EC ORTHOPAEDICS
Research Article

Multidisciplinary Management of Surgical Wound Dehiscence with Hardware Exposure in Hindfoot and Ankle Osteosynthesis

Daghino Walter[1]*, Matteotti Renato[2], Basile Giorgio[2], Navissano Massino[3], Maiello Agostino[4] and Massè Alessandro[1]

[1]*Clinica Ortopedica I, University of Turin, CTO Hospital, Turin, Italy*

[2]*SC Ortopedia e Traumatologia, Umberto Parini Hospital, Aosta, Italy*

[3]*SC Chirurgia Plastica E Ricostruttiva, CTO Hospital, Turin, Italy*

[4]*Clinica Universitaria di Malattie Infettive, Amedeo di Savoia Hospital, Turin, Italy*

***Corresponding Author:** Daghino Walter, Clinica Ortopedica I, University of Turin, CTO Hospital, Turin, Italy.

Received: January 18, 2018; **Published:** March 13, 2018

Abstract

In osteosynthesis of foot and ankle fractures, the infections with surgical wound dehiscence and exposure of the hardware are particularly frequent and difficult to treat. Classically this complication required the removal of the hardware, but this, especially if there is a situation of incomplete healing of the fracture, greatly increases the entity and the frequency of the bad outcomes.

In literature it's possible to found experimental evidence of reduced bacterial adhesiveness with the use of titanium made plate and screws: theoretically it could be helpful in prevention and treatment of infective problems, but this statements are not yet completely confirmated in clinical practice.

We have evaluated retrospectively with a multicentric study a multidisciplinary treatment protocol, that try for keeping the hardware in place at least until the healing of the fractures.

The casuistry consisted in 16 fractures of calcaneus and 3 of tibial pilon, that had exposed hardware after an average time of 45 days from the surgery. After the multidisciplinary treatment, no case required the removal of the hardware before to the healing of the fracture, while all cases achieved the skin closure, in an average time of 97 days from exposure.

Only in four cases, the hardware was next removed following healing of the fracture and skin, subsequently at discomfort arised by impingement with the soft tissues, after an average time of 385 days from the initial osteosynthesis intervention.

This study demonstrates that in the management of dehiscence's of surgical wounds with hardware exposure in the foot and ankle, if titanium implants have been used and at the same time there is the possibility of an integrated polispecialistic management of such occurrences, the classic principle requesting removal of the means of synthesis to obtain the healing of the infection can to be initially neglected.

Other studies, with more numerous observations are needed to best characterize this integrated multi specialist approach.

Keywords: *Titanium; Hardware; Infection; Calcaneal Fracture; Tibial Pilon Fracture; Surgery*

Introduction

In case of osteosynthesis, the anatomical features of the foot and ankle more easily can lead to problems of the soft tissues, respect to the other districts.

In fact, coverage of bone is provided only by a thin layer of soft tissues and also in most areas the muscle protection is not provided [1].

In fact, coverage of bone is provided only by a thin layer of soft tissues and also in most areas the muscle protection is not provided [1].

The most feared complication is certainly the deep infection, which is strictly connected to wound dehiscence with hardware exposure [2].

Local soft tissues often are damaged by the trauma or secondly interested by ischemia that may follow surgery treatment [3]. Moreover, open reduction and internal fixation (ORIF) involves the use of metallic hardware, that represents a foreign body, creating ideal conditions for bacterial contamination [4,5]. This justifies the high percentages of deep infection reported in literature for the ORIF in the fractures of calcaneus and the tibial pilon, that are the more challenging lesions to treat in these segments [6].

Classically, a deep infection is considered an absolute indication for the removal of the hardware, because this condition can lead to mobilization and further more to instability, but primarily to obtain a complete resolution of the bacterial contamination [7].

However remove the hardware in the presence of an unconsolidated fracture complicates the clinical evolution of the lesion: it extends times of healing, causes more long hospital stays and possible bad consolidation, resulting in increased economic and social costs [8-10].

The aim of this study is test a multidisciplinary method to treat the deep infections following ORIF of these difficult segments, without removing the titanium exposed hardware, at least until the healing of the fracture.

The aim of this study is test a multidisciplinary method to treat the deep infections following ORIF of these difficult segments, without removing the titanium exposed hardware, at least until the healing of the fracture. Previous studies [11,12] suggest a reduction in adhesion capacity of bacteria on Titanium hardware, and a reduction of deep infection using titanium hardware for osteosynthesis in bone fractures; on this basis we have analyzed a proposal of therapeutic algorithm, based on a close collaboration between orthopaedic surgeons, infectious disease specialists and plastic surgeons, to allow in these cases a conservative treatment and a better outcome for the patient.

