MANAGEMENT OF BILATERAL FRACTURE FEMUR WITH IMPLANT FAILURE: A CASE REPORT

J.C. Mwangi, MBChB, MMed(Surg), Lecturer, and **A.A. Admani,** MBChB, Resident, Department of Orthopaedics, College of Health Sciences, University Of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya

Correspondence to: Dr. A.A. Admani, Department of Orthopaedics, College of Health Sciences University of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya. Email: asfadmani@yahoo.com

ABSTRACT

Successful treatment of a fracture by use of implants is a race between rate of fracture healing and metal fatigue of implant used. Implant failure is thus one of the most feared but often encountered complications in the practice of an orthopaedic surgeon. It becomes even more difficult for the surgeon when a patient has multiple fractures, increasing the indication for open reduction and accurate fixation, so that the patient may be mobilized as early as possible. The early mobility of the patient may then stress the implants in an unnatural manner predisposing the construct to failure. We hereby present the case of a patient who suffered fractures of both femurs, was operated on and suffered bilateral implant failure. Corrective surgery involved a repeat operation on either femur.

Keywords: Implant failure, nonunion, plating, intramedullary nailing, stress risers, stress shielding

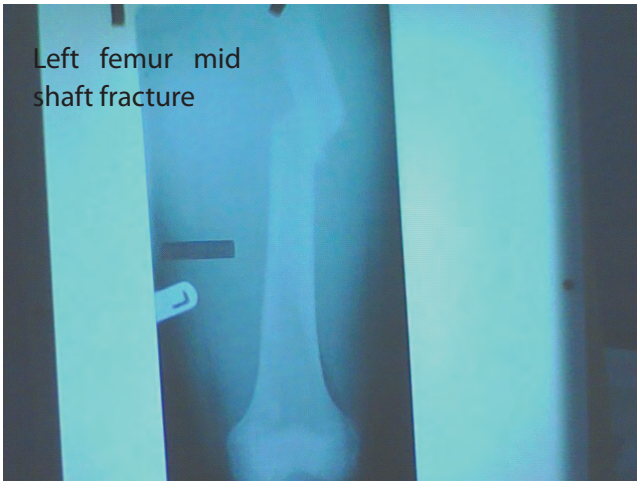
CASE REPORT

We are hereby presenting the case of one A.M, a 47 year old male who was a driver of a private vehicle which was involved in a road traffic accident along Thika Road on 17th July 2009. One passenger in the car died, another sustained fractures.

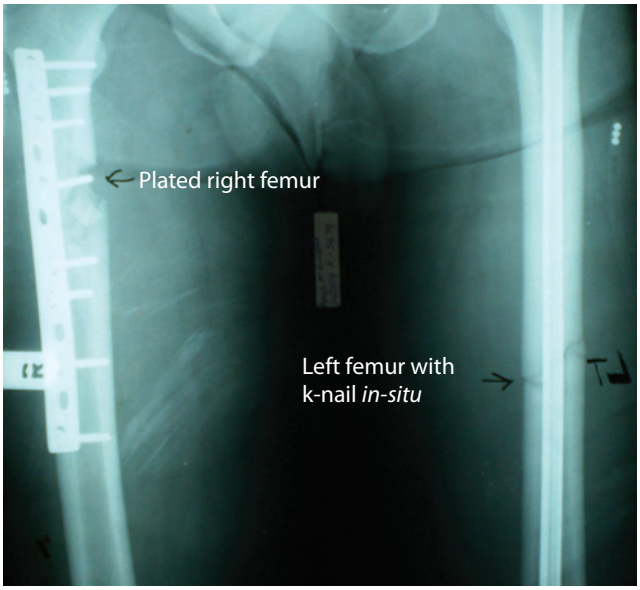
The driver lost consciousness and was taken to a nearby hospital in Chogoria by good samaritans. He was found to have sustained fractures of both femurs, confirmed on radiological examination.

The left femur had a fracture of the mid shaft, as seen above and the right femur had a fracture of the proximal third (initial radiographs not available to us). Other investigations showed a haematocrit of 33.9%.

Traction was applied awaiting ORIF. On 24th July 2009, surgery was done, whereby the right femur was plated. The left midshaft fracture was fixed with a K-nail. IV ceftriaxone, chloramphenicol, and heparin were administered during surgery. The patient was also transfused 4 pints of blood.

