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Case Study

PATIENT OUTCOMES AFTER RETROGRADE KNEE FUSION WITH LONG INTRAMEDULLARY NAILING: A RETROSPECTIVE CASE SERIES FROM KUMI ORTHOPAEDIC CENTER

John Ekure[1], Naomi Amuron[2], Douglas Kilama[3], Phillip Bulu-ma[4], Bashir Masembe[5], Saviour Kicaber[6], Faith Akello[7]

1MMed in Orthopaedic Surgery, Kumi Orthopaedic Center, Uganda
2MMed in Orthopaedic Surgery, Soroti University, College of Health Sciences, Uganda
3 MMed in Orthopaedic Surgery, Kumi Orthopaedic Center, Uganda
[4] MMed in Orthopaedic Surgery, Kumi Orthopaedic Center, Uganda
5 Bachelor of Medicine and Bachelor of surgery, Kumi Orthopaedic Center, Uganda
6 Bachelor of Medicine and Bachelor of Surgery, Kumi Orthopaedic Center, Uganda
7 MSc in Clinical Epidemiology and Biostatistics, Kumi Orthopaedic Center, Uganda

***Corresponding author**
Faith Akello, MSc in Clinical Epidemiology and Biostatistics, Kumi Orthopaedic Center, Uganda

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Abstract

Knee arthrodesis is one of the last options available to obtain a stable and painless knee in a patient with a damaged knee joint that is not amenable to other surgical procedures. Primary stability in arthrodesis of the knee can be achieved by external fixation, intramedullary nailing or plate fixation. Each method has different features and results. The purpose of this study was to investigate the success of fusion with retrograde knee fusion technique and to evaluate the satisfaction of patients who underwent the procedure.

Methods: This was a retrospective case series of 3 patients who had retrograde knee fusion done. These were all males aged 13, 28 and 34 years and were followed up for at least one year. Clinical and radiographic evaluations were performed including examination of the patients' quality of life using the MOS SF-36 questionnaire.

Results: Knee fusion rate achieved was 3/3(100%).All patients could walk at least outside the house. Activity of Daily living independence was achieved by all the patients with all patients scoring at least 50% and above in all the 8 domains of quality of life assessed. Physical functioning mean score of 70%, role limitations due to physical health problems mean score of 50%, bodily pain mean score of 83.75%, general health mean score of 72.5%, vitality mean score of 75%, social functioning mean score of 93.75%, role limitations due to emotional problems a mean score of 100% and mental health mean score of 100%.However, patients had a mean limb length discrepancyof 5.5cm. There was no complication reported within one year of follow up.

Conclusion: We observed that retrograde knee fusion approach achieved successful knee fusion in all the patients with degrees of pain relief and functionality. Its therefore a valuable salvage procedure with acceptable clinical results. Nevertheless, further studies are needed to compare different fusion techniques and subsequent outcomes so as to help advise on the most effective approach.

Introduction

Knee arthrodesis is an important procedure in limb salvage procedures [1,2]. Knee fusion is most commonly required for cases of chronic infections especially when the patient is immunocompromised, the infection is polymicrobial, or the organism is particularly virulent or resistant to antibiotics [3]. It is also useful in failed total knee revision arthroplasty or in some cases of failed primary total knee arthroplasty, severe trauma such as complex fractures with major skin and soft tissue loss, open dislocation of the knee, neuropathic arthropathy, massive bone loss secondary to bone tumors and infected knee joints like in peripheral joint tuberculosis and septic arthritis.

There is a variety of ways to achieve knee fusion.Each of these techniques have their own advantages and disadvantages but none has been shown to be clearly superior over the other [4,5]. One method is external fixation, which can be monoplanar, biplanar, or circular. Advantages to this technique include lack of intra-medullary infection dissemination, ability to modify alignment, and possibility of simultaneous lengthening [6]. However, disadvantages include pin loosening, pin site infection, difficulty with placement, and delayed weight-bearing [7,8]. Knee fusion can also be achieved with compression plating. This technique allows for a single incision and immediate compression intraoperatively but often requires extensive soft-tissue stripping, pro- longed limited weight bearing, and

knee stabilization [9,10].

