Post-operative infection at fracture site with implant in situ- Managed by retention of Infected implant till attainment of bony union- Our experience

SPS Gill[1,*], Manish Raj[2], Pulkesh Singh[3], Dinesh Kumar[4], Jasveer Singh[5], Prateek Rastogi[6]

[1]Associate Professor and HOD, [2]Lecturer, [3,4,5]Assistant Professor, [6]Junior Researcher, Dept. of Orthopaedics, UP Rural Institute of Medical Sciences & Research, Saifai, Etawah, Uttar Pradesh, India

***Corresponding Author:**
E-mail: simmygill@gmail.com

ABSTRACT

Introduction: *Early Internal fixation of any fracture now days given us great advantage with relation to early mobilization and early returns to daily activity. Rate of infection related to implant surgery reported by numerous study ranges from 0.5% to 4-5% in closed fractures and up to 10% in cases of compound fractures. Post operative infection with implant in place is one of the most difficult conditions to manage. In our study we tried to retain the implants in these cases and evaluated long term result in these cases*

Material and method: *We selected total 88 cases of infected implant without union from regular follow cases of operated post operative cases of upper and lower limb long bones managed by nailing and plating April 2011 to August 2014. Out of 88 cases 80 cases completed their follow up duration. We managed these cases with retention of implant for as long as possible with regular debridement, incision and drainage, pus culture and sensitivity and antibiotics accordingly off and on till attainment of bony union. Final results were evaluated and any implant failure and other revision surgery rates recorded.*

Results: *Out of 80 cases bony union were achieved in 65 cases (81%) with retention of same implant with proper antibiotic coverage, regular follow up and guarded weight bearing. 15(19%) of our cases shows implant failure due to delayed and non union and most of these cases were of comp Grade III & II to start with. In these cases, removal of implant was required before bony union. Infection related to implant was also cured once implant were removed after attaining bony union without any long term complications.*

Conclusion: *This increase incidence of infection related to implant also aggravated by various drug resistant microorganism. In most of these cases of infected implant, implants can be retained in situ till bony union achieved. Compromised host condition and diffuse Osteo-myelitis according to Cierny-Madar classifaication had given poor outcome with infected implant retention. Low grade infection with implant didn't have any severe negative consequence on bony union. This implant related infection can be cured with removal of implant once bony union achieved.*

Keywords: *Post operative infection, infected implant, Retained infected implant, Infected non union.*

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INTRODUCTION

Treating infection after internal fixation of fractures is one of the most challenging problems in clinical practice.With increase in frequency of high energy trauma globally and increasing trend towards the early internal fixation of compound fractures of all bones, the incidence of infection related to orthopedic implant is again showing increasing incidence[1,2,3]. The incidence of post operative implant infection in compound grade III fracture is around 10-15%[4,5].Nevertheless, fractures with infected implant present a dilemma to the treating orthopedic surgeon whether to remove implant or retain infected implant. During early postoperative period, as fractures had not have achieved bony union ,question arises whether to remove the implant to give the patient best chance to eradicate the source of infection or implant to be retained for better fracture stabilization. Traditionally it is accepted that infections cannot be cured in the presence of retained implant. Common microorganism related to implant related infection areMethicillin - resistant staphylococcus aureus, Methicillin- Suceptible Staphylocaccus Aures, Escherichia Coli, Enteroccoci and Pseudomonas Aeruginosa[6,7,8]. Till now most of these cases of infected implant, cure of an infection is generally achieved by removal of implant, and any cement or foreign body from infected site followed by regular debridement of all devitalized tissue, and long term antimicrobial treatment[(4)]. However, removing implant leads to unstable fracture with infection. These cases further required secondary procedures like external fixation and ring fixation. This leads to long morbidity, protracted immobilization or rehabilitation, and increased cost of treatment.

In literature, it is suggested that fracture will heal in the presence of infection as long as the hardware remains stable[4,5]. With better understanding of bio film and antimicrobial agents that can penetrate this biofilms prolonged retention of this implant could be possible, till union can be achieved. With regular irrigation and debridement, there will be reduction in bacterial load and then infection can be suppressed until the fracture heals[6,7]. The stability of the fracture site provided by the implants has been proved to useful in reduction of the incidence of infection after internal fixation, and help in eradication of established infections, thus making the fracture stabilization a top priority[8,9,10,11]. The primary aim of this study was to evaluate the success rates for achieving union and resolving infection with infected retained implant using this strategy.

