

ORIGINAL ARTICLE

Frequency and Risk Factors of Pin Tract Infections With Limb Reconstruction System During Management Of Open Fracture Of Long Bone Lower Limb

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ABSTRACT

Keyword: pin tract, LRS, open , infection

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Background: Many post-operative complications related to limb reconstruction system treating open fractures. Pin tract infections are a common complication that puts additional burden on the patient and the healthcare system. **Objectives:** To determine the relationship between frequency of pin tract infection with limb reconstruction system and specific risk factors. **Material and Methods:** This prospective study included 20 with open fracture of lower limbs long bone, aged between 9 to 65 years of either gender. All patients were treated with limb reconstruction system . Frequency of pin tract infection and associated risk factors were recorded and analyzed. **Result :** Pin tract infections rate was 45% (9 patients). As regard risk factors for these infections , smoking was recorded in 100% in these cases, diabetes mellitus in 5(55.5%) cases, and 6 (66.6%) and 3 (33.3%) patients were type III and type II open fracture respectively. The mean time of fracture union was 7.56 ± 1.81 . According to Anderson and Hutchinson's score all these pin tract infection cases recorded good score. **Conclusion :** Diabetes Mellitus and smoking are significant risk factors related to Pin tract infections with limb reconstruction system managing open fracture of lower limb

INTRODUCTION

Open fractures are a challenging problem faces every orthopedic surgeon. the Limb Reconstruction System (LRS) is a good method for definitive management of these fractures¹. However, pin tract infections (PTIs) are the most common complications associated with LRS^{1,2}.

PTIs may result in Pin Loosening, pain, cellulitis and Osteomyelitis. Pin Loosening consequently compromise the stability of the LRS leading to loss of fixation and mal-alignment. Osteomyelitis may require other surgical procedures as debridement ,spacer and bone grafting^{2,3} .

PTIs raise healthcare cost by necessitating higher clinic visits, antibiotic prescriptions, and surgeries^{3,4} . The frequency of PTIs varies depending on fracture degree, patient morbidity, smoking habits, and care methods^{4,5}.

The literature lacks information on risk variables for PTIs with LRS during long bone open fracture fixation, which is crucial for implementing prevention and management strategies.

We hypothesizes that there is a high possibility of the PTIs with smoking , diabetes mellitus (DM), and higher grade open fracture.

The aim of our study is recording and analyze the risk factors associated with PTIs with LRS.

PATIENTS AND METHOD

This is prospective study of 20 cases of open fractures of lower limb(tibia & femur) treated by LRS .at Orthopedic Department, Aswan University Hospital in the period between (January 2023 to January 2024) . both male and female above 8 year old with open tibia and femur fractures, regardless of the degree of fracture are included .those with closed fractures and those that were conservatively treated and open pathological fractures are excluded. Advanced Trauma Life Support (ATLS) protocol , Detailed history is taken , physical examination Were obtained . the patient's data regarding DM , smoking and degree of open fracture are recorded according to Gustillo classification⁶ .

Operative technique :

At operative theater, The wounds are extensively debride and irrigated, Fracture are reduced temporarily by k-wire or small plate . the required length of LRS are chosen then then 3 schanz pins are inserted in each fracture sides (proximal and distal) then securely fixed on clamps that tightened on the LRS rail. then removal of the temporarily by k-wire or small plate. The fixator should be applied in a manner that keeps it distant from the wound site for subsequent soft tissue coverage procedure is necessary. The wounds are closed primary without tension if accessible or leaved open for other debridement, vacuum assisted closure (VAC) and skin coverage procedures.

Postoperative care

the protocol for pin tract care was started after discharge from the hospital . Each pin site was cleaned with sterile gauze and alcohol 70% daily. After cleaning, each pin site was covered with alcohol wet sterile gauze. every three days the frame and the pin site was washed with saline , dried with a towel, and the pin site was covered with sterile alcohol wet gauze. During follow up, we recorded the cases of PTIs , early culture are obtained and administration of antibiotic according to sensitivity test and good following of pin site care. The Deep infection , fracture stability, and union rate are recorded in the PTIs cases.

Statistics

All statistics will be performed using SPSS version 27.Quantitative data will be presented as mean \pm SD and median \pm range. Qualitative variables will be expressed as percentages. Analysis of continuous data with normal distribution will be analyzed by student t-test and non-normally distributed data by Mann-Whitney U test. Categorical data will be analyzed by chi-square test and Fischer exact. P value of < 0.05 was defined as statistically significant.