Knee arthrodesis is also done by IMN fixation. This is a commonly preferred method because it allows for rigid fixation, early weight bearing [11], and seems to have quicker fusion and lower complication rates than the other techniques [7,11,12]. Intra-medullary fusion is achieved typically with either long monoblock or modular nails. [2,13,14].

In knee intramedullary arthrodesis, surgeons commonly use long intramedullary nails inserted antegrade through the trochanteric region or shorter pre-contoured /modular nails introduced through the knee. At Kumi Orthopaedic Center, the surgeons use long intramedullary nailing inserted retrograde through the mid-point of the tibial condyles through the knee into the distal femur. However, there is hardly any data documenting patient outcomes following this approach of knee fusion. This study therefore aimed to evaluate the outcomes of this fusion technique.

Methods

This was a retrospective case series of 3 patients that had been treated with knee arthrodesis using the retrograde knee fusion approach at Kumi Orthopaedic Center.

Mbale Regional Referral Hospital Research and Ethics Committee and the Uganda National Council for Science and Technology granted ethical approval. Informed consent was sought from the participants above 18 years of age and assent was sought from the 13-year-old participant. This study included all patients that had retrograde knee fusion procedure with a follow up of at least one year. Indications for knee fusion were failed total knee arthroplasty in one, severe trauma in another and avascular necrosis of femoral condyles with flexion knee contracture in another.The primary outcome was radiographic fusion at ≥12 months. The secondary outcomes assessed included complications, limb length discrepancy, outdoor ambulation ability and patient reported post-operative outcomes assessed by SF-36 domains. Radiographic fusion was defined by bridging trabeculae and absence of pain/motion assessed by a single surgeon.Data on pre-operative QOL was not collected. The post-operative QOL was assessed using the SF-36 questionnaire scored using the standard scoring algorithm with scores ranging from 0 to 100. The higher scores indicate better health and a mean score of 50 was considered average.

SurgicalTechnique

Our surgical technique utilized an incision delineated from 2cm above the patella to the tibial tubercle after surgical site preparation. Medial para-patella approach was used to expose the knee. The femoral condylar articular surfaces are osteotomised in the total knee sequence (Figure A). The tibial articular surfaces are also osteotomised to remove cartilage and all debris. In case of infection or tumors, the debris are taken for gram staining,culture, sensitivity, and histology. The knee is washed out either with either normal saline or clorpactin or 10% povidone iodine.

A medial incision is made 2cm distal to the tibial tubercle on the antero-medial surface of the leg (Figure B). Using a 6.5mm drill, an oblique drill hole is made into the medullary cavity of the tibia (Figure C).An awl is used to widen the drill hole through 90 degrees clockwise and anticlockwise turns in the proximal direction (Figure D). The starter reamer (size 7mm) is now introduced through the medullary cavity (Figure E).It is driven through the cut end of the proximal tibia and it should exit at the mid-point of the tibial condyles (Figure F).

The knee is angled at about 5-10 degrees of knee flexion and then the reamer is used to perforate the distal femur (Figure G).It is allowed to continue in a proximal direction into the femoral medullary cavity.The procedure is repeated using different reamersizes 8mm, 9mm…etc. in a progressive manner until chatter is heard. The nail size is determined by the size of the last reamer used (2mm less).The length of the nail should at least extend to the mid femoral shaft.

If using a fin nail, it should extend to the isthmus and in cases where a fin nail is used, the locking is only done on the tibial side(Figure H). When the standard nail is used, locking is done both on the proximal and distal ends. Where necessary, bone grafting is done and wounds are then washed and closed in a standard fashion using vicryl no 2 and nylon no 1(Figure I).


