Original Article

Total Knee Replacement in A Resource Constrained Environment: A Preliminary Report

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ABSTRACT

Introduction: Total knee replacement surgery is relatively new in Nigeria and available in few centres only. It has been evolving at a slow pace because of the lack of facilities, structures and adequate surgical expertise alongside patient ignorance and poverty. **Objective:** The aim of this article is to review the cases done in a resource constrained institution in Nigeria and report the short term outcomes. **Methodology:** All the patients that were booked for Total knee replacement, using same prosthesis over a 40 month period, were recruited into the study. Using a prepared data tool, information on personal biological information, clinical presentation, peri-operative management, and outcome of management were obtained after an informed verbal consent. All the patients were further followed up for at least one year. **Results:** 45 knees were replaced in 38 patients. The age range of the patients was 41–85 years with a mean age of 62.6. The male to female ratio was 1: 4.4. The indications for surgery were a combination of pain and deformity. All the patients came with varying forms and degrees of angular deformities. Eight knees had bone defects that required bone grafting while 5 knees had tibia extension rods. The commonest complication, which was recorded, was drop foot (8.9%). Knee society pain scores in the patients improved from the average of 21.35 to 83. **Conclusion:** Despite the challenges inherent in health care in developing countries, with proper institutional planning and team work, the short term outcome of arthroplasty in our resource constrained environment is good.

Keywords: *Arthroplasty, developing country, nigeria, total knee replacement*

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Introduction

Total Knee Replacement (TKR) in Nigeria has slowly progressed over the years despite the fact that knee osteoarthritis is common in the country.[1] It is the surgical use of prosthesis to replace a diseased (arthritic) knee joint following unresponsiveness to conservative modalities of treatment. It improves the quality of life of patients with Osteoarthritis of the knee while relieving pain and improving function.[2] It is indicated for disability, pain, limited function from osteoarthritis, rheumatoid arthritis, or any type of arthritic deformity about the knee.[3] Despite the world wide success of this procedure and increasing number of knee replacements done,[4] we have few reports and few numbers of cases done in Nigeria.[5] This may be because our patients have been noted to patronize traditional/ herbal medicine[6] and so do not present early to hospitals. Despite the eventual late presentation with severely degenerated knees, only a few agree to have TKR when indicated, probably because of financial constraints.

The health insurance scheme of the country is yet to be fully functional so patients pay their health bills out of pocket. In a resource constrained country like Nigeria, where more than 50% of the population lives below the poverty line,[7] the cost of TKR without support from the government is unaffordable to many, who desire to have the replacement. The lack of facilities and few surgical expertises[5] in TKR have also contributed to the low rate of TKR in our country. An increase in medical

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tourism in Nigeria,[8] has further depleted the finances that would have been used to develop the health sector. To overcome these limitations in our environment, our institution runs arthroplasty in sessions, following an institutionally designed protocol. The patients counselled for TKR are extensively investigated and reviewed by Physicians, if found to have comorbid problems, to ascertain their fitness for surgery. The surgery involves surgical cuts to excise the articular surfaces of the distal femur and proximal tibia using appropriately sized jigs. Following the cuts, the appropriately sized femoral and tibial components are cemented onto the bone ends with a polyethylene insert in between the components. This article aims to: review patients that had TKR surgery in an institution constrained by limited resources, describe the pattern of presentation, perioperative management, and evaluate the short term outcome of the procedure.