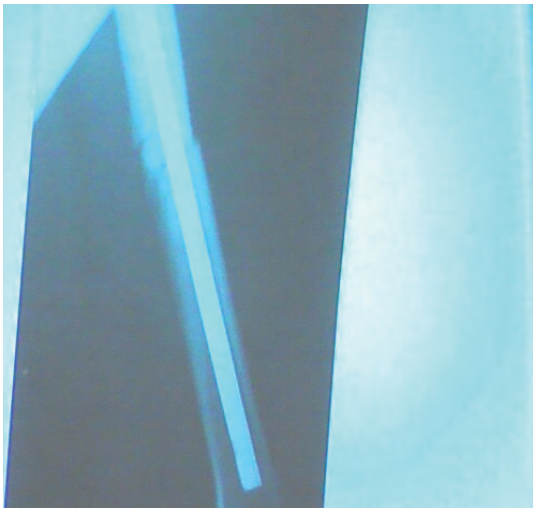


The patient was discharged on 17th July 2009, to mobilise on a wheelchair for 3 months and to be reviewed thereafter. Check radiographs availed to us showed fracture treatment as described:

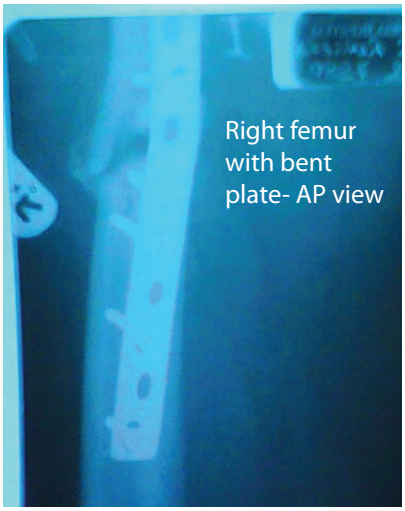


Following discharge from the hospital the patient did not return for follow up. He attempted to walk on his own.

In mid January, the patient suffered injury to both lower limbs while traveling in a wheelchair which was on top of a donkey cart. The cart slipped, and the patient was thrust forwards, injuring both lower limbs. He presented to us on 4th of March 2010 with complains of pain in the mid thigh left side and proximal thigh right side with associated inability to bear weight on the both lower limbs. On examination, we found swelling over right proximal femur- not warm, tender to deep palpation. Hip movement was possible, though limited due to pain. There was some varus deformity over the proximal femur. Knee movement- flexion, extension ranges were satisfactory. Examination on the left side mirrored that on the right except that the point of tenderness was most over the midshaft. Below are the radiographs which show a bent plate on the right side and a bent nail on the left side.



Left femur with bent nail- lateral view shows minimal bending in coronal plane



We took the patient to theatre on the 5th March 2010 and removed the plate on the right side. We replaced it with an intramedullary SIGN nail size 11. We used the reamings from the canal as bone graft

Post operative check X-rays are shown

to fill the defect on the medial aspect of the fracture(1). In keeping with the principles of minimal periosteal stripping we exposed the least part of the edges possible to achieve reduction. The plate removed is shown below

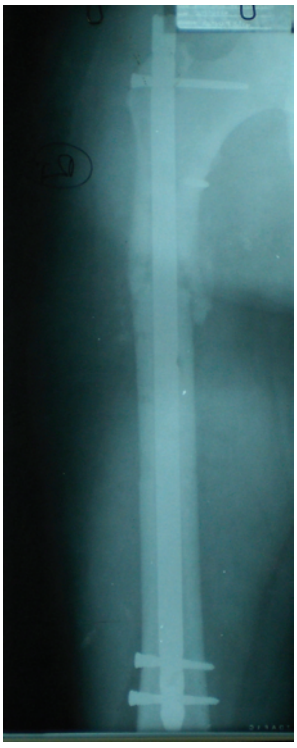
Distal femur showing distal locking

Proximal femur showing locking and fracture reduction

After one week we returned the patient to theatre to do an exchange nailing on the left side. We removed the K-nail (which was found to be size 11) via a trochanteric incision and proceeded to ream the canal further via the same incision. We then knocked in a size 13 intramedullary rod.

Postoperative check radiographs follow

We then mobilized the patient on a wheelchair, with instructions that weight bearing would be allowed as per fracture healing, and that the side to take stress once weight bearing starts will be guided by radiological X-rays. The patient has been followed up in our clinic, and check radiographs have shown the following picture after three months.



