

COMPARISON OF CLOSED FEMUR FRACTURE: SKELETAL TRACTION AND INTRAMEDULLARY NAILING COST-EFFECTIVENESS

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ABSTRACT

Background: Fractures of the femur are common injuries affecting the productive age group. Skeletal traction is the mainstay of treatment in Kenya, hence comparison with operative management, to determine which is more cost-effective. To our knowledge no similar study has been done in Africa.

Objective: To determine the cost-effectiveness of skeletal traction compared to intramedullary nailing.

Design: Prospective conventional sampling analytical study.

Setting: Hospital based study in a referral and teaching institution - Kenyatta National Hospital, orthopaedic wards.

Study population: Patients admitted at Kenyatta National Hospital with diaphyseal femur fracture aged between 18 – 50 years. The study was done from October 2012 to May 2013.

Materials and methods: A structured data collection sheet was used. It included the patient particulars, hospital stay and per diem cost, the type of injury, type of management and comparing the cost of each, X-ray findings during treatment and at 3 months to assess for union. Data was represented in form of tables, and figures.

Results: Males were more affected than females, with a mean age of 31.5 years. The mean length of hospital stay was 11.48 days for the operative group and 66.7 days for the skeletal traction group. The average total hospital cost for the operative group was Kshs 54, 380.44 (US\$640) compared to Kshs 67,792 (US\$798) for the traction group. In the operative group 24 patients had union with one delayed union while in the traction group 12 patients had union, 9 with mal union and 4 delayed union.

Conclusion: Intramedullary nailing is more cost-effective than skeletal traction. It met the dominant strategy, because it was significantly less costly than skeletal traction, with a better outcome.

INTRODUCTION

Fractures of the femur shaft are very common injuries sustained following trauma (1- 3). The main cause of trauma in our country is road traffic accidents, which have been on the increase from 10,300 in 1990 to 17,400 in 2009, of the reported cases (4, 5). These injuries mainly affect people in the productive age group, between 20 – 40 years, with men more affected than women (1,6).

Fractures of the femur take approximately 6-12 weeks to unite and 16-24 weeks to consolidate (7). In Kenya, conservative management, mainly skeletal traction remains the mainstay of treatment, a pattern seen in most developing countries (2). In developed countries this method has been obsolete for roughly the past forty years (8, 9).

Skeletal traction leads to prolonged hospital stay and has more complication rates in comparison to operative management (7). The operative options for the management of closed femoral shaft fractures are; Intramedullary nails (K-nails, interlocking nails), plates and screws. The two treatment options result to eventual healing of the fracture. The question has been which one to adapt of the two treatment methods that will have better benefit to the patient and the

hospital in terms of cost and outcome. Therefore, a cost-effectiveness analysis study is necessary to come up with the best way of management of femoral shaft fractures.

Cost-effectiveness analysis study is the most commonly utilized full economic health analysis. It has been used to compare different treatment modalities in the various medical and surgical fields. Cost –effectiveness analysis is a fairly new concept in the medical field (10). It has been found to be useful especially in formulation of policies. An intervention is said to be more cost effective if:-

- (i) It is less costly with an equal or better outcome, hence the preferred method of treatment (10,11).
- (ii) It is less costly with a worse outcome, but the added benefit of the alternative is not worth the extra cost (12,13).
- (iii) It is more costly with better outcomes, and the added benefit is worth the extra cost (12,13).

Little has been done on cost effectiveness of skeletal traction compared to open reduction and internal fixation of fractures of femoral shaft with majority of the work done in the paediatric age group (14,15). In Cambodia a cost-effectiveness analysis study was done comparing skeletal traction and intramedullary nailing using the SIGN nail model (12). There is no

documentation in Kenya and Africa showing the cost implications of skeletal traction compared to intramedullary nailing.

MATERIALS AND METHODS

This prospective study included all the patients aged between 18-50 years admitted with closed fracture of one femur shaft, in the three orthopaedic wards at Kenyatta National Hospital. This was done over a 6 month period.