Methodology

It is a prospective study of cases of TKR done over a 40 month period from November 2009 (when it first started in our centre) to March 2013. All the knees, replaced using Johnson and Johnson Depuy PFC sigma system, were recruited for this study. Knees replaced with other prosthesis were excluded as they were quite few. Surgeries were done by different surgeons using the same protocol. The patients are pooled together from the different orthopaedic units, evaluated and prepared by the arthroplasty team. All the knees were done as unilateral procedures. The bilateral knees were done at least three months apart. The surgeries were done in the hospital's Orthopaedic main theatre which is reserved for only clean orthopaedic cases. There is no dedicated theatre for arthroplasty in the hospital. The theatre has no laminar air flow system. Arthroplasty patients are pooled together and surgeries done in batches bimonthly. The theatre is fumigated prior to the commencement of each arthroplasty session and no non-arthroplasty case is done until the session is over. The choice anaesthesia method was *épidural regional anaesthesia*, except a few, that had general anaesthesia because of failed epidural. Pneumatic tourniquet was used for all the patients apart from 2 where the tourniquet failed soon after the procedure started. The inflation pressure was 150 mmHg above the systolic blood pressure of the patient. In the event of the procedure lasting more than 3 hours, the tourniquet was either discontinued or deflated and re-inflated after 20 minutes, while the surgical wound was packed firmly with gauze during the interval. All the knees were accessed through a medial para-patella incision. The posterior stabilized (cruciate sacrificing) prosthesis was used in all the patients because of the extent of the state of the cruciate ligaments. All the prostheses were cemented with Palacos antibiotic impregnated bone cements, which were vacuum, mixed. Redivac drains were used in all the wounds and staples used for the skin. The patients were managed in a particular ward reserved for arthroplasty patients within the periods of arthroplasty sessions. The ward was prepared prior to each arthroplasty session by moving out other in-patients (strictly clean surgical cases), fumigating and thoroughly cleaning out the ward. All the patients, post-operatively, received subcutaneous enoxaparin 40mg daily for a period of 2-3 weeks, and subsequently oral DVT prophylaxis for another 3 weeks at home. Prophylactic antibiotics (ceftriaxone and metronidazole) were used in all the patients. They all received the same rehabilitation protocol for TKR from our physiotherapy department, which include early mobilization, quadriceps strengthening, and knee extension and flexion exercises from the first day post surgery. The department does not have a continuous passive motion machine and so passive motion is achieved manually by the physiotherapists. The patients were discharged from the 14th day and were all followed up for a mean period of 2.7 years (range of 1.1-4.3 years). They were all reviewed at 6 weeks, 3 months, 6 months and yearly in the arthroplasty clinic at the outpatient department. The data collected for the study included demographic data, aetiology of the pathologic knee, deformities present, co-morbidities, intra-operative details and components used, peri-operative care and the outcome of surgery. The outcome was assessed using the Knee Society Scoring System[9] and the complication rates. Descriptive analysis of data was done using the version 16 SPSS. The work was approved by our Institutional Review Board.

Results

45 knees were replaced in 38 patients. 7 patients had bilateral knee replacement. The age ranged from 41-85 years with a mean age of 62.6 years. 57.8% of the patients were aged 61–70 years [Table 1]. 7 males and 31 females were treated, giving a ratio of 1: 4.4. The Body Mass Index of the patients ranged from 24–39 kg/m^2 with a mean of 31.5kg/m^2. At presentation, all the patients had continuous and progressive pain, [Table 2], which were unresponsive to conservative management. Primary osteoarthritis [Figure 1 a,b] was the indication for the TKR in 34 knees (75.6%) while 11 TKR's were done on knees with secondary arthritis following previous trauma (9) or surgery such as high tibia osteotomy (2).

All the patients had angular deformities of the knees. Varus deformity ranging from 10-45 degrees was seen in 23 (51%) knees, while 22 (49%) had valgus deformity ranging from 10-50 degrees. 6 patients with valgus

Table 1: Age range

Age range	Number	Percentage
≤ 40	0	0%
41–50	3	6.7%
51–60	12	26.7%
61–70	26	57.8%
71–80	3	6.7%
81–90	1	2.2%

Table 2: Duration of pain prior to presentation at the arthroplasty unit

Duration of pain	Frequency n (%)
1–5 years	16 (42.1%)
6–10 years	5 (13.1%)
11–15 years	7 (18.4%)
16–20 years	5 (13.1%)
20 years	5 (13.1%)
Total	38

deformity (27.3% of valgus knees) had bone defects on the lateral tibia plateau [Figure 1c]while 2 (9% of the varus knees) had defects on the medial tibia plateau that were bone grafted. Thus 8 (18%) knees had bone defects that required bone grafting. Bone defect grafting was done with morsellized autografts in 3 (37.5%) of the 8 knees, while structural autografts were used in 5 (62.5%) knees. The structural bone grafts were fixed to the defect with one or two screws [Figure 1d]. 5 knees (11.1% of the total number of knees) needed Tibia Extension Rods (PFC modular fluted rods) [Figure 1e] for stabilization due to significant compromise of the plateau secondary to bone loss from the existing deformities.