Materials and Methods

The patients treated by the Department of Traumatology, Centro Traumatologico Otrtopedico (CTO), Turin (Italy) and by the Department of Orthopedics and Traumatology, Ospedale Regionale Valle d'Aosta "Umberto Parini", Aosta (Italy) in nine years (2005 to 2014), for a dehiscence of the surgical wound with hardware exposure following ORIF with titanium plates and screws in fractures of ankle or hindfoot were retrospectively revised.

The patient's data's were collected in a custom-made database (Access, Office 2003®), considering age, sex, the segment interested and classification of the primary injury, type of surgery and of mean of synthesis employed, finally the time elapsed between the surgical treatment and the surgical wound dehiscence.

Ankle fractures were classified by AO method, the calcaneal fractures with the Sander's classification.

All patients were treated with a multidisciplinary approach, consisting in a plastic surgery treatment (advanced wound dressings and, if necessary, coverage with surgical flaps), antibiotic therapy, prescribed by an infectious disease specialist, and repeated orthopaedic evaluations, to decide whether to remove or leave the hardware.

The choice of the type of wound dressing was done after evaluation of the bottom of the dehiscence, considering this variables: if the bottom was cleaned or, if not, whether the exudate was low, profuse or with fibrinous reaction. On the basis of these data, was used hydrocolloids, Aquacell® Argentum, alginates, hydrogel, polyurethane foams, collagenase, neomycin or collagen based dressing (Prisma-Promogran®) according to the protocol shown in figure 1.

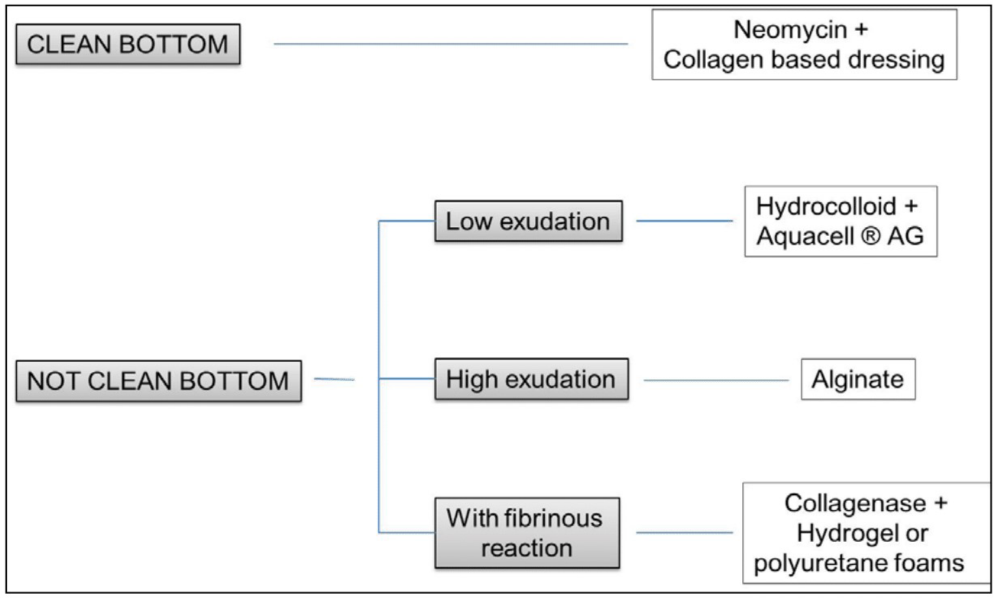

Figure 1: *Protocol of advanced dressings, based on cleaning of the bottom of the dehiscence and on amount of exudation.*

Patients was checked weekly in plastic surgery ambulatory, with renewal of the dressing and if needed removal of the necrotic tissue.

The choice of antibiotic therapy was dictated by the result of an antibiogram, choosing the most effective antibiotic for each particular bacterium. The sample was made on every patient at the moment of the dehiscence, on the bottom of the wound.

In the case of negative antibiogram, according to the literature it was choiced a beta-lattamine (for example Amoxicillina + clavulanic acid or Ceftriaxone) and, in case of no response at this therapy, a glycopeptide (Teicoplanin, Vancomycin) or as second option a lipopeptide (Daptomycin) [13,14]. A combination therapy with a fluoroquinolone (ciprofloxacin or levofloxacin) was administered in case of multi-resistant germs [15]. The intermediate controls by an infectious disease specialist were accomplished every 2 weeks with contemporary evaluation of blood tests.