MATERIAL AND METHODS

This study was conducted on 88 patients in the Department of Orthopaedics, Uttar Pradesh rural institute of medical sciences and research(UPRIMS & R) a 1000 bedded tertiary level medical college situated in rural setup of north India, overa period of 40 months, after obtaining the permission from institutional ethical committee and taking informed and written consents from the patients.

We included patients with an infected implant who fulfilled the following inclusion criteria:

- Post-operative cases of fractures of long bones managed with internal fixation presented with local sign and symptoms of infection like erythema or warmth of the skin overlying the implant, joint pain or infusion, or systemic feature like fever present.
- A stable implant shown radio logically and during follow up examination.
- Onset of sign and symptoms of infection within 3 weeks of fixation.
- Healthy bone stock and surrounding soft tissue.

The exclusion criteria for the patient with retained infected implant in our study include:

- Any contraindication to receiving the recommended long term antimicrobial agent
- Fractures with unstable fixation or loose fixations are not included in this study.
- Known cases of multidrug resistant cases with high grade infection also excluded.
- Patients with other systemic disease leading to increase susceptibility to infection like uncontrolled diabetes, HIV and other immune compromised conditions.

Out of total 5000 cases of fracture fixation done during April 2011 to August 2014, 88 cases of fracture fixation by intramedullary nailing and Plating shows early post operative infection (1.5%) were selected from the Department of Orthopedics, Uttar Pradesh rural institute of medical sciences and research. Cases of prosthetic infection not included in current study. Out of these 88 selected cases 80 cases completed their follow up till bony union. The cases were selected according to inclusion criteria and further evaluated radio logically and routine investigations carried out like complete blood count, ESR, CRP, local pus microscopy, culture and sensitivity. Infections were confirmed by growth of the same micro-organism on two or more cultures of either a pre-operative aspirate or intra-operative tissue specimens. Cases with acute post-operative infection were taken to operation theatre for local wound irrigation and debridement. Local aspiration and tissue sampling was done for histopathological and culture and sensitivity investigation. During this irrigation and debridement, the stability of fixation also assessed and cases with good stable internal fixation only selected for further continuation of retention of implant. All these cases were kept on intravenous antibiotics for 2-4 weeks depending on the microbial followed by oral antibiotics. Antimicrobial protocol used was depending on culture and sensitivity of pus collected from infected site. These antimicrobial were also according to our institutional antimicrobial policy. Implant related infections always have problem of antibiotics bio availability due to bio film around the implant[12,13]. Tab Rifampicin 450 mg BD added in all cases of infected implant to overcome this biofilm[14,15,16,17].

Table 1: Antimicrobial protocol Used for implant related Infection

Organism	Antibiotics used (Initial)	Dose	Duration	Continuation Phase	Dose
Staphylococcus methicillin-susceptible	Cloxacillin or nafcillin‡ + Rifampicin	2 g every 6 hrs IV 2g every 6 hrs IV 450 mg BD PO	2 weeks	Levofloxacin + Rifampicin	750 mg OD PO 450 mg BD PO
Staphylococcus methicillin-Resistant	Vancomycin + Rifampicin	1 g every 12 hrs IV 450 mg BD PO	4 weeks	Fusidic acid or minocyclin + Rifampicin	500 mg TDS PO 100 mg BD PO 450 mg BD PO
Streptococcus species	Penicillin G or Ceftriaxone	5 million U 6 hrly 1 gm 12 hrs IV	4 weeks	Amoxy+Clavulanic Acid	625 mg TDS PO
Pseudomonas aeroginosa	Ceftazidime +Amikacin	2gm QID IV 500mg BD IV	4weeks	Levofloxacin	750 mg OD PO
Anaerobes and Mixed Infection	Clindamycin Imipenam or Meropenam	600 mg QID IV 500 mg QID IV 1 g TID IV	4 weeks	Clindamycin	300 mg QID

PO- per orally, **OD-** once daily, **BD-** twice daily, **TID-** Three times daily, **QID-** Four times Daily
*****Antibiotics selection also depends on culture and sensitivity reports and modified accordingly