Figure 1a: x-ray of patient with bilateral primary knee osteoarthritis

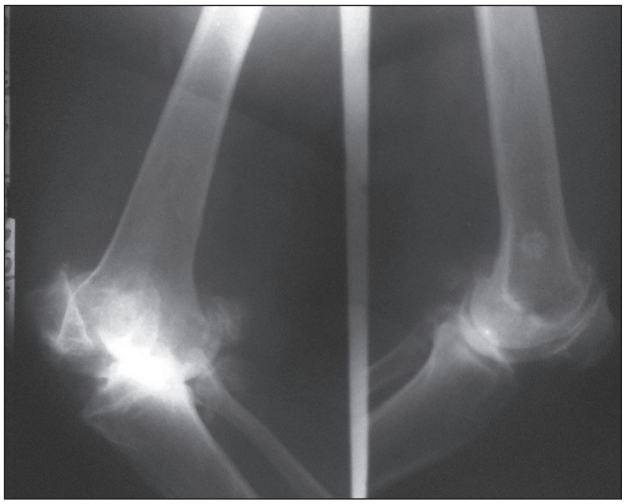

Figure 1b: x-ray (lateral view) of patient with bilateral primary knee osteoarthritis

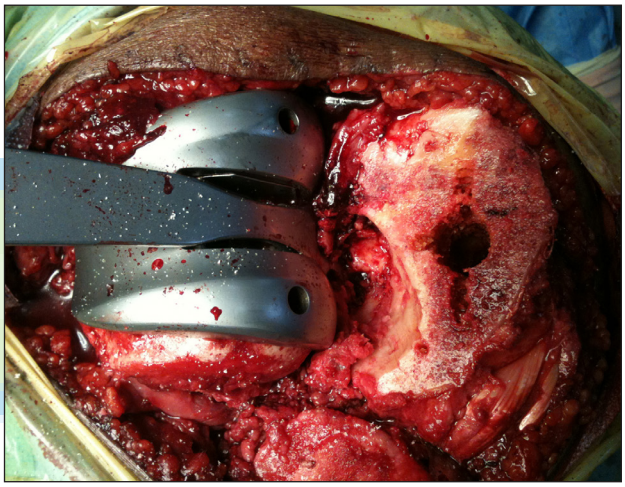

Figure 1c: Intraoperative picture of right knee with an uncontained defect of the lateral tibia plateau posteriorly

Figure 1d: Fixation of a structural autologous bone graft into the defect with a screw

Figure 1e: Post operative x-ray of total knee prosthesis with an extension rod and the autologous graft with screw insitu

24 (53.3%) knees had marched (same size) femoral and tibial implant components, while 21 (46.7%) knees had different implant sizes in the femur and the tibia. The tibia was down sized (one size smaller than the femoral component) in 5 (11.1%) knees; and the femur down sized in 16 (35.6%) knees.

Table 3: Complications

Type of Complications	Number of knees
Common peroneal nerve injury with foot drop	4
Persistent limb oedema	1
Sacral pressure sore	1
Fibula fracture	1
Superficial infection	2
Deep seated infection	1
Urinary tract infection	2

Patella resurfacing was done in 22(57.9%) patients. One patient with bilateral TKR had both patellae resurfaced while 3 with bilateral TKR had only one patella resurfaced. In 16 (42.1%) patients, the patella was not resurfaced, but had osteophytes excised.

Pre-operative haemoglobin levels ranged from 9.1–16.0g/dl with a mean of 13.1g/dl. The post-operative haemoglobin level ranged from 5.7–10.8g/dl (mean, 8.61g/dl). The estimated total blood loss intra operatively was 200–1500ml (mean 365ml). 50 % of the patients were transfused with an average of 2 units of blood. Duration of surgery ranged from 2.00 hours to 4.00 hours (mean, 3.27). Post-operative drainage from the closed redi-vacuum drain averaged 500ml in first 24 hours; reducing over the next 3 days until drain removal at ≤ 50 ml. Average duration of post op wound drainage is 3.6 days. The most common

