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Case Report

'Simple Classical' Diaphyseal Forearm Fracture with Complicated Post-Operative Period: Deciphering a Case in a Resource Limited Setting

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Abstract

The aim of this write-up was to decipher why an apparently 'simple' forearm fracture would end up with severe initial post-operative complications, requiring multiple interventions for correction.

We therefore reviewed the case of a 41years old man, that we managed by two-staged surgery for an 'armed' septic non-union after a previous treatment of a 'simple' transverse right forearm fracture. Poor understanding of fracture treatment techniques, non-respect of aseptic measures, poor choice of implants and the non-respect of soft tissues and vascularisation could be responsible for the development of septic non-union in this patient, with an apparently simple appearing fracture.

Forearm fractures should therefore not be minimised based on their appearances, but should be adequately evaluated, treatment corrected planned and follow-up rightly pursued.

Keywords: *Simple Forearm Fracture; Septic Non-Union; Multiple Interventions*

Introduction

Simple diaphyseal forearm fractures in young adults pose a surgical indication as a principle for their proper management [1]. They generally require an open anatomic reduction, a stable internal fixation and an early range of motion to prevent complications [2]. A proper understanding of this principle could mean that general surgeons or even senior residents in traumatology could safely carry out this 'simple routine' intervention. When this intervention is properly carried out, respecting the principle involved, it prevents complications like loss of prono-supination, implant failure, surgical site infection, delayed union, non-union and loss of strength of lifting objects and grasping.

Current fixation techniques in forearm fractures with the application of the AO principles have proven to be quite effective to achieve healing with a reported non-union rate below 5%, and infection rate following open reduction and internal fixation (ORIF) for diaphyseal forearm fractures ranges between 2% and 6% [3].

However, the outcome of treatment following the management of these simple fracture entity in traumatology is not always the best [4], especially when surgical interventions are carried out in areas and by surgeons of doubtful technical know-how especially in resource limited setting.

We therefore decided to describe this case of a failed primary osteosynthesis of a 'simple' diaphyseal forearm fracture in a 41 years old male, examining the possible reasons for the failure and efforts made to restore the function of the forearm of this patient.

Case Report

This is the case of a 41 years old male, right-handed dominant, employed in a brewery company in the North region, whose right forearm was hit by a heavy machine during a workplace accident. Initial evaluation revealed a stable patient with simple short oblique fractures of the radius and ulnar of the right forearm, without neurovascular injuries (Figure 1).

Figure 1: *Initial radiograph showing short oblique fractures of both radius and ulnar of right forearm.*

Open reduction and internal fixation with plate and screws was posed as indication by his treating surgeon at a hospital in Garoua and carried out with an uneventful early postoperative period (Figure 2). About 4 months after this primary osteosynthesis, the patient noticed progressive varisation of the right forearm, with a draining sinus on the ulnar side, abnormal movement at the operated site and persistent loss of function of the said limb (Figure 3). This motivated his consultation at our centre in Yaounde.

Figure 2: *Control radiograph in the early post-operative period.*

Figure 3: *Radiograph at 4 months showing complete Implant failure and varisation of right forearm.*

Clinical evaluation on arrival revealed the right upper limb in varus, mildly tender, 2 draining fistulae on the ulnar side, forearm blocked in pronation and complete loss of supination, and abnormal mobility of fracture site. There were no systemic signs of infection and neurovascular evaluation was normal.

Plain forearm radiographs showed implant failure (debricollage of plate and screws), lack of fracture union with gap between eutrophic bone ends at fracture site. We concluded that he had a septic, armed, loose, eutrophic non-union of forearm (Figure 4).

Figure 4: *Forearm non-union site with minimal critical defect. Immobilised by posterior plaster splint.*

To remedy this situation, we planned and carried out a 2 staged repair of forearm non-union.

Stage 1: Hardware removal, sample collection for culture and sensitivity, surgical wound revision, fistulectomy, decortication and abundant lavage. This was followed by temporary immobilisation a long arm plaster splint (Figure 4). This was completed with a 2 weeks intravenous targeted antibiotherapy and weekly control CRP and ESR.

Findings during this initial re-intervention included (Figure 5 and 6);

- A 5 hole 4.5 mm half tubular plate on the radius, fixed with three 3.5 mm cortical screws and a 3.5 mm cancellous screw.
- A narrow 4.5 mm 5 hole DCP on the ulnar, fixed by a 4.5 mm cortical screw, 2 malleolar screws and a locking bolt of a universal locking tibia nail. Both plates showed signs of multiple usage.
- Non-consolidated site with rotational deformity and oligotrophic bone ends.
- Normal soft tissue on radial side but purulent collection on ulnar side.

Figure 5: *Radial side plate: 4.5 mm Half tubular plate, signs of re-use with 3.5 mm cortical screws.*

Figure 6: *Ulnar side plate: Narrow 4.5 mm plate, signs of re-use, malleolar screws and locking bolt.*

Culture and sensitivity test showed a multi-resistant poly-microbial infection with *Klebsiella pneumoniae* and *Enterobacter cloacae*, sensitive to certain reserved antibiotics such as imipenem and amikacin. After two weeks of targeted antibiotherapy, the clinical and biological signs of infection subsided, then we proceeded to the second stage of management.