A


B


C


D


E


F


G

H

I

Results

There were three participants recruited for this study. All were male aged 13 years, 28 years and 34 years at time of the fusion procedure. Of these, one had history of failed total knee arthroplasty, one had severe trauma to the articular surfaces of the tibia and one was immunocompromised with avascular necrosis of the femoral condyles with flexion knee contracture. All patients were followed up for at least one year (Table 1).

Table 1

Patient	Age	Sex	Indication	Co-morbidities	Follow up duration (months)	Complications	Final status
1	13	M	Flexion knee contracture	Sickle cell	16	Limb length discrepancy	Fused knee, no crutches needed
2	28	M	Closed right knee injury	None	12	Hematoma, limb length discrepancy	Fused knee, no crutches needed
3	34	M	Failed knee arthroplasty	None	24	Limb length discrepancy	Fused knee, no crutches needed

Both clinical and radiographic fusion was achieved in all the three patients with no history of repeated surgery. No infections occurred within 12 months following surgery; one patient developed a superficial hematoma around the wound that resolved. There was also limb length discrepancy of approximately 5.5cm noted in all the participants. This was measured clinically and was corrected by shoe lift. The quality of life survey showed that all the participants on average had a good quality of life with each domain scoring above average as indicated in the table below:

Table 2: Quality of life assessment using the MOS SF-36 questionnaire

Parameter	Mean raw score	Mean raw score(0-100 scale score)
Physical functioning	24	70
Role limitations due to physical health problems (RP)	6	50
Bodily pain (BP)	10.375	83.75
General health (GH)	19.5	72.5
Vitality(VIT)	19	75
Social functioning (SF)	9.5	93.75
Role limitations due to emotional problems (RE)	6	100
Mental health(MH)	27.5	90

The highest scores were noted in social functioning (93.75%) and role limitations due to emotional problems (100%) and the lowest scores were seen in role limitations due to physical health (50%) and physical functioning (70%) (Table 2).

Discussion

This study retrospectively reviewed three patients who had knee fusion done with intramedullary nailing with retrograde approach. The fusion rate was 100% (3/3) with no major patient complication recorded. These results suggest that this is a satisfactory technique for limb salvage is the various clinical scenarios.

This fusion rate is comparable to that found by other various studies assessing knee fusion outcomes with an Intra-medullary nail. A study evaluating the efficacy of using the SIGN nail for knee fusion found that all the 6 consecutive patients had clinical and radiological evidence of fusion after a final mean follow-up of 10.7 months [15]. A consecutive series of 18 patients in the USA with chronically affected TKA treated with arthrodesis using a long antegrade intramedullary nail also found a high fusion rate of 94% [3]. Another study also carried out in the USA found a high fusion rate of 96% among patients who underwent knee arthrodesis with intramedullary nailing technique [7]. A mono centric retrospective study of 48-knee arthrodesis in Switzerland between 2000 and 2023 got a fusion rate of 89.6% in patients with failed knee arthroplasty due to infection [1]. However, in all the above studies, the surgical approach was not explicitly specified whether antegrade or retrograde.

The leg length discrepancy in this study was 5.5cm among all the participants. This is similar to the findings in a study on 12 patients in the USA who underwent arthrodesis after removal of a prosthesis because of infection, which also found a leg length discrepancy of 5.5cm among its patients [16]. In Spain, a study by Aparicio G et al on 45 patients found that successful fusion was achieved in 91.1% of the participants but with a mean limb length discrepancy 0f approximately 2.4cm [17].