Table 4: Constraints

Our constraints	Ideal setting	How we overcame our constraints
No dedicated theatre for arthroplasty	Dedicated theatre suites for arthroplasty	We pool patients and operate on them as a batch within the week after fumigation of the theatre/ ward.
No laminar air flow theatre	Lamina air flow theatre	We close the theatre to other cases, fumigate for 48 hours, clean and operate on all the pooled cases.
No dedicated ward for arthroplasty	Dedicated arthroplasty ward	We relocate non arthroplasty patients from a particular ward used, fumigate and clean in preparation for their admission. We do not allow relations/ non relevant staff into the ward.
Paucity of skilled manpower	Adequate personnel trained in arthroplasty at all levels down to orderlies.	We work as a team and train paramedics as we proceed while consciously limiting the number of staff/ students in the operating room.
No Continuous passive motion (CPM) machine	CPM machine used early in rehabilitation and to prevent deep vein thrombosis.	Manual rehabilitation by the physiotherapists
Unavailability of some useful haemostatic agents	Some centres use intravenous Tranexamic acid, intraarticular clonidine and some other drugs not readily available here for intraarticular cocktail to control post-operative bleeding.	We use closed drains for post op collection of haematoma.
Paucity of trained physiotherapists in TKR rehabilitation, and paucity of rehabilitation centres in the region/country.	Physiotherapists and rehabilitation centres readily available for home care.	Longer stay on admission to benefit from post op rehabilitation.

complication noted was foot drop [Table 3]. All the patients with foot drop had severe valgus deformities that ranged from 20–50 degrees, and had complete recovery within a year as they all had neuropraxia. They were managed with physiotherapy, nerve stimulation and neurotropic drugs. 12 (31.6%) patients were hypertensive, 1 had diabetes mellitus, 3 had both hypertension and diabetes, while 1 had peptic ulcer disease. Thus, 17 (44.7%) patients had associated serious co-morbidities and three had more than one co- morbidities.

Using the Knee Society Score, the average pre-op knee score was 21.35 (range of 0–51); the average functional score was 42 (range of 0–80), while the average post op knee scores at one year follow up were 88 (60-100) and 81.7 (45-100) for function. There was no mortality recorded. Our constraints and how we were able to overcome them are listed in Table 4.

Discussion

The absence of ideal infrastructure and equipment alongside deficient surgical expertise and the cost of the surgery are the reasons many hospitals in Nigeria have not established arthroplasty units yet. Nevertheless, some few hospitals like ours commenced offering arthroplasty services in spite of the challenges and constraints, hence this report from the institution.

The majority (66.7%) of the patients that had arthroplasty in our series were over 60 years and this is similar to what was reported by Tateishi.[10] In our series, more females had TKR than males, possibly because women are more prone to osteoarthritis than men,[11] similar to report from South Korea national registry.[12] The mean body mass index of the patients in our study was comparable to a work done in Jordan by Hawamdeh.[13]

A significant number of patients, 22 (57.9%), presented after they have had pain for more than 6 years. Several factors may contribute to this late presentation and these include:

- Preference for patent medicine dealers where they have direct access to the dealers and their drugs, without having to pass through the long protocols of hospitals.
- Cultural beliefs, which encourage unorthodox health care patronage, and the recent trends of religious/faith healings.
- Beliefs, that knee pains and deformities are part of the aging process and the patients tend to accept them until they become immobile.

They also tend to patronise the traditional bone setters because of cheap treatment and accessibility and only come to hospitals when these treatments have failed.[14] By the time they are presenting to the Orthopaedic Surgeons, the pathology has become complex with severe degeneration, stiffness, deformity, and instability unresponsive to conservative management. Thus, arthroplasty becomes the only veritable option. Yet, the cost of TKR in Nigeria is unaffordable to many people who need this service, as health insurance does not cover the cost and the medical bills of the patient.

Most of our patients had primary osteoarthritis, which also happens to be the commonest reason for a TKR.[4,5] All the patients had angular knee deformities probably due to late presentation, thus, allowing childhood angular deformities to subsist till adulthood, which predisposes to osteoarthritis. The long term outcome of TKR in these patients with angular deformities in our series is yet to be determined. Some workers have, however, shown that there is no significant difference in the outcome of TKR in patients with angular knee deformity ≥ 20 degrees and patients without angular deformity. Therefore, such patients should not be denied TKR solely because of the deformity.[15] The valgus knees in our series posed some technical difficulties with release of the lateral structures via a medial parapatellar approach. This is a common problem and has made some surgeons propose easier ways of managing valgus knees.[16]

We utilize structural autologous bone graft from cut outs from the femur for severe bone defects in the tibia. These were contoured to fit into the defect and fixed with the paediatric screws similar to other works.[17] For smaller contained bone defects, we impact morsellized autogenous bone graft before cementing in the prosthesis.

