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Infection Severity at Weekly and Daily Dressed Pin Sites in External Fixation

Olusegun O. Olanipekun[1], Christian C. Madubueze[2], Akinwale M. Oluwasina[3], Muideen Adegoke[3], Olusola O. Akanbi[1], Olukemi Lawani[4]

[1]*Surgery Department, Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso, Nigeria*
[2]*Department of Orthopaedics and Trauma, National Hospital , Federal Capital Territory,Abuja, Nigeria*
[3]*Departement of Orthopaedics and Trauma, Federal Medical Centre, Keffi, Nasarawa state, Nigeria*
[4]*Cedarcrest Hospitals, Federal Capital Territory, Abuja, Nigeria*

Abstract

Background

The use of external fixation has become an integral component of modern Orthopaedics especially in trauma and reconstructive surgery. However, the use can be complicated by pin site infections which remain a major challenge in Orthopaedic practice. Despite various studies done on pin site care, there has not been any universally acceptable protocol as reliance on surgeon's preference and consideration of results from local studies has been the practice in many centres. Frequency of dressing also has been a subject of controversy and there are few studies available on this. This study, therefore aimed to investigate the difference in the rate or severity of infection between daily and weekly pin site care using the same dressing agents.

Material and Method

This study employed a prospective and comparative design. Forty-two patients with indications for external fixation between the ages of 18 and 65 years were purposively selected as the study respondents with appropriate ethical considerations and informed consent. The respondents were assigned to two study groups for post-operative pin site care; group A comprised of 21 patients receiving daily pin site care and group B comprised of 21 patients receiving weekly pin site care. External fixation was carried out as described using a standard technique. The same dressing agents were used for the two groups. A structured proforma was used to examine patients in the two groups for pin site infections. Data obtained were subjected to statistical analysis using the statistical package for social sciences (SPSS) version 23. Descriptive and inferential statistical analyses were conducted, with chi square analysis used in testing the stated hypotheses at 0.05 significant level.

Results

There was no statistically significant difference in the presence of pin site infection reported by patients receiving daily pin site care and those receiving weekly pin site care ($\chi^2 = 0.47$, $p > 0.05$). There was no statistically significant difference in the severity of pin site infection among patients receiving daily pin site care and their counterparts receiving weekly pin site care ($\chi^2 = 2.09$, $p > 0.05$).

Conclusion

The rate and severity of infection is not significantly affected by the frequency of pin site care and thus weekly dressing may suffice for pin site care in our environment.

Key words: ***External fixation, Pin site infection, Pin site care***

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I. Introduction

The use of external fixation has become an integral component of modern Orthopaedics and it is widely used in trauma and reconstructive surgery[1,2]. External fixation involves the use of pins inserted through a small skin incision through the bone to stabilize fracture fragments. They were first used in the management of comminuted fractures and open fractures, but later found to be useful in distraction osteogenesis, correction of congenital and acquired deformities and treating specific fracture complications.[2] External fixation helps in early mobilization, permits axial loading of the fracture, and better access for wound care in cases of open fractures[2]. It can be used temporarily before definitive management like open reduction and internal fixation is done especially in cases of severe soft tissue injury. It can also be used as the definitive method of managing fractures and their complications.

Unfortunately, its use has been associated with complication of pin site infections.[1,2]Pin site infections are common Orthopaedic challenges encountered from the use of percutaneous pins which include; external

fixation, skeletal traction, and pins and wires in the management of fractures. Pin sites are prone to infections when there is disruption in the metal or pin-skin interface which could be due to instability of the construct. This makes the environment unsuitable for bone healing because of increased movement at the interface of the pin with the skin and bone thus causing irritation and infection.[1, 2.]

Pin site infections often present as signs of inflammation at the pin sites, purulent discharge, loosening of the pins and there may also be radiological evidence of osteomyelitis at the advanced stage. The infection has been graded in several classifications of which four are commonly used which include Ward, Saleh and Scott, Checketts, and Dahl classification.[18,19,20]

Checketts–Otterburns Grading System (1999)[20]

Grade 1—Slight erythema, little discharge. Treat with improved local pin care
Grade 2—Erythema, discharge, pain, warmth. Treat with improved local pin care and oral antibiotics
Grade 3—As per grade 2, but no improvement with oral antibiotics. Pins/ex fix can be continued.
Grade 4—Severe soft tissue infection involving several pins ± pin loosening. Ex fix must be discontinued
Grade 5—As per grade 4, but with bone involvement visible on radiographs. Ex fix must be discontinued
Grade 6—Major infection occurring after ex fix removal. Treatment requires curettage of pin track.