Convenience sampling was used to assess patient data. Patients were recruited depending on the default management to avoid bias. Patients already on traction were followed up to 3 months and patients who were operated within one week were included in the operative group. Radiological examination in this case the X-rays of the affected limb were taken:

- (i) On admission
- (ii) At 2 weeks, for patients on skeletal traction to ascertain whether reduction was proper and maintained.
- (iii) Skeletal traction also at 8 and 12 weeks to observe for adequate radiological evidence of fracture healing and at 3 months.
- (iv) Surgery patients, post operatively to assess for success of operation and at 3 months.

Patients with multiple fractures, co morbidities, mentally disturbed, pregnant, pathological fractures and those who were operated before 3 months on traction elapsed, were excluded from the study.

A structured data collection sheet was used. This included the patient particulars, hospital stay and per diem cost which were inclusive of bed charges, meals, nursing care and doctor visits. The type of injury, type of management and comparing the cost of each, X-ray findings during treatment and at 3 months to assess for union. Data was represented in forms of graphs and charts.

Data collected was analyzed using SPSS 17.0. Patients were not matched for age because they have the same healing characteristics hence the same expected outcome measure. The means generated from the study were compared using the student t-test. A p-value of 0.05 was used.

RESULTS

Data was collected for 50 patients, 25 for the skeletal traction group and 25 patients who underwent surgery (intramedullary nailing). Follow up was done for upto 3 months. There was no loss to follow up. Males were more affected than females, with 45 males affected compared to 5 females. The mean age was 31.5 years in both groups with majority of the patients (26 patients) between the ages of 18 – 30 years and the least affected between the ages of 41 – 50 years as demonstrated in Figure 1.

Figure 1

The number of patients between the three age groups for both groups. On the x-axis is the number of patients and on the y-axis the age groups of the patients in years. The most common fractures were the transverse fractures, in 21 patients, oblique fractures in 13 patients, comminuted fractures in 10 patients and spiral fractures in 6 patients

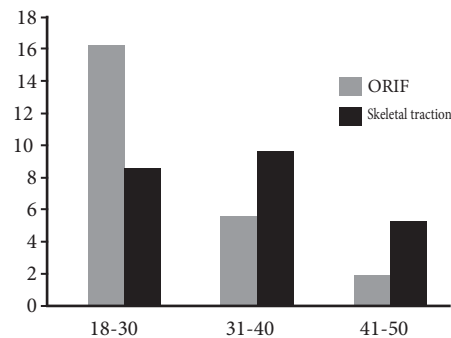
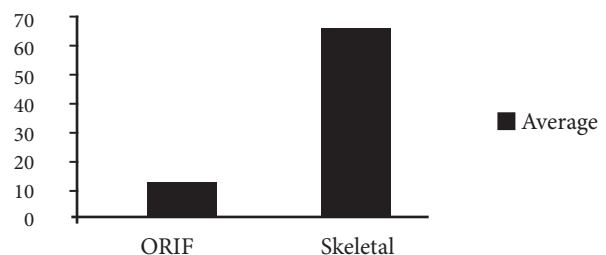


Figure 2 demonstrates the average length of hospital stay of the patients.