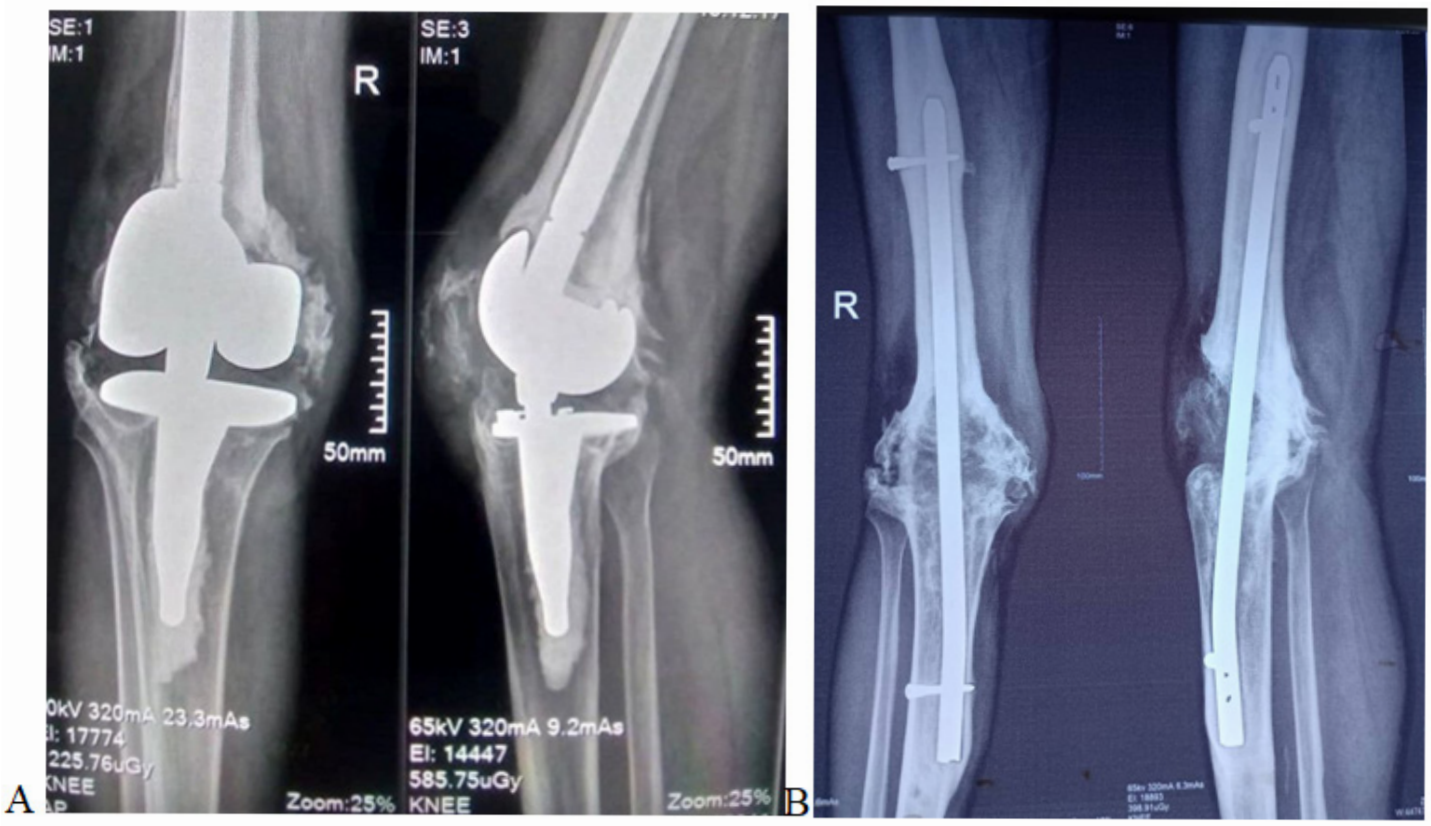
The study also showed that the participants' quality of life is better following the surgery. However, pre-operative quality of life was not assessed making it difficult to assess the magnitude of change in the quality of life among the participants.

The limitation to this study was that it was a retrospective study therefore most likely to have missing data, although this is a very rare procedure, so prospective data collection is difficult to collect on time. There was also no comparator to help strengthen our results. The sample size is also too small to provide conclusive findings limiting the generalizability of these findings.