Regular weekly follow up of these cases are done to asses to effectiveness of given antibiotics by reduction in swelling and reduction in the amount of pus coming out of sinus and also by lab investigations like ESR and CRP. Cases which are responding to antimicrobial therapy are managed in this way. Cases not responding to systemic antimicrobials were further managed by local wound irrigation and local antibiotics beads and repeat culture and sensitivity[18,19,20]. Any collection of superficial of deep pus was watched carefully and immediate incision and drainage carried out. Radiograph of limb obtained every 4 weeks. Cases during follow up also carefully assessed and evaluated for any sign of implant loosing, failure of fixation, osteolysis at fracture site and screw site. A successful outcome was defined as a functional and pain free implant, normal routine blood examination, and absence of radiological features of either loosening or pseudoarthrosis. Failure of the implant includes clinical sign and symptoms suggestive of infection, abnormal laboratory tests or radiological signs suggestive of recurrent infection[21]. Failures of the implant were further managed by implant removal, debridement, and external fixation and in some cases delayed revision internal fixation.

RESULT

In the present study, 88 patients who fulfilled the inclusion criteria were continued with same implant were managed and followed up in our study. Out of these 88 cases, 80 cases complete their follow up. Out of these 80 cases, 51 were males and 29 cases were female with age range from 19 to 56 years. Follow up duration of these cases were range from 14 months to 36 months with average follow up duration of 24 months.

Out of these 80 cases, 46 cases were of lower limb, 30 tibia and 16 femoral cases presented with infection following internal fixation. 34 cases were of upper limb; out of this 10 cases were of humerus and 24 cases of forearm internal fixation. Out of total cases, 38 cases were of compound grade I, 20 cases were of compound grade II, 12 cases were of compound grade III. 10 cases were closed fracture with no sign of infection to start with.

Table 2: Microbial seen during culture and sensitivity report in Infected implant cases.

Micro Organism		No of Case	% of cases
Staphylococcus Aureu	Methincillin Sensitive	24	30%
	Methincillin Resistant	16	20%
Pseudomonas Aerogunosa		12	15%
Streptococci		10	12.5%
Klebsiella		4	5%
Mixed Organisms		6	7.5%
Sterile Culture		8	10%

During follow up debridement and culture sensitivity positive culture reported in 72 cases, out of which 40 samples are positive for staphylococcus aureus, 12 cases were positive for pseudomonas aeruginosa, 10 cases were positive for streptococci and 4 samples were positive for klebsiella and rest 6 are positive for polymicrobials. In 8 cases culture didn't shown any growth. Resistance of methicillin was seen in 40% of staphylococcus aureus isolates.

Table 3: Site Distribution and result of the cases of retained Infected implant.

Total cases	Limb	No	Site	No	Compound Grade				Union Achieved	Failure case
					Closed	GrI	GrII	GrIII		
80	Lower Limb	46	Tibia	30	2	22	12	6	25(83%)	5
			Femur	16	2	8	3	2	12(75%)	4
	Upper Limb	34	Humerus	10	2	4	2	2	8(84%)	2
			Forearm	24	4	4	3	2	20(84%)	4
Total Failure Case				15	1	3	5	6		15(19%)

Table 4: Cierny -Madar Classification of bone infection and outcome

Anatomical Site	Cases	Type of Host	CASES	OUTCOME		Remark
				Union	Failed	
Medullary Osteomylitis	38	A	33	31	2	15.7% Failure
		B	5	1	4	
		C	0	NA	NA	
Superficial Osteomylitis	12	A	10	10	---	8% Failure
		B	2	1	1	
		C	0	NA	NA	
Localized Osteomylitis	22	A	20	19	1	9% Failure
		B	2	1	1	
		C	0	NA	NA	
Diffuse Osteomylitis	8	A	3	2	1	75% Failure
		B	5	-----	5	
		C	0	NA	NA	

Out of these 80 cases, we were able to achieve good to excellent outcomes in 65 (81%) cases. During follow up of these 15 (19%) cases shows failure and continuation of infected implant could not be possible in these cases. Removal of infected implant, debridement and fracture is stabilized with external fixator in these failure cases. Out of these 15 failure cases, in 12 cases loosening of implant and failure were seen due to uncontrolled infection during progressive course of duration after internal fixation. Out of 15 cases of failure of implant, 11 cases were of compound grade III and compound grade II which were treated by primary internal fixation, correlating the association between presence of infection and failure of implant with the occurrence of soft tissue injury during initial presentation. Out of 80 cases, 25 (83%) cases of tibia, 12 (75%) cases of femur, 8 (80%) cases of humerus, 20 (84%) of forearm cases achieved complete bony union during follow up with retained implant without any further complications. Out of these successful 65 cases, 51 cases agreed for removal of implant after bony union. Rest 14 cases do not give the consent for the removal of implant as in majority of them infection is cured at the time of bony union, or they are not interested for implant removal as little or negligible problem with implant in situ. According to Cierny-Madar classification of Osteo-myelitis of bone, we evaluated the result and final outcome according grade and localization of the Osteo-myelitis.