Pin site care considered to be standard starts from insertion, ensuring a stable construct with the knowledge of the biomechanics of external fixation, meticulous surgical technique and adequate post-operative cares including prompt removal of the construct when it has served its purpose.[2]

Despite various studies done on pin site infections, there has not been any universally acceptable protocol for pin site care including the frequency of care. This is because no protocol has demonstrated complete elimination of the risk of infection and differences in the conditions under which they were carried out.[4,5,7,11,12.]

What is adopted in various centers is based on individual surgeon's preference and results from local studies.[3,7].The frequency of pin site care especially cleaning and change of dressing suggested by various authors include once daily, twice daily, weekly or when required.[1] It becomes imperative to carry out a study about the frequency of cares as regards prevention of infection that is best suitable for our locality.

The role of dressing of the pin sites cannot be overemphasized in the prevention of pin site infections. However, the frequency of dressing has been a subject of controversy[1, 3, 5, 9] and studies done in this regard are very few with even fewer randomized controlled trials. Most studies were carried out among the Caucasian population, and hence the need to study the severity of infection in pin sites dressed daily and weekly in our environment.

II. Material and Methods

This is a prospective comparative study carried out in the department of Orthopaedic and trauma, Federal Medical Centre, Keffi, Nasarawa state, Nigeria from December, 2018 to December, 2019. 42 patients between 18 and 65 years of age with need for external fixation presenting at the Accident and Emergency unit and Orthopaedic Outpatient unit of the hospital were recruited for the study.

Study Design: Prospective comparative, hospital based study.

Study Location: Federal Medical Centre, Keffi, a tertiary healthcare centre, strategically located in the North central part of Nigeria

Study Duration: December, 2018 to December, 2019.

Ethical approval was obtained from the Ethics and Research Committee of Federal Medical Centre (FMC) Keffi.

Sample size: 42 patients (though, 46 was recruited to allow for about 8.7% drop rate)

Sample size calculation: Leslie-Fischer's formula for minimum sample size estimation was used in determining the sample size as follows[36]:

$$n = \frac{Z^2Pq}{d^2}$$

n = minimum sample size.
Z = standard normal deviation usually set at 1.96 which corresponds with confidence interval of 95%.
d = Desired maximum allowable margin of error: a maximum of 5% margin of error will be allowed in this study.
P = proportion in the target population estimated to have a particular characteristics.
q = 1 – p
Pin site infection rate of 7.9 % was reported in a previous published study done in Nigeria by Ogbemudia et al[8].
Therefore,
P = 0.079
q = 1.0 – p = 1.0 – 0.079 = 0.921
The minimum sample size (n) =

$$n = \frac{(1.96)^2 \times 0.079 \times 0.921}{(0.05)^2} = 111.80$$

n = 111.80.

However, sample size calculation for study population less than 10,000 was further calculated as follows:

$$nf = \frac{n}{1 + n/N}$$

Where nf = desired sample size when population< 10,000.

A review of procedures done in Orthopaedic department of Federal Medical Centre, Keffi between June, 2017 and May, 2018 (1 year) revealed a total of 258 procedures of which pin related procedures were 67 during this period.

Therefore, N (estimate of population size) is 67.

$$nf = \frac{111.80}{1 + 111.80/67} = 111.80/2.67 = 41.87$$

nf = 42 .

Inclusion Criteria

(i) Patients with need for external fixation for fractures of the upper and lower limbs.
(ii) Age between 18 and 65years, both males and females.