Stage 2: After infection control, re-osteosynthesis on an ordinary operating table, with forearm rested on an arm table (Figure 7), with adequate correction of rotational deformities, realignment of both forearm bones (Figure 8), re-fixation in compression with 3.5 mm LC-DCP with 10 holes and 12 holes, and 4 cortical 3.5 mm screws on both sides of the non-union site.

Figure 7: *Clinical appearance before surgery.*

Figure 8: *Clinical appearance after surgery.*

The post-operative period was uneventful; our patients was placed on oral clindamycin for 3 months, wound healed properly, stitches removed on POD 10, patient steadily regained prono-supination with progressive physiotherapy and consolidated at 4 months post-op.

Discussion

Forearm bones are subjected to torsional, rotational and flexion/extensional forces. The basic principle guiding the treatment of their fractures in young adults include their anatomic reduction, stable internal fixation, preservation of vascular supply and early mobilisation [1]. The non-respect of the principles could lead to dreaded outcomes including loss of prono-supination [3], surgical site infection and non-union. Non-union of the forearm are uncommon but severely disabling and challenging to treat especially when infected by multi-resistant germs [5-7]. Septic non-union are defined as the absence of evidence of fracture healing and persistence of infection at the fracture site for 6 to 9 months [4]. In our case however, we considered it as septic non-union at 4 months because of the evidence of implant failure, abnormal mobility of site and purulent discharge. Consolidation would therefore have never occurred without re-intervention.

In our patient, the complications presented after primary osteosynthesis could be principally due amongst others to:

- Non anatomic fracture reduction.
- Lack of experience by the surgeon.
- Poor planning of fracture management.
- Poor choice of implants (plates and screws alike).
- Screw placement in the fracture site.
- Non-respect of soft tissue and vascularisation.
- Non-respect of aseptic measures.

Standard fixation technique of forearm fractures is by the use of 3.5 mm LC-DCP, with at least 3 screws on both sides of a simple fracture site [1]. The poor choice of implants initially used in this patient's management and the overall non-respect of the surgical principles, significantly contributed to the treatment failure. The infected nature of the non-union site could mainly indicate the poor hygienic conditions and the non-respect of aseptic measures, the nosocomial environment or simply the risks involved in the multiple use of plates and screws, as the removed implants showed signs of multiple use. The multiple or repeated use of implants has been shown to favour the spread of multi-resistant germs. These implants are colonised by the formation of biofilm, rendering these germs very resistant to sterilisation and even to antibiotics [8,9]. The poor hygienic conditions in some operating theatres, like the non-use of disposable drapes and gowns and non-disinfection of hands with hydro-alcoholic solutions, may also play a role.

Management of infected non-unions remain a major challenge for orthopaedic and trauma surgeons and usually require multiple surgical interventions (debridement, sequestrectomy, restoration of soft tissue envelop and eventually stable re-fixation) and long term antibiotherapy and sometimes bone grafting [3,10]. Diaphyseal forearm non-union management differs from that of other type of diaphyseal nonunions because of the intimate relationship between the radius and the ulna and their reciprocal movement. The Masquelet membrane induced technique has been described as an acceptable method in the management of these septic non-union [6]. During the first stage of our intervention, the patients after hardware removal, underwent thorough debridement of the non-union site which was eutrophic in nature. The eutrophic nature (biological factor) of the bone ends confirmed the fact that there was a good or acceptable osteogenic ability but poor fixation technique (mechanical factor) was responsible for failure. After the debridement, there was no critical-size defect. A critical-sized defect is defined as the smallest bony defect that does not heal spontaneously and is generally defined as 6 cm. However, it is more logically defined in the context of the bone, with a critical sized defect defined by multiplying the shaft diameter by 2.0 - 2.5 [6]. The lack of critical defect meant we did not use any antibiotic-impregnated spacer, and eventually no bone graft needed, similar to what was described by Lapcin., *et al* [5]. We used a long arm plaster splint to temporary immobilise the site. Targeted antibiotherapy was the done for 2 weeks, with regular clinical and biological control.

Definitive re-fixation in compression mode with 3.5 mm LC-DCP with 10 and 12 holes, with 4 cortical 3.5 mm screws on both sides of the non-union site (Figure 9 and 10) and patient evolved satisfactorily with progressive amelioration of function, regaining prono-supination (Figure 11 and 12).

Conclusion

There is actually no 'simple' fracture in terms of management irrespective of how fractures may present of radiography. Diaphyseal forearm fractures need to be considered and treated as 'articular fractures', respecting the principle of anatomic reduction and stable internal fixation, with conservation of vascularisation and early post-operative rehabilitation. This definitely requires that the surgeon

Figure 9: *Control X-ray after re-fixation, AP view.*

Figure 10: *Lateral view.*

Figure 11: *Consolidation oncourse at 6 months post-op.*

Figure 12: *Regain of functional ranges of motion at 6 months post-op.*

develops some experience, properly plan for surgery in environments that respect the basic aseptic measures. The respect of these rules will definitely prevent complications in the post-operative period and enable patients to return to work early.

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