The orthopaedic checks were performed monthly, with X-ray assessment; hardware removing before fracture healing was scheduled in case of contemporary presence of three criteria: persistent wound dehiscence, blood inflammatory examines altered over the limits and radiographic signs of loss of stability of the implants.

Goal of treatment has been considered the healing of the fracture without removal of the implants; in case of complete closure of the skin, was registered the interval time between the dehiscence and skin closure, the time elapsed until the suspension of antibiotic therapy and until an eventual hardware removal next fracture healing, if carried out.

Results

19 patients were included in this study (see Table 1); they were aged 23 to 63 (mean ± SD age: 45 ±10 years): 15 males and 4 females; the causes of the primitive injuries in five cases were road accidents and in 14 falls from height.

Nr	Patient	Age	Center of Treatment	Segment	Classification of the Primary Fracture	Time from ORIF to Exposure (days)	Bacterium Isolated	Hardware Removal Before Fracture Healing	Time to Skin Closure (Days)
1	BA	36	2	1	IIB	33	SA	No	42
2	LS	26	1	1	IIIAC	29	SA	No	118
3	RM	37	1	1	IIC	14	SA	No	116
4	PM	62	1	1	IIB	63	EC	No	20
5	BV	35	1	1	IIA	30	SE	No	33
6	CA	47	1	1	IIA	38	SE	No	121
7	GI	37	1	2	43C2	47	SE	No	12
8	CM	36	1	1	IIA	25	KP+ EC	No	91
9	VP	50	2	1	IIB	22	SC	No	147
10	VD	59	2	1	IIA	50	None	No	81
11	BA	56	2	1	IIB	22	EC	No	66
12	JM	23	2	1	IIIBC	20	SA	No	97
13	CV	57	1	1	IIC	49	None	No	223
14	BP	45	1	1	IIA	59	SA	No	142
15	PM	36	1	1	IIC	68	SAA	No	139
16	BV	50	1	2	43B3	37	SE	No	108
17	PR	49	2	1	IIIAB	30	None	No	80
18	PD	63	2	1	IIIAB	18	None	No	125
19	PT	41	1	3	43C2	67	None	No	74

Table 1: *Patients treated with the multidisciplinary protocol.*

Bacterium Isolated: *SE: Staphylococcus epidermidis; SA: Staphylococcus aureus; EC: Enterobacter cloacae; AA: Streptococcus alpha haemolyticus; SC: Staphylococcus capitis; KP: Klebsiella pneumoniae*

16 patients underwent surgery with ORIF of calcaneal fractures, 3 patients for pilon tibial fractures.

The pilon tibial fractures were ranked 43B3 in a case, 43C2 for the others. The calcaneal fractures were classified according to Sanders classification: 5 were type IIA, 4 was IIB, 3 were type IIC, 2 were type IIIAB, 1 case was IIIBC e 1 case was type IIIAC. No fracture were exposed.

Two patients with calcaneal fracture had associated a contralateral fracture, not surgically treated.

Two patients with pilon tibial fractures had associated fracture of the distal ipsilateral fibula (AO type 44B3), both treated with ORIF.

All patients were operated employing titanium locking plates and screws (Synthes®, Paoli, PA) for the osteosynthesis, in association with a Poly-L-Lactide Acid (PLLA) bar (Smart Pin, Linvatec®,Utica) in a case of calcaneal fracture and with interfragmentary cannulated titanium lag screws (SuperScrew, Lima®, San Daniele del Friuli) in a tibial pilon fracture case.

Patients have presented skin's dehiscence with hardware exposure in an average time of 38 days (minimum 14, maximum 68 days) from osteosynthesis.

The bacterial wound culture showed that the infection in 4 cases was caused by *Staphylococcus epidermidis* (three of them were methicillin-resistant), in 5 cases by *Staphylococcus aureus*, in 2 cases by *Enterobacter cloacae*, in one case by *Streptococcus alpha haemolyticus*, in one case by *Staphylococcus capitis* and in one case by *Klebsiella Pneumoniae* together with *Enterobacter cloacae*.

On the basis of antibiogram and of our protocol, patients received antibiotic therapy as indicated in table 2; in five patients the wound culture was negative: in this cases it was administered broad-spectrum antibiotic therapy (Ciprofloxacin) for 7 days.

