OUTCOME OF UNION AND INFECTION IN SUPRACONDYLAR FRACTURE OF FEMUR TREATED WITH DISTAL FEMUR LOCKING PLATE AMONG ADULT PATIENTS FROM 2014 TO 2018

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ABSTRAK

Pengenalan: Kepatahan pada tulang femur bahagian supracondylar, walaupun jarang berlaku tetapi ia membawa morbiditi yang signifikan. Dewasa ini, 'Locked plate' untuk kepatahan distal femur telah digunakan secara meluas. Walau bagaimanapun, laporan kajian berkenaan hasil rawatan adalah berbeza-beza. Tujuan kajian adalah untuk mengkaji kesembuhan tulang dan kadar jangkitan pada bahagian tulang tersebut yang dirawat dengan 'locked plate' distal femur di kalangan pesakit dewasa di Hospital Sultanah Nur Zahirah (HSNZ) dan Hospital Universiti Sains Malaysia (HUSM).

Metodologi: Ini adalah kajian retrospektif yang melibatkan 92 pesakit dengan kepatahan tulang suprakondylar femur yang dirawat dengan 'locked plate' distal femur; dinilai dari tahun 2014 sehingga Jun 2018 daripada dua buah pusat trauma. Data klinikal dan pengimejan diambil daripada rekod pesakit. Kesembuhan dan jangkitan digunakan sebagai pemboleh ubah hasil. Data demografi, klasifikasi patah (33A dan 33C), jenis patah (terbuka dan tertutup), kecederaan yang berkaitan yang boleh mengubah pemulihan, mekanisme kecederaan, diabetes dan status merokok dianggap sebagai faktor yang berkaitan.

Keputusan: Enam puluh lapan (73.9%) pesakit dengan kepatahan tulang suprakondylar femur mencapai kesembuhan tulang manakala 24 (26.1%) tidak mencapai kesembuhan tulang. Sepuluh (10.9%) pesakit didiagnos dengan jangkitan kuman. Tiada persamaan yang signifikan antara klasifikasi patah (sama ada 33A atau 33C), jenis patah tulang termasuk kedua-dua patah terbuka dan tertutup dengan hasil kesembuhan tulang dan hasil jangkitan. Diabetes (OR 1.35) didapati meningkatkan risiko untuk mendapatkan tulang tidak sembuh tetapi tidak signifikan secara statistik ($p = 0.60$). Untuk jangkitan, faktor diabetes (OR 8.9, $p = 0.02$), merokok (OR 10.84, $p = 0.008$) dan pesakit dengan kecederaan yang berkaitan yang boleh mengubah program pemulihan (OR 6.56, $p = 0.04$) didapati signifikan.

Kesimpulan: Secara keseluruhannya, kajian kami menunjukkan kadar kesembuhan tulang dan jangkitan dalam kepatahan tulang suprakondylar femur jenis 33-A and 33-C adalah memuaskan. Faktor diabetes, merokok dan kecederaan yang berkaitan yang boleh mengubah pemulihan,adalah signifikan menyumbang kepada jangkitan.

ABSTRACT

Introduction: Supracondylar fractures of femur is relatively uncommon and carries significant morbidity. Locked plate of distal femoral fractures are widely used for treatment recently. However, the literature reports on the outcome of treatment are variable. The purpose of our study is to study and analyze the union and infection rate of supracondylar fracture of femur treated with distal femur locking plate among adult patients in HSNZ and HUSM.

Methodology: This was a retrospective cohort study involving 92 patients with supracondylar fracture of femur treated with distal femur locking plate evaluated from 2014 till Jun 2018 from two trauma centers. The clinical data and imaging were retrieved from patient's record. Radiological union and infection were used as outcome variables. Demographic data, fracture classification (33A and 33C), fracture type (open and closed), associated injury that can alter rehabilitation, injury mechanism, diabetes and smoking status were regarded as associated factors.

Result: Sixty eight (73.9%) of patients with supracondylar femur fractures achieved union while 24 (26.1%) developed non-union. Ten (10.9%) patients were diagnosed with infection. There was no significant association between fracture classification (either 33A or 33C) of fracture including both open and closed fractures with union and infection outcome. Diabetes (OR 1.35) was found to increase risk to get non-union but it is not statistically significant (p=0.60). For infection, diabetes (OR 8.9, p = 0.02), smoking (OR 10.84, p = 0.008) and patient with associated injury that alter rehabilitation program (OR 6.56, p = 0.04) are found to be significant.

Conclusion: Our study showed that the union and infection rate in fracture distal femur type 33-A and 33-C are overall satisfactory. Being diabetic, smoking and associated injury that can alter rehabilitation are the associated factors that have a significant effect on infection.