RESULT

our prospective study included 20 patient . the mean age of was 36.3 ± 15.1 years with minimum age of 9 years and maximum age of 65 years. there were 17 (85%) male and 3 (15%) female . there were 14(70%) smoker patients and 6 (30%) non-smoker patients, there were 6 (30%) diabetic patients .according to gustello classification, there were 12 (60%) type II patients and 8 (40%) type III patient . the mean complete radiological union time was 6.9 ± 1.9 months. According to modified Anderson and Hutchinson's criteria ,the final results were poor in 3(15%) patients (15%), moderate in 6 (30%) patients and good in 11(55%) patients . **(table 1)**

		All Studied patient N(20)	
AGE	Mean \pm SD	36.3 ± 15.1	
	Min – Max	9 – 65	
SEX	Male	17	85%
	Female	3	15%
SMOKING	Smoker	14	70%
	Non	6	30%
DM	Yes	6	30%
	No	14	70%
CLASSIFICATION	Type II	12	60%
	Type III	8	40%
Anderson and Hutchinson's Score	Good	11	55%
	Moderate	6	30%
	Poor	3	15%

Table 1 : show clinical and demographic data

PTIs cases

We recorded pin tract infection in 9 (45%) cases. Eight (88.9 %) PTIs cases healed with pin site care and antibiotic except one (11.1%) case was resistant to antibiotic and pin care protocol and required the removal of the infected pins and application of new pins at a new site due to loosening . no recorded cases (0%) loss of LRS frame stability or fracture nonunion were between the PTIs cases.

In All 9(45%) cases of PTIs, all cases were smoker (64.29%) of all smokers in all studied patients, 5(83.33%) patients with DM comorbid recorded PTIs in 6 patient with DM . 6(75%) cases of PTIs were type III open fracture and 3(25%) cases of PTIs were type II open fracture .the mean of time of fracture union in PTIs cases was 7.56 ± 1.81 and all PTIs cases were good result according to modified Anderson and Hutchinson's score⁷ 9(81.8%) cases of 11 good result cases. (**Table 2**)

	Total number (N 20)	PTIs		X ²	P. value
		Yes (N 9)	No (N 11)		
Smoking	Yes (n14)	9(64.29%)	5(35.71%)	7.013	0.012*
	No (n 6)	0(0%)	6(100%)		
DM	Yes (n6)	5(83.33%)	1(16.67%)	5.089	0.038*
	No (n 14)	4(28.57%)	10(71.43%)		
Grade of open fracture	Type II (n 12)	3(25%)	9(75%)	4.848	0.040*
	Type III (n 8)	6(75%)	2(25%)		
Time of fracture union	Min – max	5 – 10	3 – 8	1.290	0.214NS
	Mean \pm SD	7.56 \pm 1.81	6.45 \pm 1.97		
Anderson and Hutchinson's Score	Poor (n 3)	0(0%)	3(100%)	13.388	0.001**
	Moderate (n 6)	0(0%)	6(100%)		
	Good (n 11)	9(81.8%)	2(18.2%)		

Table2: show relationship between PTIs and smoking ,DM, grade of open fracture , time of fracture union and score

Illustrative case :

Male patient , 30 years old ,motor car accident ,presented by Right open fracture (OGIII RT distal third tibia and fibula fracture) , neurovascular bundle was intact. By history, patient was type I DM and Heavy smoker. Open fracture were treated by aggressive debridement and irrigation then fracture was reduced and stabilized by LRS . During follow up , the PTIs complication was recorded then patient has had good pin site care and good antibiotic were given to the patient. finally full fracture union was achieved



Figure show OGIII RT Distal third tibia and fibula fracture fixed by LRS



Figure Show PTIs complication are recorded and follow up

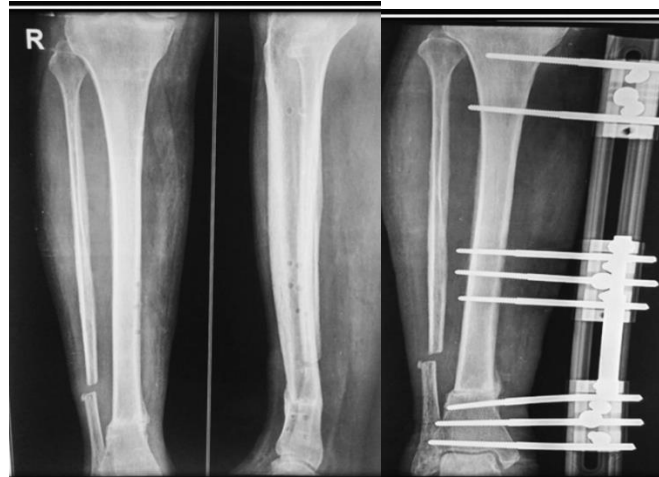


Figure Full fracture union of distal tibia fracture

DISCUSSION

In literature, the most reported complication associated with open fractures has been treated by LRS is PITs . overcome of PTIs is important for good outcomes of LRS².