Exclusion Criteria

(i) Patients with skin infection in the affected limb.
(ii) Patients with acute or chronic osteomyelitis in the affected bone.
(iii) Patients with limb ischemia.
(iv) Patients with infected open fractures.
(v) Patients with life threatening conditions requiring intensive care.
(vi) Patients with evidence of infection at the first wound review, 72 hours post operatively.
(vii) Patients unable to attend follow up care appointments.
(viii) Patients with allergies to the dressing agents to be used.
(ix) Patients with diabetes mellitus and other immunosuppressive conditions.

Subjects and Selection method: Forty-two (42) patients between the ages of 18 and 65years presenting to the accident and emergency unit of the hospital with open fractures of the extremities and to clinics with Orthopaedic conditions requiring external fixation were recruited for the study after thorough history taking, examination, radiological investigations and other base line investigations. Those with aforementioned criteria not suitable for the study were excluded.

Baseline investigations to determine fitness for anaesthesia were conducted. Informed consent for the procedure and study was obtained separately prior to the surgery after a detailed explanation and questions had been entertained. Choice of anesthesia was sub-arachnoid block for patients with lower extremity injuries and general anaesthesia or axillary block for those with upper limb injuries.

All the patients were given the same brand of the prophylactic antibiotic, IV Ceftriaxone 1g stat and then 1g 12 hourly and IV Gentamycin 80mg 8 hourly (patients with good renal status), extended to 48hours after surgery according to the antibiotic protocol of the Orthopaedic unit in Federal Medical centre, Keffi.

Procedure for external fixation was carried out for all patients as described in the standard operative textbooks of Orthopaedics.

Each 4.5mm Schantz screw for Hoffmann's external device or 6mm for linear rail system-LRS (uncoated) was inserted through a short longitudinal incision made with size 10 surgical blade and tension was avoided on the surrounding soft tissue. Dissection was carried down to the bone with minimal soft tissue trauma.

The holes in the near cortex were pre-drilled with sharp 3 mm drill bit or 4.5mm drill bit for LRS at low revolutions using the drill sleeve. Saline irrigation was done during drilling to prevent heat necrosis and to wash out bone debris which could form sequestrum and thus a nidus for infection. The Schantz screws were inserted under image intensifier ensuring bicortical purchase in the uniplanar external fixation. It was ensured that the pins were not loose as this predisposes to pin site infections. After a stable construct was achieved, dressings were applied and crepe bandage applied in the theatre. Limbs were elevated and multimodal analgesia was given according to the protocol of the unit.

The first change of dressing was done 72 hours after surgery (if not soaked) according to the practice in the department of the Orthopaedics, FMC, Keffi. The patients who had symptoms and signs of infection at the first post-operative wound review were excluded while those with no signs of infection were divided into two; group A for daily dressing (the control) and group B (the study group) for weekly dressing using balloting methods. The cleansing solution, dressing agents and method of dressing were the same for the two groups.

Pin sites for both groups were cleaned with 0.9% normal saline, removing crusts. A dressing with sterile gauze impregnated with mixture of 1% silver Sulphadiazine (Dermazin® cream) and 5% Chlorhexidine solution was then applied, lightly compressive to prevent hematoma formation. The dressing agents selected have been shown in a study by Ogbemudia et al[8] to have a significant effect in reducing pin site infection in our environment. Dressings were done with sterile glove and surgical instruments using sterile gauze from hospital Central Sterile Services Department (CSSD) to ensure asepsis.

Group A patients had their pin sites examined daily for features of infection as stated above and dressed daily, while the group B weekly.

This was done in the hospital for minimum of 28 days (few patients discharged before this period were followed up in the outpatient dressing room)**.** Presence of erythema, cellulitis, purulent discharge when seen signified infection. Pin site infection was categorized based on Checkett[20] classification. Swabs were taken from infected pin sites for microscopic culture and sensitivity and patients commenced on antibiotics. Antibiotics choice was empirical first and later guided by culture and sensitivity results. In the case of infection, daily or twice daily pin site care were done regardless of the group and other management instituted depending on the grade of infection according to Checkett[20] classification stated above. The cost implications for both group A and group B were estimated, likewise the extra cost incurred through the cost of antibiotics and analgesics in those with infected pin sites regardless of the group.

