Aetiology and Patterns of Implant Failure Following Fracture Fixation in a Developing Country.

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Background: ***Implant failure is traumatic for patient as it increases the cost of treatment and may negatively affect the confidence of patients in the superior outcome of operatively treated fractures. Hence the objectives for this study were to determine the proportion of implant fixations that fail, types and causes of implant failure in our practice.***
Methods: ***A retrospective study conducted at a tertiary health institution, South west, Nigeria. Data of patients who presented with implant failure following fracture management between 2006 and 2011 were reviewed. Outcome measures were type and causes of implant failure. Data were analyzed using SPSS 16.***
Results: ***A total of 349 patients had implant fixation done following fracture during the study period of which 19 (5.4%) had failure of their implant. The commonest type of failure was a broken implant while the commonest cause for implant failure was non union 9 (47.4%) which resulted in fatigue failure of implant.***
Conclusions: ***We recommend adherence to principles of internal fixation. Education of our patients with regards to compliance with instruction will also go a long way in reducing the rate of failure.***

Keywords: Internal fixation; Fractures; Implant failure

Introduction

Internal fixation of fractures with implants such as intramedullary nail, Dynamic Compression plate (DCP), angled blade plates, screws and others, enhances anatomical reduction and early mobilisation of patients. Patients are known to also have lesser duration of hospital admission. However, one must realise that as soon as the fixation is done, a race between fracture healing and fatigue of the implant leading to its eventual failure begins[1]. Other complications of operative surgery such as infection and peri-implant fracture may also occur. Implants may fail as a result of failed union of the fracture[2], technical problems and infection, amongst other reasons.

Various types of implant failure exist. This may include fracture of implant, which may result from repetitive loading or even a re-fracture from a new trauma. Loosening of implant can also occur as well as plastic deformation. Plates are noted to exhibit load shielding effect on the applied segment of the bone and at the same time serve as stress risers at either end of the plate[2].

Open reduction and internal fixation is associated with soft tissue dissection which in turn may adversely affect the contribution of the soft tissue to union and may give rise to non-union. This end result eventually leads to fatigue failure of the implant. Intramedullary nails on the other hand are noted to exhibit a load sharing effect and provide good stability for fractured long bones as well as good biomechanical environment for healing[2]. However, Bucholz et al noted that locked intramedullary nails concentrates high stress at either ends of the nail thus making it susceptible to failure at these points.[3] Implant failure in fractures fixed with plate is commoner than in those treated with intramedullary nail which is at the centre of the shaft and is spared from bending forces responsible for fatigue[4]**.** It is said that the ends of plates also acts as stress riser where fractures can occur[5].

Implant failure is an unfriendly guest for both patient and surgeon because it increases the cost of treatment especially in developing countries where a good number of people live below poverty line.

This study was carried out to determine the proportion of implant fixations that fail, characterise the type of failure and identify the risk factors in our practice. This is with a view to preventing its re-occurrence.

Patients and Methods

This was a retrospective review of patients with implant failure following open reduction and internal fixation of their fractures at the Orthopaedic and Trauma unit of the Obafemi Awolowo University Teaching Hospitals Complex,(OAUTHC) Ile-Ife, Nigeria from August 2006 to July 2011.

All patients who presented with fractures and had implant fixation of their fractures done within the study period were reviewed. Type of implants used included: locked intramedullary nails (of the Surgical Implant Generation Network (SIGN) model), Dynamic Compression Plates (DCP), angled plate device and screws. Plates and screws were sourced from Apothecary Sundries Company (ASCO). Outcome measures were the proportion of implants which failed overall and within each type of implant used as well as type and aetiology of failure of such Implants. The implants were all removed and examined only visually. Data were analysed using SPSS version 16. Frequency distribution of the outcome measures was done.

Results

A total of 349 cases of open reduction and internal fixation were done for long bone fractures during the study period. The mean age of the patients was 40.95years ± 18.72, while sex distribution showed male to female ratio of 2: 2.8 with a slight female preponderance. Proportion of patients with type of implants used is highlighted in Table 1. Most of the cases were managed with locked intramedullary nail (38.68%).