Pathogenic bacterium	Antibiotic	Dosage
Alpha hemolytic *Streptococcus*	Amoxicillin + clavulanic acid	4.4 gr iv 8-hourly
Methicillin-resistant Staphylococcus aureus (MRSA)	1th choice: Teicoplanin or Vancomycin	Teicoplanin 10mg/kg iv daily or Vancomycin 1 gr iv 12-hourly
	2nd choice: Levofloxacin + Rifampicin	Levofloxacin 1gr/die iv daily + Rifampicin 600 mg iv 12-hourly
Methicillin-sensitive *Staphylococcus aureus* (MSSA)	Ciprofloxacin	400 mg iv 12-hourly
Methicillin-resistant *Staphylococcus epidermidis* (MRSE)	Teicoplanin or Vancomycin	Teicoplanin 10 mg/kg iv daily or Vancomycin 1 gr iv 12-hourly
Methicillin-sensitive *Staphylococcus epidermidis* (MSSE)	1th choice: Amoxicillin + clavulanic acid	4.4 gr iv 8-hourly
	2nd choice: Ciprofloxacin	400 mg iv 12-hourly
Enterobacter cloacae	Ciprofloxacin	400 mg daily
	Addition of a coverage empirical antibiotic therapy in case of contaminated wound	
Staphylococcus capitis	Teicoplanin or Vancomycin	Teicoplanin 10 mg/kg iv daily or Vancomycin 1 gr iv 12-hourly
Klebsiella pneumoniae	Ciprofloxacin	400 mg iv 12-hourly
Alpha-hemolytic *Streptococcus*	Ceftriaxone	2 g iv daily

Table 2: *Extremes of the dispensed antibiotic therapy for the isolated bacteria.*

In case of positive bacterial culture, antibiotic therapy was administrated intravenous for at least 2 months; subsequently, in case of clinical good evolution, with no signs of local and general complications, patients received yet oral antibiotic therapy for 30 days after wound closure.

All fractures healed without remove the hardware (see Figure 2); in only a case, whit a large exposure area (about 3 for 2 centimeters) in a tibial pilon fracture, it was necessary to perform a paramalleolar skin flap with dermo-epidermal graft. The average time of wound closure was 97 days, with a minimum and a maximum of 12 and 223 days, respectively.

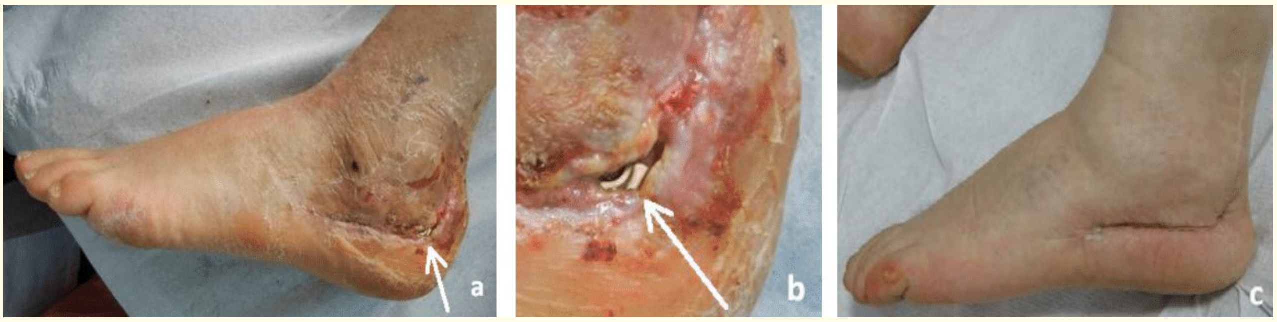

Figure 2: *Case of hardware exposure through surgical wound dehiscence at 60 days after surgery (a); white arrows indicate the area of the exposure of the hardware, more easy visible in the magnified particular (b); next the treatment, 122 days after operation the skin was closed and the soft tissues completely recovered (c).*

In four patients the hardware was next removed during the follow-up, with 385 days average time after the ORIF (min 185, max 550); in this cases the bone consolidation was complete and the skin was closed, while the symptoms were only caused by impingement of the metal with soft tissues.

In all cases full weight bearing was not influenced by treatment of wound and it was possible recover it like in normal follow-up program, three months after the ORIF.

At the 24 month follow-up, all the patients had good outcomes, with functional level of activities comparable with other cases that underwent similar lesion and treatment not followed by dehiscence complications.

Discussion

The management of soft tissue in case of dehiscence of the surgical wound with exposure of hardware in the foot and ankle is a very important issue in the post–operative and follow-up evolution; this complication can interfere the therapeutic procedures and connected results and is characterized by the lack of absolute experimental data and guidelines available in literature.