46.7% of the knees had different sizes of components used for the tibia and femur with no negative outcome. Some works show that combination of two implant sizes within limits as recommended by prosthetic company confers no disadvantage.[18] Patella resurfacing was done for the patients with severe patellofemoral involvement. The others with mild to moderate involvement with some cartilage cover had excision of the osteophytes. So far, we have not noted any significant difference in outcome; even in patients with bilateral TKR who had one knee resurfaced, while the other patella remained un-resurfaced. Work by some authors[19] showed no significant difference in outcome of anterior knee pain and patient satisfaction in those with and without patella resurfacing. Yet, some report that patellar resurfacing reduces the risks of reoperation and anterior knee pain after total knee arthroplasty.[20] Excision of osteophytes was done in 42.1% with early patellofemoral involvement. Some studies have reported better outcome in respect to anterior knee pain, clinical and radiological results, when patella denervation with electrocautry is compared with only osteophyte removal on the contra-lateral knee performed during single-stage bilateral TKR.[21]

Posterior stabilized semi constrained knee prosthesis were used in all our patients as the patients came late with unstable knees and degenerated or ruptured posterior cruciate ligaments. Therefore, retaining the posterior cruciate ligament was not an option.

The blood loss seen in our series is similar to a report from Bombay hospital, India.[22] We did not use any chemical modality to reduce intra operative blood loss. We used diathermy to coagulate bleeders and subsequently applied firm bandaging and elevation of limb. The indications for the transfusion in this study are significant intra operative blood loss (>1000ml) or a post op haemoglobin level ≤ 9.0 grams. The duration of surgery is prolonged because the procedure is new in our setting and the learning curve is being developed. The length of surgery is likely to contribute to the intra operative blood loss and can predispose our patients to infection as some work had reported.[23] We had recorded only one case of deep seated infection in a diabetic with post-operative poor glycaemic control. She had wound debridement, irrigation and parenteral antibiotics based on sensitivity which resolved the infection. Our study recorded a high incidence of common peroneal nerve injury (8.9%). This is higher than what was recorded by other workers.[24,25] The reason for this finding may be a combination of the valgus deformities noted and prolonged tourniquet time of 2-3 hours with varying pressures of 300-350mm Hg, as there are reports that pressures > 300mmHg for > 120 minutes may be enough to produce transient neuropathies.[26] The complications following TKR are not unexpected and Healy *et al.*[27] have reported 22 complications and adverse events, that they believe are important for reporting outcomes of TKA. The complications contribute to poor outcome of the procedure and should be reduced to the barest minimum and also treated early. 44.7% of our patients had co morbidities, which had been noted to influence the outcome of TKR as they can contribute to morbidity and mortality following the surgery.[28] The average post-operative knee scores are somewhat similar to other reports,[29,30] but our pre-operative knee scores are low compared to other studies.[29,30] This may be as a result of late presentation of our patients who do not come until the pain becomes intolerable, limiting function despite medication. Our post-operative knee scores are, therefore, satisfactory in the short term.

TKR in resource constrained institutions is possible with careful planning and re-organisation of available resources and facilities. Subspecialty training in arthroplasty and government health policies, that will increase funding for arthroplasty in Nigeria, is needed. Most of the patients seen in Nigeria and other African 3rd world countries come late with complex primary joints. Creation of awareness of this means of treatment of advanced Osteoarthritis and the need for patients to present early is recommended. This is likely to reduce the incidence of deformities and complexities of the knees presenting, as well as increase the number of TKR's done. This will generate more resources for the institution and significantly improve the lives of the citizenry. While we await the long term outcome, this procedure should be encouraged and understudied bearing in mind the peculiarities of our sub region. In addition, training and establishment of revision knee arthroplasty should be initiated.

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Conflicts of interest

There are no conflicts of interest.

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