral)	65.3 (24 to 84)	98 female, 29 male	OA (150), ON (1), SCA (1), RA (1)	9
Lisenda et al. ⁹ (2016)	March 2009 to October 2015	Botswana	193 (170 unilateral, 23 bilateral)	64.5 (26 to 86)	NR‡	OA (189), RA (4)	Not stated
Lisenda et al. ⁸ 2016	February 2009 to November 2010	Botswana	58 (51 unilateral, 7 bilateral)	65.6 (46 to 81)	46 female, 5 male	OA (53), RA (5)	0
Niu et al. ¹¹ (2011)	March 2009 to March 2010	Dominican Republic	55 (34 unilateral, 21 bilateral)	Not stated	Not stated	Not stated	Not stated
Mulla et al. ¹⁵ (2010)	1998 to 2010 (months not stated)	Zambia	7	Not stated	Not stated	Not stated	Not stated
George et al. ¹⁰ (2009)	October 2006 to October 2007	Ghana	8 (7 unilateral, 1 bilateral)	Median, 59.3 (48 to 71)	6 female, 1 male	OA (8)	0

*TKA = total knee arthroplasty, HIV = human immunodeficiency virus, OA = osteoarthritis, ON = osteonecrosis, SCA = sickle-cell arthropathy, RA = rheumatoid arthritis, OKS = Oxford Knee Score, PPJI = periprosthetic joint infection, PE = pulmonary embolism, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, and SF-36 = Short Form-36 questionnaire. †The values are given as the mean, with the range in parentheses or as the mean and the standard deviation. ‡NR = not reported. The study did not specify the numbers of male and female patients who had bilateral involvement.

mean duration of follow-up of 4 years and 3 months, with excellent and sustained functional outcomes in this cohort.

The study demonstrated good functional outcomes and low infection rates in a small cohort of HIV-positive patients with no history of hemophilia or intravenous drug use who underwent TKA in a low-income country. Although that subgroup of patients was small, we believe that it is still the largest of its type in the literature to date.

A small number of similar studies have been reported in the literature; however, those studies commonly have involved very small patient cohorts and have included limited data on outcomes and complications⁷⁻¹¹ (Table II). Additionally, of the 5 similar studies known to us, 3 were from Botswana and the Dominican Republic, which are classified as upper-middle-income countries by the World Bank⁷⁻¹¹. The other 2 studies included only 7 and 8 TKAs and were from Zambia and Ghana, respectively, which are classified as middle-income countries^{10,12,13}. Therefore, our results are the only reported from a low-income country¹².

As a low-income country, Malawi has a gross national income (GNI) of ≤\$1,005 per capita, whereas high-income economies have a GNI of ≥\$12,236 per capita, as calculated with use of the World Bank Atlas method¹². Little is known about the indications for TKA in low-income countries and if they are the same as those in high-income countries. In the U.K., osteoarthritis was the sole stated indication for 96% of the 871,472 primary knee replacements that were entered into the National Joint Registry from 2002 to 2016¹⁴. This finding is similar to our experience in Malawi and also to those in other studies from low and middle-income countries⁷⁻¹¹.

A total of 57% of primary knee replacement procedures in the U.K. in 2002 to 2016 were performed in women¹⁴, whereas the MNJR demonstrated a much higher proportion of female patients (77%). Again, the male:female ratio among patients undergoing total hip arthroplasty (THA) in this low-income setting is more balanced². Furthermore, patients in the MNJR were slightly younger than those in the U.K. (mean age, 65.3 compared with 70 years)¹⁴. Although not reported in the U.K. National Joint Registry, it is likely that the MNJR includes a larger proportion of HIV-positive patients who have undergone TKA, as the prevalence of HIV is approximately 9.1% in Malawi¹⁵ compared with 0.16% in the U.K.¹⁶.

The patients in the MNJR had a mean OKS of 45.61 (range, 29 to 48) at a mean of 4 years and 3 months of follow-up, whereas those in the U.K. National Joint Registry had a mean OKS of 39 (range, 29 to 44) at 36 months of follow-up¹⁴. This difference in OKS between the Malawi and U.K. NJR potentially could be explained by varying levels of patient expectation; however, this explanation is speculative and, to our knowledge, this is the first comparison available in the literature.

There has been an increase in the number of primary TJAs being performed by visiting surgical teams in low-income countries, including Malawi. Reports have demonstrated mixed success in association with this approach to health-care provision^{3,11}, with some groups reporting concerning rates of complications¹⁷. These visiting surgical teams may not have the experience of operating in a low-income setting, and, on occasion, no follow-up is provided, even in the short term.

TABLE II (continued)

Duration of Hospitalization† (d)	Inpatient Mortality (no. of patients)	Duration of Follow-up†	Preoperative Outcome Measure†	Postoperative Outcome Measure†	Complications (No. of Patients)	No. of Revisions
8.2 (5 to 20)	0	4 yr + 3 mo (6 mo to 10 yr + 6 mo)	OKS 16.81 (4 to 36)	OKS 45.61 (29 to 48)	Early PPJI at <6 wk (1), late PPJI at 1 yr and 3 yr (2), aseptic loosening at 2 yr (1)	4
7 (4 to 21)	3 (2 cardiac-related; 1 PE)	Until discharged from hospital at 7 days	—	—	Not stated	Not stated
Not stated	2 (both cardiac-related)	Minimum 26 mo (26 to 47 mo).	—	—	PPJI at 6 mo (1), dislocation following fall at 7 mo (1)	1
Not stated	Not stated	1 yr	WOMAC pain 30.5 ± 16.5, WOMAC function 28.0 ± 16.3, WOMAC stiffness 32.0 ± 21.9, SF-36 mental 69.2 ± 14.9, SF-36 physical 13.4 ± 13.1	WOMAC pain 86.8 ± 10.9, WOMAC function 85.9 ± 17.6, WOMAC stiffness 88.0 ± 10.9, SF-36 mental 86.3 ± 16.6, SF-36 physical 73.4 ± 17.9	Not stated	Not stated
Not stated	0	6 wk	—	—	0	0
10 (5 to 12)	0	6 mo (3 mo to 1 yr)	OKS median, 15.5 (5.0 to 26.0)	OKS median, 44.5 (32.5 to 51.3),	Failure of bone-grafting to tibial defect; time point not stated (1)	1

Therefore, it is important to ensure that these patients are followed in registries such as the MNJR. Furthermore, we are not aware of any published reports on TKAs performed by visiting teams in low-income countries; all of the reported results to date have pertained to THAs.

Our 10-year experience with, and short-term results of, primary TKA in a low-income setting show that good results can be achieved and sustained in a controlled hospital environment. Our results provide a benchmark against which other hospitals and registries in low-income countries can compare their outcomes. Currently, the only benchmarks are from high-income countries, which may not be comparable. We encourage other countries in our region to establish joint registries. Comparative registries will highlight strengths and weaknesses in different forms of arthroplasty service, including TJA “camps”, where international surgeons provide visiting arthroplasty services in areas where no services are available. Comparative registries can help to focus training or adjustment of clinical practice, and thus optimize good clinical governance for TJA in the region. Furthermore, pooling the data may allow conclusions about long-term outcomes to be derived earlier. ■

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