Figure 2

The average lengths of hospital stay for the two groups of patients

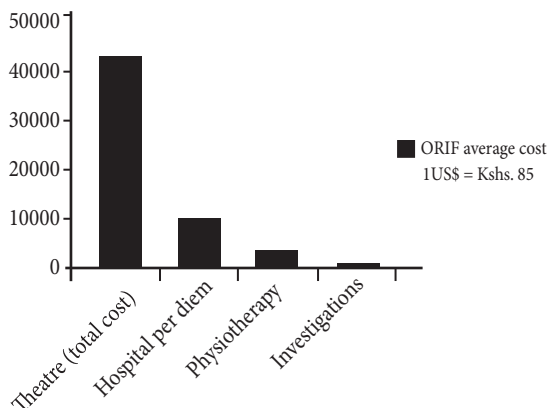


The average total hospital costs for the operative group was Kshs 54, 380.44 (US\$640), ranging from Kshs 45, 080 – 62, 378 (US\$530-734). This was inclusive of the total theatre cost which contributed 75.3% of total cost for the operative group. This included the operation fees which contributed around 50% of total theatre fees, anaesthetic fees, theatre time charges, oxygen time charges, consumables fees, pharmacy fees and TSSU fees. Apart from the operation and anaesthetic fees which were constant for all the patients, the other charges differed depending on the length of surgery; drugs used and blood loss, though the difference amongst all the patients was not significant. The hospital per diem costs contributed to 16.8% of the total cost. This was inclusive of the consultation, meals and bed, nursing care, doctor and medication administered. The physiotherapy costs and investigations contributed to the last 7.9% of the total costs. The physiotherapy costs were inclusive of the sessions by the physiotherapist which were two to three sessions per week.

The investigations were the X-rays done and the blood works in preparation for surgery, which are the full blood count and urea/electrolytes/creatinine. The findings are demonstrated in Figure 3.

Figure 3

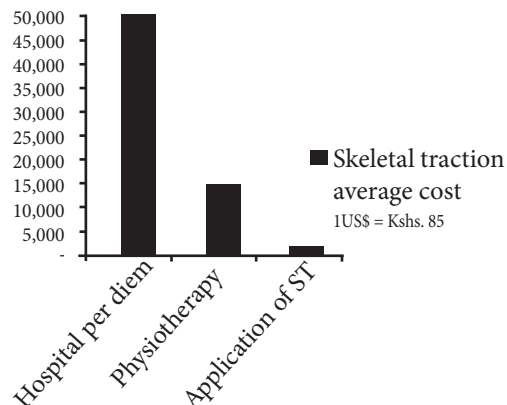
The average total theatre cost, hospital per diem, physiotherapy and investigations contributing to the average total cost for the operative group.



The average total hospital costs for the traction group was Kshs 67, 792 (US\$798) ranging from Kshs 47, 900 – 122, 800 (US\$564-1445). The hospital per diem costs were the main contributing factor to the total costs, averaging 73.7% of the total costs. This was inclusive of the consultation, nursing care, meals and bed which were higher than the operative group due to the number of days in hospital. The cost of drugs was less than the operative group, because they needed analgesics for the first few days and didn't require antibiotics. Physiotherapy and investigations done contributed 23.4% of the total cost. The investigations were X-rays, there were no blood works done, thus slightly cheaper than the operative group. The cost of X-rays was similar to that of the operative group. The physiotherapy costs were higher for the traction group compared to the operative group due to the number of days in hospital hence the sessions were more. Application of the skeletal traction which included the local anaesthesia, application costs and the components of the traction contributed to 2.9% of the total cost. These findings are demonstrated in Figure 4.

Figure 4

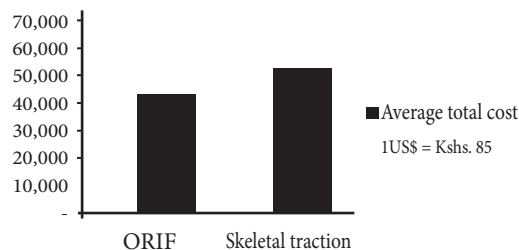
The average hospital per diem, physiotherapy and investigations, and application of skeletal traction cost, contributing to the average total cost



The average total costs for the operative group was compared to that of skeletal traction using the Student's T-test, with a p-value of 0.05. There was a very significant difference in cost with a p-value of 0.04. The average costs for the two groups are demonstrated in Figure 5.