The literature has deficient in information on risk factors for PTIs with LRS during long bone open fracture fixation, which is critical to establishing prevention and treatment strategies.

In this current study, we recorded that PTIs are most Post operative complication with LRS . 9 (45%) cases of PTIs healed with good pin site care and antibiotic except one (11.1%) case was resistant to antibiotic and pin care protocol and required the removal . we analyzed the risk factors for PTIs with LRS. Where, we recorded most risk factors related with PTIs was smoking , DM and grade of open fracture.

Smoking was recorded in 14 (70%) patients in our study and all PTIs patients were smokers (100%), that was statistically significant risk factor for PTIs.

Six (12 %) patients in our study were DM, 5 (83.33%) of them suffered from PTIs recording significant difference.

There was significant relationship between grade of open fracture and incidence of PTIs complication. We recorded PTIs in 6 (75%) patients between 8 with type III, in comparison to 3 (25%) patients between 12 with type II open fracture according to Gustillo classification⁶ .

according to time of complete fracture union there was non significant difference (P value = 0.214) between cases that recorded PTIs and other cases. Between PTIs cases, the mean of time of fracture union was 7.56 ± 1.81 , while it was 6.45 ± 1.97 between the non-PTIs.

In our study, the PTIs did not affect on LRS frame stability , or fracture union rate. also we reported that PTIs had no effect on the final outcome when treated properly with appropriate antibiotics, debridement, and changing the pins when they became loose or with resistant

infections. according to modified Anderson and Hutchinson's score⁶ , we recorded good score in all 9 PTIs cases.

the recorded PTIs with LRS in Other literatures , Ibad Sha et al ,pin tract infection was present In 8 (40%) patients,. pin tract infection which was seen in 6 (24%) of patients which healed on suitable parenteral antibiotics after culture and sensitivity in Kamal Arora et al study. Kale AB et al showed that The most common complication encountered was pin tract infections seen in 8 (28%)cases. Mahajan NP reveal incidences of pin tract infection 5(25%) patient , pin loosening 3 (15%) cases. Shady S et al reported in their study 4 (50%) patients with Pin-tract infection and 3 of them were resolved after pin wounds care and parenteral antibiotics. The PTIs was resistant in one patient, where a secondary procedure of debridement and exchange of two pins was performed. Also Chahar HS et al reported Pin-tract infection in 2 (14.29%) out of 14 cases. KISHOR et al recorded 10 (38%) cases had PTIs, 9 of which, the antibiotics were enough for treatment while one patient had infection severe that required pin removal. **(Table 3)** the recorded PTIs rate in our study and other literatures

Studies	Total cases	Pin tract infection	Percentage
Our study	20	9	45%
Ibad Sha et al	20	8	40%
Kamal Arora et al	25	6	24%
.Kale AB et al	30	8	28%
Mahajan NP	20	5	25%
Shady S et al	8	4	50%
KISHOR UIKEY1	26	10	38.46%
Chahar HS	14	2	14.29%

Table3: show Recorded PTIs in other studies

LIMITATIONS

Limitations of this study were a lack of comparison group or a control group and less sample size. Considering further multi-centric studies and randomized control trials .

RECOMMENDATION

We encourage that future studies analyze the risk factors of PTIs with LRS in order to provide a guideline for the prevention and treatment of these disorders. Surgeons and nursing staff should develop a standard pin care routine for their patients, which can be taught to everyone engaged in the patient's care. During fixation of the open fractures with LRS, the smoker and diabetic patients should take a special care for the possibility of PTIs.

CONCLUSION

Two major risk factors for PTIs of LRS during the treatment of open long bone fractures are diabetes mellitus and smoking. the prognosis was unaffected, when PTIs were appropriately treated with the right antibiotics, debridement, and replacing the pins when they came loose or that had resistant infections.

Disclosure of interest

The authors declare that they have no competing interest

Authors contributions

HR : study design, data analysis reviewing and writing the manuscript

AF: performing operations , collecting data and writing manuscript

MS : data analysis reviewing and writing the manuscript

EY: study design, writing the manuscript , reviewing the manuscript

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