Table 1. Distribution of implant cases.

Type of Implant Used	No of Patients	Percentage (%)
Plate and Screw	101	28.94
Angled blade plate	44	12.61
Unlocked intramedullary nail	44	12.61
Locked intramedullary nail	135	38.68
Screws	25	7.16
Total	**349**	**100**

Table 2. Proportion of Patients with Implant Failure by Type of Implants

Implant	Number of Failed Implant	No of Successful Implants	Total Cases per Implant
Plate and Screw	8 (7.9%)	93 (92.1%)	101 (100.0%)
Angled blade plate	2 (4.5%)	42 (95.5%)	44 (100.0%)
Unlocked nail	4 (8.8%)	40 (91.2%)	44 (100.0%)
Locked nail	4 (2.9%)	131 (97.1%)	135 (100.0%)
Lag Screw	1 (2.8%)	24 (97.2%)	25 (100.0%)
Total	**19 (17) (5.4%)**	**330**	**349**

Of the 349 patients, 19 (5.4%) had failure of their implants. The proportion of patients with implant failure for each of the type of implant fixation done is shown in Table 2. Unlocked nail had the highest proportion of patients with failed implants while lag screws had the least. Ten patients (52.6%) had either deformed or fractured implants while 7 (36.8 %) had loosening of their implant while the remaining two patients had peri- implant fracture. The 2 cases of peri-implant fractures were as a result of falls, otherwise no case of deformation was recorded with the use of the locked nail. The patient with per-trochanteric fracture had severe osteolysis with resulting loosening which led to eventual failure and consequently had excision arthroplasty.

The commonest cause of implant failure seen in this study was failure of the fracture to progress to union (non-union). This was seen radiographically as the failure of bridging callus across the fracture line. This was accountable for 9 (47.3%) of the cases of implant failure seen whatever the type of implant. There was a case of medial comminution amongst patients who had plate fixation done. This was later complicated as a deformation of the plate fixation done following early weight bearing of the patient in question. Early ill-advised weight bearing accounted for 3(15.8%) while other reasons are as outlined in table 4.

Table 5 shows the salvage procedures carried out for the failed implants. Those that had failure of intramedullary nail had exchange nailing with bigger nails except one case that had the nail converted to plate. Three other cases had repeat plating, while other procedures done are as shown in the table below.

Table 3. Types of implant failure.

Type of failure	**Frequency**	**Number (%)**
Bent or broken implant	10	52.6
Implant loosening	7	26.3
Peri-implant fracture	2	5.3
Total	**19**	**100.0**

Table 4. Aetiology of Implant Failure.

Cause of Failure	**Number (%)**
Non union	9(47.3)
Ill-advised early weight bearing	3(15.8)
Fall	2(10.5)
Infection	2(10.5)
Osteolysis	2(10.5)
Manipulation	1(5.3)

Table 5. Salvage procedures.

Revision Surgery	**Number (%)**
Locked nailing	11(57.9)
Plate and screw	3(15.8)
Debridement with ext fixation	2(10.5)
Angled blade plating	1(5.3)
Screw and washer	1(5.3)
Excision arthroplasty	1(5.3)
Total	19(100)