DISCUSSION

According to Biomaterials Science(2), causes of failure of a biomaterial may be summarized as follows. Biomaterial breakdown may be due to various causes such as: Mechanical i.e due to creep, wear, stress cracking and fracture; Physicochemical i.e. due to adsorption of biomolecules such as proteins absorption of water or lipids and dissolution; Biochemical reactions i.e hydrolysis of amide and ester bonds, oxidation and reduction, mineral deposition and excessive fibrous deposition; electrochemical i.e corrosion.

Other causes of breakdown include: faults in design such as femoral stem design; fabrication leading to contamination; sterilisation methods- conventional methods may or may not be used; inappropriate testing of implant; packaging and shipping errors; clinical handling and surgical procedure- poor choice of implant or technique of application and finally the patient who may stress the implant in an unforeseen manner keeping in mind there are various possible causes of implant failure, we feel there are some outstanding possibilities of failure in this instance. These are discussed forthwith.

In a fracture of the proximal third of the femur the implant of choice is an intramedullary nail. Keeping in mind the fracture class after Winquist and *et al*(3), we feel we would have used an interlocking nail instead of the plate used. The use of a plate in absence of an adequate medial buttress would also be inappropriate.

On the left side a K-nail was used to fix a midshaft fracture of the femur. This would be considered appropriate given the fracture pattern and the site of the fracture. Unfortunately the size of the nail was only 11. This may be considered small given that the patient himself was of a large body stature, and that we were comfortably able to ream upto size 13 when doing the exchange(4).

The patient was of large body stracture, and had a fracture on both femurs. He also likely stressed the implants in a way that they were not designed to face, and this would likely have strongly contributed to the failure.

To minimise the phenomenon of stress shielding during revision, we avoided the use of a plate on the right side. Thus we did minimal dissection to open the fracture site, placed an IM nail and used reamings as bone graft on the medial aspect of the femur(5,6).

The use of a dynamised SIGN nail would help in fracture healing by secondary union. The SIGN nail is an IM nail which has one static and one dynamic proximal slot with both distal slots being dynamic. This enables the surgeon to fix the nail with less worry about stress risers at the nail-bone-screw interface distally and the consequent risk of a fracture or failure of implant at this point.

On the left side, we did a closed exchange nailing. That is, we proceeded to use the trochanteric incision to ream the medullary cavity, and knocked in a larger nail- size 13 diameter. This is a procedure recommended by none other than Kuntscher himself and confirmed by other authors in recent times(4,7). It would give us better axial stability, at the same time not interfering with the biological healing processes already in place.

By increasing the nail diameter by a factor of 2 we greatly increased the 'strength' of the nail, reducing its chance of failure.