A proforma designed for this study was filled when patients were recruited and kept in their case-files, to be updated daily or weekly as the case may be. The proforma contained the biodata, the group of the patient (A or B), diagnosis or indication for external fixation and symptoms and signs of pin site infections. It also included report of microscopy, culture and sensitivity. The cost implication was included in the proforma along with other useful information. 46 patients were recruited in total, however, 2 patients opted out of the study, and proformas from 2 patients were incomplete making only 42 proformas available for analysis.

Statistical Analysis: Data obtained from the study were analyzed using the IBM SPSS STATISTICS version 23. Descriptive and inferential statistical analysis was conducted. Chi square analysis was conducted to test the stated hypotheses. For all statistical tests, $P<0.05$ was considered statistically significant. Results were presented in appropriate statistical tools like tables and charts.

Limitations of the Study

It was impossible in some cases to ensure that surgeries were done within a particular period of time post injury as some patients did not present in the hospital immediately after the injury. It was also impossible to control the treatment the patients received prior to presentation some of which predisposed to infection especially in cases of prior intervention by traditional bone setters.

III. Results

A total number of 42 patients with open fractures of the extremities with need for external fixation and others presenting with conditions requiring external fixation for their treatment at the Orthopaedic clinic of the Federal Medical Centre, Keffi, Nasarawa state were recruited for this study. The results presented below were gathered from the information gotten from the respondents.

Socio-demographic Characteristics

Table 1. Socio-Demographic Characteristics of Respondents

Socio-demographic characteristics	Frequency	Percent
Sex		
Male	40	95.2
Female	2	4.8
Age		
18 – 29	18	42.9
30 – 39	11	26.2
40 – 49	7	16.7
50 – 59	5	11.9
60 and 65	1	2.4
Occupation		
Business	3	7.1
Cattle Rearing	14	33.3
Civil servant	4	9.5
Commercial driver	5	11.9
Farming	11	26.2
Footballer	1	2.4
Public servant	1	2.4
Student	3	7.1

Social status		
Above average	8	19.0
Average	30	71.4
Below average	4	9.5
Level of education		
Tertiary	10	23.8
Secondary	7	16.7
Primary	25	59.5
Total	**42**	**100.0**

Results of the descriptive statistics presented in Table 1 showed that more males (95.2%) than females (4.8%) participated in the study. The Table also showed the age group distribution among the respondents, of whom 42.9% were aged between 18 and 29 years, 26.2% aged between 30 and 39 years, 16.7% aged between 40 and 49 years, 11.9% aged between 50 and 59 years, while the remaining 2.4% were aged between 60 and 65years.

Table 3. Presence of pin site infection between patients receiving daily and weekly pin site care

		Pin site infection					
		No	Yes	Total	χ^2	**df**	**Sig**
Pin site care	Daily	16 (76.2%)	5 (23.8%)	21 (100%)	.47	1	.49
	Weekly	14 (66.7%)	7 (33.3%)	21 (100%)			
	Total	30 (71.4%)	12 (28.6%)	42 (100%)			

The result in Table 3 revealed that there was no statistically significant difference in the rate (presence) of pin site infection reported by patients receiving daily pin site care and those receiving weekly pin site care (χ^2 = 0.47, $p > 0.05$).

Table 4. Severity of pin site infection across daily and weekly pin site care

		Severity of pin site infection					
		Grade 1	**Grade 2**	**No infection**	**Total**	x^2	**df**	**Sig**
Pin site care	Daily	3 (14.3%)	2 (9.5%)	16 (76.2%)	21 (100%)	2.09	2	.35
	Weekly	3 (14.3%)	4 (19.0%)	14 (66.7%)	21 (100%)			
	Total	6 (14.3%)	6 (14.3%)	30 (71.4%)	42 (100%)			

There was no statistically significant difference in the severity of pin site infection among patients receiving daily pin site care and their counterparts receiving weekly pin site care (χ^2 = 2.09, $p > 0.05$). However, the result indicates that while there was similarity in the proportion of infection graded 1 among patients receiving daily and weekly pin site care, 19.0% of patients receiving weekly pin site care compared to two (9.5%) of those in the daily pin site care group manifested grade 2 pin site infection.