Figure 5

The average total cost comparing the operative group and skeletal traction group

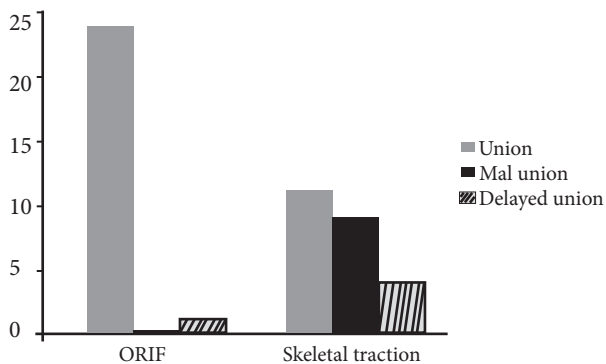


Follow up was done at 3 months. In the operative group, fractures of 24 (96%) of the patients had radiological evidence of union. There was no mal union, but in one patient there were no signs of union. For the skeletal traction group, 12(48%) patients had both clinical and radiological evidence of union.

Nine patients (36%) had mal union while 4 (16%) of the patients had no signs of union of the fracture.

Figure 6

Demonstrates the outcome in the two groups, the number of patients is on the x-axis



The Student's T-test was used with a p-value of 0.05 to compare union as an outcome measure between the two groups. The p-value was 0.03 which is very significant between the two groups. The findings are demonstrated in Figure 6.

DISCUSSION

Fractures of the femur shaft are responsible for morbidity of majority of the patients in the orthopaedic wards with the mainstay of treatment being skeletal traction in our setup (2). These fractures can either be managed conservatively, that is skeletal traction that results in prolonged hospital stay for at least 6 weeks, with higher complication rates (7,12,16). The other option is operative management either using plates and screws or intramedullary nails, which has an advantage of faster management of the patient with quicker mobilization and has fewer complications.

Being in an economic constrained environment, this study set out to establish the best way to manage these fractures and at a cheaper cost for both the patient and the hospital, which would also help decongest the wards. A cost-effectiveness analysis was adapted, a sample of 50 patients analyzed, 25 in each group. The patient demographics were taken (sex and age), the type of fracture and the length of hospital stay. The main aspects of the study; the cost for each mode of treatment and outcome, in this case union were analyzed and comparisons were done.

Majority of the patients were male (90%) while the remaining 10% were female. The average age affected was 31.5 years, with the most affected age group between 18 -30 years. Fractures of the femur have been shown to be more common in the reproductive age group, between 20 – 40 years, with men more affected than women (1,6). This is because most of the fractures are due to RTA's (4,5). This is probably due

to the risky and high speed driving by the younger age groups especially men, and also this is the age group constantly on the road travelling to and from work places as opposed to the older age groups. The most common fracture configuration was the transverse fracture, with the least common the spiral fracture. This is likely because of the mechanism of injury, and since K-nailing was the most utilized fixation method and the indications are limited.

The mean length of hospital stay for the operative group was 11.48 days, ranging from 4-19 days. The mean time to surgery from admission was 4 days. The skeletal traction group had an average length of hospital stay of 66.2 days ranging from 44 – 119 days. The only adult study done in Cambodia comparing skeletal traction to SIGN nailing, found the mean length of hospital stay for the traction group to be 52.3 days while that for the operative group to be 34.9 days (12). The pitfall was that for the operative group the mean length in traction before surgery was 20.7 days, therefore the actual mean LOS was 14.2 days (12). CEA studies done in the adolescents also demonstrated longer LOS for the traction group compared to the operative group, despite the period in skeletal traction being approximately 3 weeks, half that of the adults (14,17-19). In the operative group the least number of days in hospital was 4 days. The patient was operated on arrival and discharged 4 days later. This was not the case for majority of the patients who had to wait at least 4 days due to difficulty in availability of theatre space. In the ideal situation where patients are operated on arrival or one day later at latest, with aggressive rehabilitation the length of hospital stay would have been reduced to one week or less. Two patients took 16 and 19 days in hospital, this was due to delayed payment following discharge from hospital affecting the number of days. The patient who took the least time was 42 days on traction, rehabilitated in 2 days on crutches and discharged taking a total of 44 days. Two of the patients took roughly 116 and 119 days (4 months), this was due to the time taken to clear the hospital bills. The fractures of both patients had not united at 4 months.