Conclusion

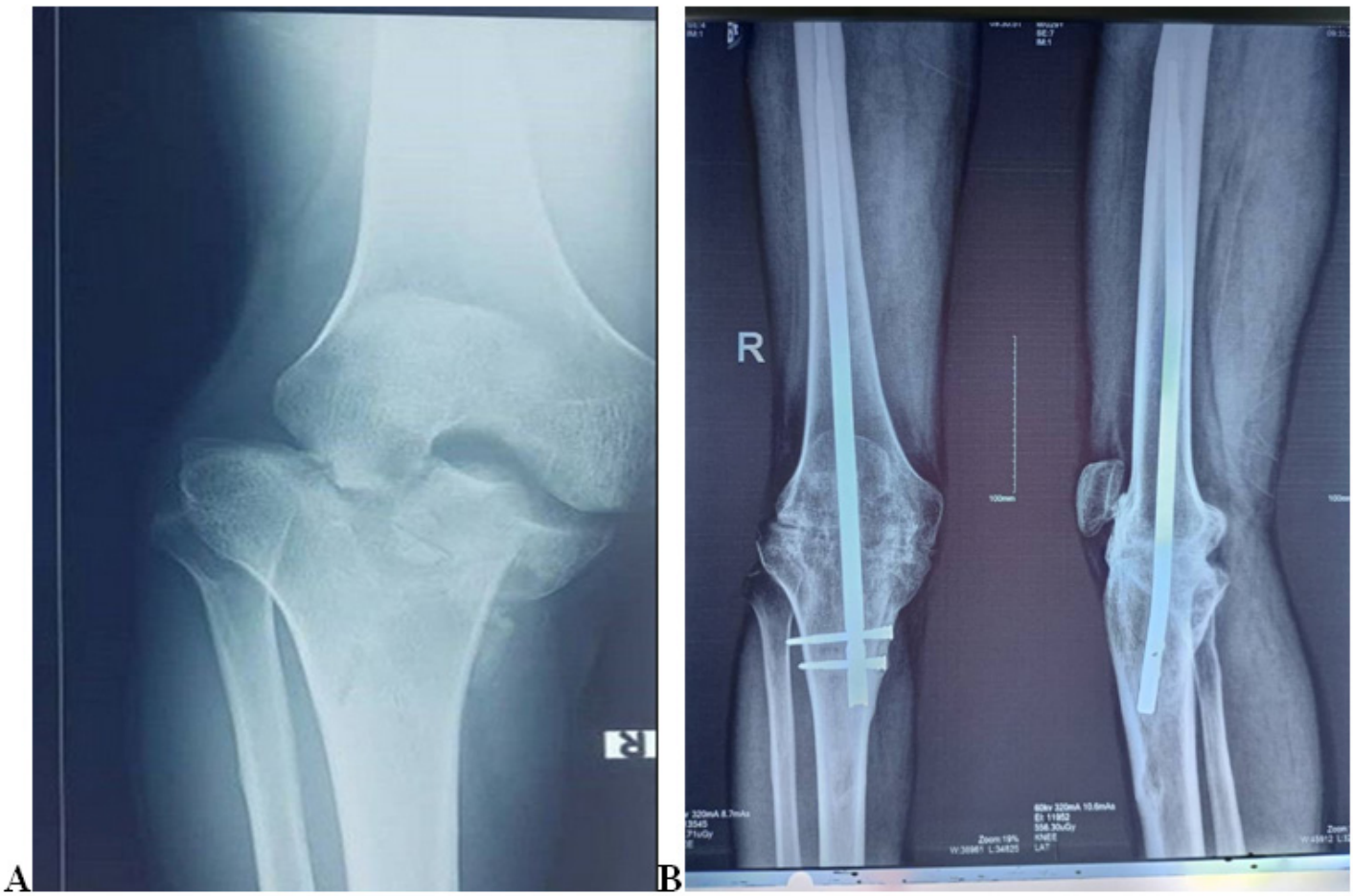
Knee arthrodesis with a long intramedullary nail using the retrograde approach is a suitable alternative to the antegrade approach with a high successfulfusion rate for the various clinical scenarios indicative for knee fusion as a salvage procedure.