In these cases classically in past the best therapeutic choice was to remove the hardware to allow the healing of the infection below. This meant further surgery, with reconstruction of soft tissue, which are functionally and aesthetically compromised, a more long healing time but mostly a big risk of loss of reduction of the fracture and consequently of bad consolidation.

More, besides a longer healing times, additional surgical interventions and increased hospital stay, all complications of the fracture healing produce a more difficult rehabilitative path and in general an increase of costs of treatment.

With clinical application of previous basic scientific knowledges [11,12], this study demonstrates that in surgical wound dehiscences a new approach can be adopted, without remove exposed hardware, if this is titanium made.

The multidisciplinary treatment has given the support intervention of infectious disease specialist, that adapted time and indications in high-dosage antibiotic therapy, and of the plastic surgeon, that optimally chooses the type of advanced dressings and or of covering by surgical flap if necessary.

This approach has made optimal the orthopaedic management of the surgical hardware exposition and helped decisively to obtain the prefixed target, consisting mainly in maintain the plate and screws in place up until the fracture consolidation.

Afterwards the treatment all patients had an optimal course, without any consequence from the orthopedic and rehabilitation point of view, no one showed local signs of chronic infection or reinfection, as well as systemic flogistic complications.

Conclusion

This encouraging results that we achieved can provide of new guidelines for the management of soft tissue injuries that cause exposure of synthesis devices in the foot and ankle surgery; we need more extensive studies to better demonstrate this statements, but from now it’s possible to says that to use hardware titanium made can decrease problems and consequences of eventual succeeding infection with surgical wound dehiscence in the foot and ankle traumatic lesions.

Conflict of Interest

We have no conflict of interest to declare.

Bibliography

1. Ozsoy Z., *et al*. “Reconstruction of the distal lower extremity defects with distal pedicled fasciocutaneous flaps”. *Handchirurgie, Mikrochirurgie, Plastische Chirurgie* 27.3 (1995): 149-151.

2. Trampuz A and Zimmerli W. "Diagnosis and treatment of infections associated with fracture-fixation devices". *Injury* 37.2 (2006): S59-S66.

3. Borrelli J., *et al*. "Extraosseous blood supply of the tibia and the effects of different plating techniques: a human cadaveric study". *Journal of Orthopaedic Trauma* 16.10 (2002): 691-695.

4. Murray CK. "Infectious disease complications of combat-related injuries". *Critical Care Medicine* 36.7 (2008): S358-S364.

5. Darouiche RO. "Treatment of infections associated with surgical implants". *New England Journal of Medicine* 350.14 (2004): 1422-1429.

6. Matthew A Frank., *et al*. "Calcaneal fractures: surgical exposure and fixation technique update". *Current orthopaedic Practice* 22.1 (2011): 4-11.

7. Budny PJ and Fix RJ. "Salvage of prosthetic grafts and joints in the lower extremity". *Clinics in Plastic Surgery* 18.3 (1991): 583-591.

8. Lentino JR. "Prosthetic joint infections: bane of orthopedists, challenge for infectious disease specialists". *Clinical Infectious Diseases* 36.9 (2003): 1157-1161.

9. Gardener MJ., *et al*. "Surgical treatment and outcomes of extrarticular proximal tibial nonunions". *Archives of Orthopaedic and Trauma Surgery* 128.8 (2008): 833-839.

10. Reddy V., *et al*. "Calcaneus malunion and nonunion". *Foot and Ankle Clinics* 12.1 (2007): 125-135.

11. Shida T., *et al*. "Adherence ability of Staphylococcus epidermidis on prosthetic biomaterials: an in vitro study". *International Journal of Nanomedicine* 8 (2013): 3955-3961.

12. Arens S., *et al*. "Infection after open reduction and internal fixation with dynamic compression plates-clinical and experimental data". *Injury* 27.3 (1996): SC27-SC33.

13. Kaplan SL. "Recent lessons for the management of bone and joint infections". *Journal of Infection* 68.1 (2014): S51-S56.

14. Thompson S and Townsend R. "Pharmacological agents for soft tissue and bone infected with MRSA: Which agent and for how long?" *Injury* 42.5 (2011): S7-S10.

15. Habash M and Reid G. "Microbial biofilms: their development and significance for medical device-related infections". *Journal of Clinical Pharmacology* 39.9 (1999): 887-898.

Volume 9 Issue 4 April 2018