Table 5. Need for prolonged use of antibiotic among patients receiving daily and weekly pin site care

		Prolonged use for antibiotic					
		No	Yes	Total	χ^2	**df**	**Sig**
Pin site care	Daily	18 (85.7%)	3 (14.3%)	21 (100%)	0.17	1	.68
	Weekly	17 (81.0%)	4 (19.0%)	21 (100%)			
	Total	35 (83.3%)	7 (16.7%)	42 (100%)			

Table 5 shows that there was no statistical significant difference in the cost implication as expressed by a need for prolonged use of antibiotic among patients receiving daily pin site care and those receiving weekly pin site care (χ^2= 0.17, $p > 0.05$). This implies that patients that received daily pin site care and those that

received weekly pin site care both showed no need for prolonged use of antibiotic, which suggests relative low cost of care after surgery for patients in the two groups.

Table 6. Need for prolonged use of analgesic among patients receiving daily and weekly pin site care

		Prolonged use for analgesic					
		No	**Yes**	**Total**	**χ^2**	**df**	**Sig**
Pin site care	**Daily**	21 (100%)	0 (0.0%)	21 (100%)	3.23	1	.07
	Weekly	18 (85.7%)	3 (14.3%)	21 (100%)			
	Total	39 (92.9%)	3 (7.1%)	42 (100%)			

There was no statistically significant difference in the cost implication as expressed by a need for prolonged use of analgesic among patients receiving daily pin site care and those receiving weekly pin site care (χ^2= 3.23, p > 0.05). Although compared to none of the patients in the daily pin site care group, a fraction (14.3%) of those in the weekly pin site care group showed need for prolonged use of analgesic, the result suggests relatively low cost of care after surgery for patients in the two groups. From the results presented in Table 5 and 6, the stated null hypothesis 3 was confirmed.

IV. Discussion

Pin site infection is a major complication of external fixation in Orthopaedics. One of the preventive measures for PSI is pin site care. However, the choice of cleaning, dressing agents and frequency of care remain controversial as many depend on what is obtainable in their environment and surgeons' preference [3,4,9]. There are few studies that give information about what is obtainable in this environment and hence the need for more studies in this regard.

Forty-two respondents that met the inclusion criteria participated in this study, 95% of whom were males (95.2%) and only 2(4.8%) were females.

Twenty-one patients were selected into two study groups: Group A- for daily dressing and Group B for weekly dressing. The social demographic variables of these groups are similar.

The rate of infection in the group A was 23.8% (5patients) while that of group B (weekly) was 33.3% (7 patients). Although, more patients had PSI in the weekly group than the daily group, there was no statistically significant difference in the two groups (P> 0.05).

In similar vein, the finding from hypothesis two showed that the most severe infection was grade II infection. Equal number of patients (3 respondents) had grade I infection in both groups while more patients (4 respondents) had grade II among the patients receiving weekly care compared with only 2 patients receiving daily wound care. However, the result showed no significant difference in the severity of infection in both groups (P> 0.05). In line with this finding, Dahl et al[19] also found no difference in the severity of infection in either daily 1.5% and weekly 1.6%[10] . On the cost implication, daily and weekly pin site care was examined from the point of need for prolonged antibiotics and analgesics after surgery. There was no significant difference between those receiving weekly and daily care as regards the need for prolonged use of antibiotics and analgesics, though the number of patients who had need for prolonged use of these drugs were more in group B(weekly group) than the group A (daily group).

The findings showed that there was no statistically significant difference in the cost implication of care in both group with respect to the need for more antibiotics and analgesics when infected. However, daily dressing cost more money than the weekly dressing as expected. In agreement with the findings of this study, Egol et al[14] and some studies also concluded that weekly change of sterile dressing is adequate and cheaper.[14, 21]. Camathias et al[31] even concluded from his randomized control study that routine pin site care is unnecessary[31].

V. Conclusion

One of the inferences made from the findings of the study is that the rate and severity of infection is not significantly affected by the frequency of pin site care and thus weekly dressing may suffice for pin site care in our environment.

It is cost effective to dress pin site weekly than daily as there was no significant difference in the rate and severity of pin-site infection, nor was there significant difference in need for further treatment with antibiotics and analgesics. Therefore, there is no need for the financial burden of daily dressing as the rate and severity of infection is not significantly affected by it

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