Case 1



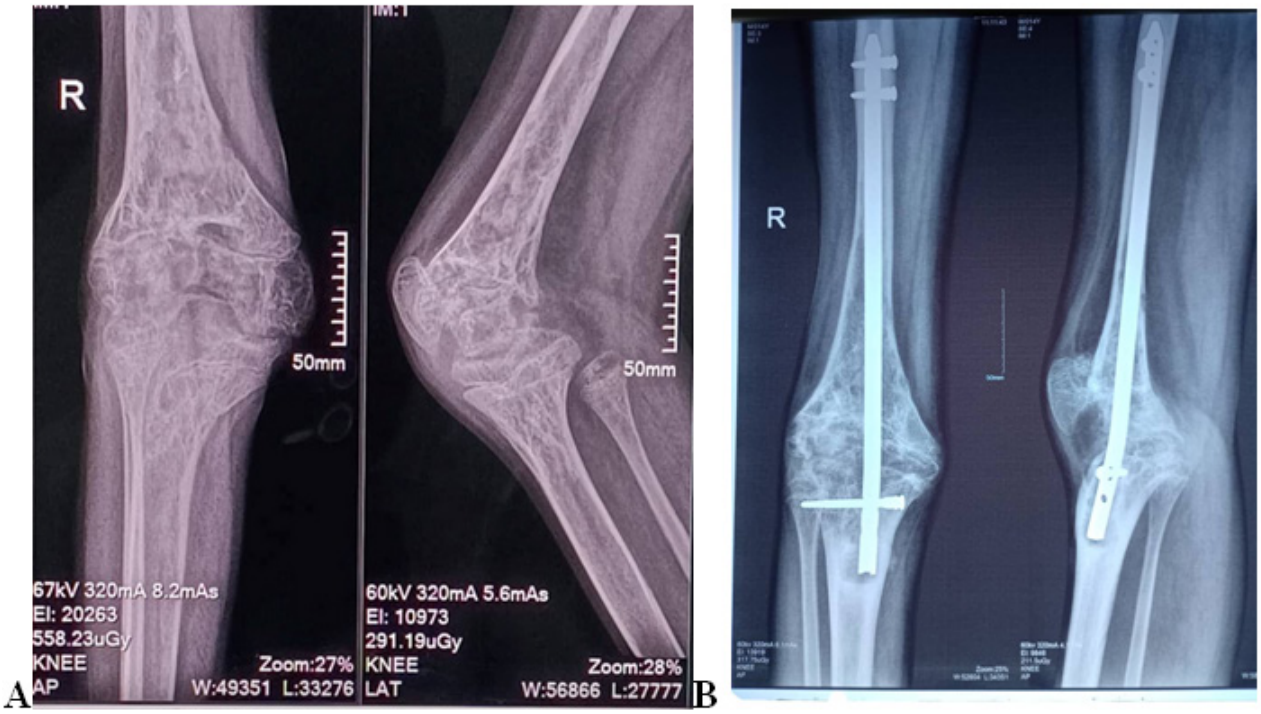
A) A 34-year-old male with failed total knee arthroplasty in the right knee. B) Patient at 24 months follow up with knee fusion achieved.

Case 2



A) A 28-year-old with a closed right knee injury following a fall. B) Fusion at 12 months follow up.

Case 3



A) A 13-year-old sickle cell patient with a flexion contracture. B) Fusion at 16 months follow up.

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Conflict of interest
We do not have any conflict of interest to disclose.

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