The average total costs for the operative group was Kshs 53, 380.44 (US\$628). The difference in cost was due to length of hospital stay, in that the ones who paid higher had a comparatively longer stay. The theatre costs contributed 75.3%. Half of this was the operation fees, that is the cost of implant and the surgeons' fee. The hospital per diem costs contributed to less than a quarter of the total fees. The physiotherapy costs were also low because, there were no complications like knee stiffness to deal with, but how to use crutches. The average costs of the traction group was Kshs 67, 792 (US\$798) ranging from Kshs 47, 900 – 122,800 (US\$564-1445). The hospital per diem costs were responsible for 73.7% of the total cost. The cost of physiotherapy was also higher comparing to the

operative group. The difference in costs within the traction group was dependent on length of hospital stay. There was a significant difference in terms of cost between the two groups with a p-value of 0.04. Skeletal traction was therefore shown to be more costly in the management of femoral shaft fractures in comparison to intramedullary nailing. The findings were similar to the study done in Cambodia, where they found that skeletal traction was more costly compared to the operative group with a difference of US \$ 121 per patient (12). The operative group had an average hospital stay of 34.9 days, of which 20 days were on traction (12). This means the difference in cost would even have been higher comparing the two groups.

Other studies on costs were done in the paediatric age group and adolescents. The study done by Onche and Igo (20) comparing compression plating to skeletal traction showed operative treatment to be more costly. The shortcoming was that the difference in length of stay was around 2.4 weeks and the implant costs contributed largely to the costs. Despite 3 week hospital stay for the traction group in the study done by Timmerman and Rab (17), the cost of traction was two times that of the operative group. Two other studies showed similar costs in both groups (14,18). In the study done by Flynn *et al* (18), the type of nails used (TEN's) are generally very expensive nails, hence contributing to the costs. Comparison with these studies is fairly difficult because in majority, the length of hospital stay in the paediatrics for the traction group is about half that of the adults (3 weeks comparing to 6 weeks). Otherwise, the studies showing similar costs (14,18), done in adults, the traction costs would have been higher. On the overall the hospital per diem costs are shown to be the main contributor of the difference in costs between the two groups (12,14,15,17-22). The total cost of treatment for fractures of the femur shaft is largely dependent on the length of hospital stay.

The outcome measure in the study was union. In the operative group, 96% united and 4% had not united. For the skeletal traction group, 48% of the fractures united, 36% mal united and 16% had not united. The difference between the two groups was very significant with a p-value of 0.03. Skeletal traction has higher complication and worse outcomes than intramedullary nailing for fractures of the shaft of the femur. This was similar to the study done by Gosselin *et al* (12). They did a follow up for 16 weeks. The operative group had early weight bearing, 92% of the fractures united, there was no malunion and 8% of the fractures did not unite. In the traction group 74% united, 4% went into malunion and 22% into non union. Flynn *et al* (18) showed a high complication rate in the traction group of 34%, with the main complications being limb length discrepancy, angulation, loss of reduction, knee stiffness and pressure ulcers. The study done by Webb, *et al* (23) showed traction had higher complication rates

and union took a longer time, 34 weeks for the traction group compared to 18 weeks for the operative group. Studies done in the paediatrics also showed higher complication rates in the traction group compared to the operative group (14,17,19, 24).

CONCLUSION

Intramedullary nailing is more cost-effective than skeletal traction. It met the dominant strategy, because the cost was significantly low compared to skeletal traction and the outcome was better compared to skeletal traction. The length of hospital stay was shorter for the operative group compared to the traction group, and this had a direct impact to the total cost. Therefore from this study, the best way to manage closed fractures of the femur shaft is intramedullary nailing, and should be done as soon as possible if there are no other co-morbidities. This will help reduce the cost to the patient, help decongest the wards and reduce the complication rates. Thus other orthopaedic conditions can be managed due to available ward beds and in the overall increase the productivity in the country, by aiding people to get back to work sooner.

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