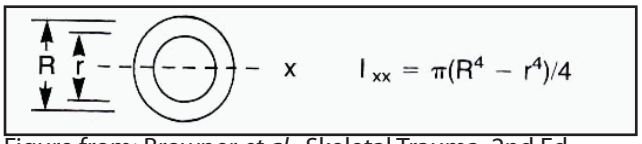


Figure from: Browner *et al*, Skeletal Trauma, 2nd Ed, Saunders, 1998

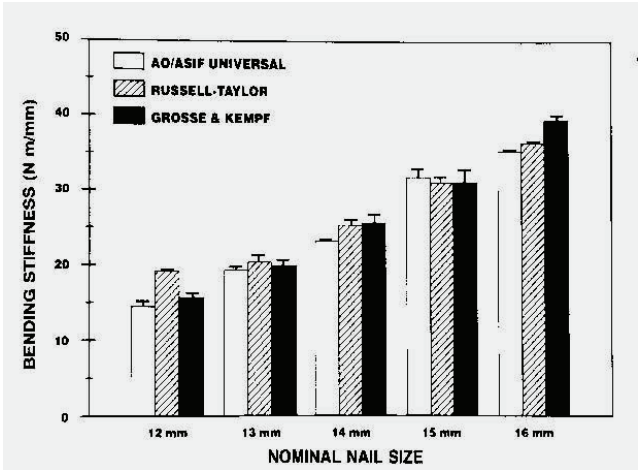


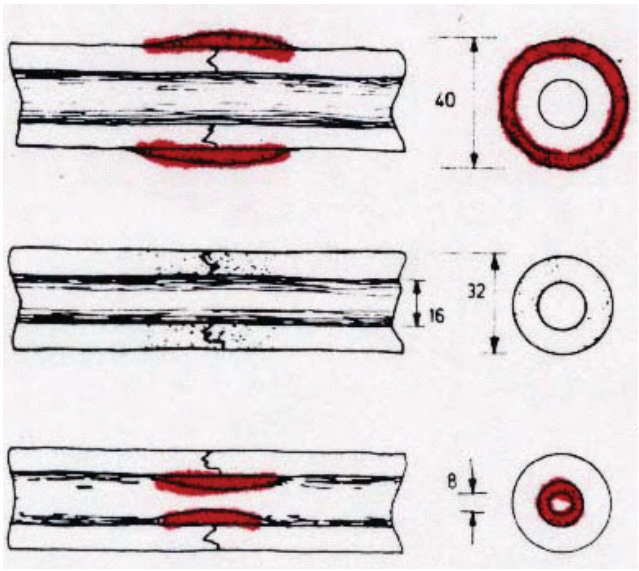
Figure from: Tencer et al, Biomechanics in Orthopaedic Trauma, Lippincott, 1994.

In summary, patients with bilateral fractures of the femur are difficult to treat. These are factures where one must consider strongly the use of operative method of fixation. Further, one needs to choose a means of definite fixation which will allow the patient to bear weight at the earliest opportunity.
In event of failure of implant, one needs to consider the best available means of fixations available, and tailor it to the individual demands of the fracture itself.

In long bone fractures the most commonly used mode of fixation is the intramedullary nail. Reaming only disturbs the endosteal blood supply. Plating on the other hand disturbs the periosteal blood supply and the return of this takes much longer(8).

The other advantage of intramedullary nailing over plating is in the mechanical advantage proffered by the external callus observed in nailing as opposed to endosteal callus seen after plating8.

1.6 x stronger



0.5 times weaker

Figure from: Tencer et al: Biomechanics in Orthopaedic Trauma, Lippincott, 1994

The IM nail is conventionally a load sharing implant as opposed to the plate which bears the load. The nail therefore allows early weight bearing at the same time encouraging callus formation, whereas the plate allows early weight bearing but does not encourage fracture healing by so doing.

One must remember that the unlocked nail does not give rotational or axial stability unless it is inherent in the fracture pattern, as noted by the Winquist and Hansen(3) classification of fractures of the femoral shaft. The indications for an unlocked nail must then be clear on the surgeon's mind(9).

Hollow intramedullary nails (such as the K-nail) have increasing stiffness proportional to increasing diameter.

The SIGN nail, which is the locked nail we used in our patient, is a solid nail with dynamised slots at the distal end. This allows the surgeon to lock distally without worrying about stress risers. The SIGN nail, which is the locked nail we used in our patient, is a solid nail with dynamised slots at the distal end. This allows the surgeon to lock distally without worrying about stress risers.

Finally, one must take note that, as noted above, implant failure may occur due to a myriad of factors, some of which the surgeon has no control over. However, proper instructions to the patient and close follow up are crucial to the success of fracture healing.

REFERENCES

1. Johnson E. E and Marder R. A. Open intramedullary nailing and bone-grafting for non-union of tibial diaphyseal fracture. *J. Bone Joint Surg. (Am)* 1987; **69:** 375-380.
2. Biomaterials Science: Ed. Buddy D. Ratner *et al;* pp 443-444
3. Winquist R. A, Hansen R. T. and Clawson D. K. Closed intramedullary nailing of femoral fractures. A report of five hundred and twenty cases. *J. Bone Joint Surg.* 1984; **66A**: 529-533.
4. Kuntscher, Gerhard: Practice of Intramedullary Nailing. Springfield, Illinois, Charles C Thomas, 1967.
5. Frölke J. P. M, Nulendb J. K, Semeinsb C. M *et al:* Viable osteoblastic potential of cortical reamings from intramedullary nailing: *J. Orthopaed. Res.* 2004; **22 (6):** 1271-1275.
6. Tydings JD, Martino LJ, Kircher M *et al:* Viability of intramedullary canal bone reamings for continued calcification. *Am. J. Surg.* 1987; **153(3):** 306-309.
7. Bong, M. R., Kummer, F. J., Kenneth, J. K. *et al.* Intramedullary nailing of the lower extremity: Biomechanics and Biology. *J. Am. Acad. Orthop. Surg* . 2007; **15:** 97 - 106.
8. Rand JA, An KN, Chao EY *et al:* A comparison of the effect of open intramedullary nailing and compression-plate fixation on fracture-site blood flow and fracture union. *J. Bone Joint Surg. (Am)* 1981; **63:** 427-442.
9. Brinker MR, O'Connor DP: Exchange Nailing of Ununited Fractures. *J. Bone Joint Surg. (Am)* 2007; **89:** 177-188.