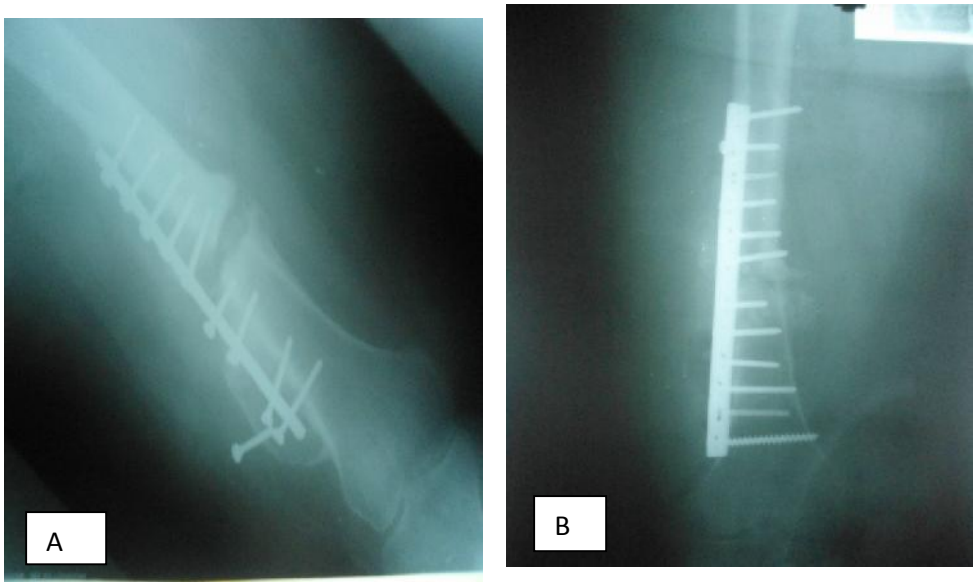

Figure 1. Loose Implant with Non-union (A) and the Radiograph Post Repeat Compression Plating with Bone Grafting (B).

Discussion

The overall prevalence of implant failure in this study (5.4%) is higher than the 3.4% recorded by Ogbemudia et al in their study[6], but very close to incidence of 4.7% recorded by Chi-Chuan Wu et al[7] in Taiwan though their study was limited to interlocking nail failure. Unlocked nail contributed significantly to implant failure in our series and was closely followed by plate and screw. The reason for this finding may be due to the fact that unlocked nails does not afford stable fixation due to ability of fracture fragments to still rotate at the fracture site around the nail. Hence macro motion produced might result in non-union. In contrast, locked nails afford stable fixation and in this series, the failure rate following the use of this type of nail is much lower. This finding is in contrast to the findings of Ogbemudia et al where plate and screws contributed significant number to fractured implants[6]. This may be as a result of higher number of intramedullary nailing (locked and unlocked) done in this series compared with their series where plate and screws dominate. Furthermore the unlocked nail in this study was the cloverleaf type (kuntscher) and in contrast to the locked nail which is solid, can easily undergo deformation and fracture under load. Use of unlocked nail has disappeared from the practice in OAUTHC over the last few years as a result of advent of interlocking nail with its advantage over the unlocked nail, hence the relatively smaller number of cases in this series.

Non union was the leading cause of implant failure in this study, accounting for 47.4%. The fact that non union may lead to failure is documented in the literature and it has been said that when a surgeon inserts an implant, he must realise that he is entering into a race between fatigues of the implant and healing of fracture[1]. Failure of compression of fracture ends, excessive stripping of the periosteum are some of the reasons why non union may occur and since all the patients in this study had open surgery, may account for the high rate of non union as the cause of implant failure especially in plate and screws in this series where all the patients had open surgeries. Three of the patients bore weight ill-advisedly and prematurely and had failure of their implant (plates and screws). Bhat et al corroborated this finding in their study and concluded that nail failure can occur when weight bearing begins before the fracture regains 50% of its original stiffness[8]. Yang Huan et al also stressed the importance of initial load time after operation as a risk factor to failure of internal fixation and therefore concluded that patients should be kept from early loading [9].

One of the patients had series of manipulations of the operated limb from quacks after discharge from hospital, subsequently leading to loosening of the plate and screws. Educating the patients will go a

long way to prevent this unwanted manipulation. Most of the patients had re-operation with locked intramedullary nail following the removal of prior implant. Reaming was done to further stimulate healing and to allow placement of larger nails while in cases of atrophic non union, bone grafting was also done.

A limitation of this study is the lack of information on the patterns of the fractures vis-a-vis the choice of implants for their fixation at the initial presentation being a retrospective study.

In conclusion efforts must be made to adhere to the principles of fracture fixation so as to achieve union. Physical rehabilitation therapists should be carried along in the overall management of fractures and patients should be educated about their fixation and possible outcomes. This will avoid premature, ill-advised weight bearing that may load an unstable fracture fixation.

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