There is clear relationship between severity of Osteo-myelitis according to Cierny -Madar classification with final outcome. Superficial and localized Osteo-myelitis cases given better outcome in relation to diffuse and medullary Osteo-myelitis. Out of 80 cases, none were from host C group, 66 cases were of type A and 14 cases were of Type B host. Out of 66 Type A host failure seen in 4 cases (6%) and out of 14 Type B host failure seen in 11 cases(78.5%). Hence diffuse Osteo-myelitis and type B host have poor outcome with retention of implant.

4 cases (25%) of femur, 5 cases (16.5%) of tibia, 2 (20%) cases of humerus and 4 (16%) cases of forearm shows failure with retained infected implant. Failure rate is higher in tibia probably due to less soft tissue occurrence and higher proportion of open fractures in tibia. These cases showing failure of

retained implant were treated with implant removal, local debridement, stabilization with external fixator, prolonged antibiotic coverage and delayed definitive secondary procedure of fracture stabilization when infection is cured. All of these cases achieve bony union. The mean follow up was 24 months (range 14 months to 3 years). Bone union is achieved in all cases with in a mean period of 4.2 months (3 to 8 months). The functional outcome is satisfactory in most cases.

DISCUSSION

Traditionally management of postoperative infection includes a prolonged course of antimicrobial agent, aggressive debridement, and most importantly, removal of the infected implant [3,7,8]. Steckelberg JM et al [12] in his study found success rate of more than 80% using above said protocol in cases of prosthetic infections, but had its own complication including prolonged immobilization, unstable fracture site and poor patient compliance. Recently several investigators suggest that the fracture will heal in the presence of infections as long as the fixation material remains stable [13-15].

Right mire et al [9] retrospectively identified 69 patients with acute and late post operative (<16 weeks) infection and their findings included a success rate of 68% of osseous union with original hardware in place. Tsukayama, Estrada and Gustilo [16] reported a success rate of 68%, but debridement with retention of the implant was limited only to infections of short duration (less than one month after surgery). Meehan et al[17] reported a one-year recurrence-free rate of 89%, but only infections with penicillin-susceptible streptococci were included.

The stability provided by the implants has been proved to reduce the incidence of infection after internal fixation, and to aid in the clearance of established infections, thus making the maintenance of fixation a top priority.[4,5] Berkes et al [11] retrospectively analyzed 123 postoperative wound infections that had developed within six weeks after internal fixation of a fracture and found that 87 patients (71%) had fracture union with operative debridement, retention of hardware, and culture specific antibiotic treatment. In an experimental study warlock et al[5] fixed diaphysis fractures of the tibia with a stable compression plate or with an unstable endomedular pin, and inoculated Staphylococcus aureus in the fracture zone. They found out that in the unstable group there were two times more infections than in the stable compression plate group (71% vs 35%).Numerous studies have proven that there is no significant difference in the time of bony union between the infected and uninfected fracture but the main concern is fracture stability.

In the present study, we were able to achieve good to excellent outcome in 65 cases (81%) out of 88 of our cases. In present study our main purpose was to retain the infected implant in situ as long as possible to attain bony union without any serious complications. Success of retention of infected implant also depends on the initial soft tissue condition of the patient. Most of the failure cases of infected implant retention were from compound grade III & II group to start with. Classification of Osteo-myelitis and host according to Cierny - Madar also have influence on final outcome. Diffuse and medullary Osteo-myelitis had shown poor outcome of implant retention. Type A host also shown better outcome in relation to type B type of host. As literature does not suggest any fixed guidelines regarding whether implant should be removed or retained in the presence of an acute infection, the management requires flexibility in the management plan while trying to avoid a poor outcome or any limb or life threatening serious complications. The present study suggests it is possible to achieve union with regular follow up of the cases, proper antibiotic coverage, and better nutrition of the patients. Any implant loosing and unstable fixation with infection should not be continued with same implant as these cases given poor results.

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