Keyword; *Outcome, Supracondylar fracture femur, distal femoral locked plate*

Chapter 1

INTRODUCTION

1.1 INTRODUCTION

Supracondylar fracture of femur is one of the most challenging aspects of distal femoral fractures that favors operative treatments. It accounted for about 6% of femur fractures [1] and occurs about 10 times less frequently than fracture at the proximal femur. This fracture occurs commonly among young patients who were involved in high-energy accidents (including motor vehicle accidents and sports trauma) and older patients, often osteoporotic, sustaining low-energy fractures. Henderson and colleagues observed that there were increasing rates of successful operative fixation from 52% to 54% in the 1960s to 80% in the 1980s [2]. The current trend is toward periarticular distal femoral locking plates, which can be inserted via minimally invasive submuscular procedure to preserve blood supply, fracture hematoma, and avoid extensive soft tissue damage [3]. The successful outcome of an operative intervention is possible if it follows the principles of anatomic reduction, restoration of alignment, stable fixation and early motion[4].

Although there is lack of published data on the outcome of supracondylar femur fracture following surgical fixation in Malaysia, a few studies had been done elsewhere. Fracture non-union was one of the common outcomes of the operative intervention of supracondylar fractures. A reviewed article reported that a non-union rate of over 1000 cases ranged from 0% to 19% while delayed union ranged from 0% to 15% [2]. Schuetz et al studied from multiple European centers; they found that healing occurred in 37 of 40 patients (93%) [5]. Kregor et al reported early union in 58 of 61 patients (95%) with distal femur fractures [6]. In a small study done on 27 post-operative patients who sustained supracondylar fracture showed the radiological union was at 17 weeks on average [7]. Almost similar finding was reported by Yeap and Deepak (2007) in which they found the average time to union was 18 weeks and there was no non-union and deep infection occuring

among the patients. However, there was no associated factors related to the outcome was mentioned [8].

A retrospective study done by Ricci et al had found that 19% of cases in his study ended up with union problems which lead to reoperation to promote fracture union. This was required in 37% of patients with open fractures, 10% with closed fractures and 28% of patients with diabetes compared to 17% of non-diabetic. For close fracture, young age and diabetes were proven as independent predictors of reoperation to promote union while for open fracture, only diabetes was proven to be associated with fracture healing [9].

In a study done in 2013, fracture non-union occurred in 18% of the patients following operative intervention. A higher rate of non-union was found in those requiring open reduction (32%) as compared to submuscular minimally invasive group (10.7%) [10]. However, other studies done among limited number of patients with distal femoral fracture by Kayali *et al* (2007), Syed *et al* (2004), Virk *et al* (2016) and Kanabar *et al* (2007) did not mention about associated factors to the occurrence of union problems and infection post-operatively and most of the studies were done using less invasive surgical technique. Kayali did a prospective study on 27 post-operative patients with distal femoral fractures found that all of the patients achieved union while 7% of them were complicated with both superficial and deep infection involving all age groups. Those who have deep infection also had another concomitant injures [11].

A retrospective study on 16 patients with distal femoral fracture by Kanabar et al revealed 1 case with delayed union, 2 cases with non-union and 3 cases developed infection [12]. A prospective pilot study among 25 patients with distal femoral fractures undergone less invasive operative method by Syed et al revealed 3 non-union occurred in which two were open fractures and one closed fracture. Low rate of infection with only two superficial and one deep infections which

successfully treated by oral and intravenous antibiotics [13]. A prospective study on 25 patients over 2 years follow up by Virk et al showed that radiological union was achieved in almost all cases except only 1 case of malunion and only 2 superficial infections developed among the patients [14] .

Both deep and superficial infections were also reported to be one of the commonest complications of the distal femoral locking plate. Ricci et al (2014) found that among all 355 cases reviewed, there was high percentage of occurrence of infection in those with diabetes and open fracture as compared to non-diabetic and closed fracture. Deep infection occurred in overall 5% of patients, 11% of patients with diabetes as compared to 4% without diabetes and 8% of open fractures as compared to 4% of those with closed fractures. Univariate analysis identified DM and comminuted fracture were associated with deep infection, however further logistic regression failed to show any significant association between the occurrence of deep infection with types of fracture [9].

According to a retrospective review of 243 cases from two trauma centers, 7.2% of patients who developed deep infection requiring irrigation was significantly associated with open fracture (18.0%) and current smoking status (14.3%). Nevertheless, there was no relationship between developments of infection with diabetes, implant material, or initial treatment with external fixation was found in his study [10].

Khan et al found that there was presence of associated injuries in 32 (25.8%) out of 219 patients with distal femoral shaft fractures in his study at a London trauma center [15]. Thirty (93.8%) of these patients had a second fracture elsewhere. Weight et al. conducted a retrospective study on 26 patients with 27 high-energy fractures of the distal femur treated by means of internal distal

femoral fixation and found twenty patients had associated injuries [16]. However, both of the studies did not analyze the association of the associated injuries with the outcome of the fracture.

1.2 JUSTIFICATIONS OF STUDY

In Malaysia, there is a lack of published data regarding the outcome of fixation in supracondylar fractures of femur especially in government hospitals. The available literature were from foreign countries which may differ in terms of patients' characteristics, operative techniques and timing of fixation in relation to onset of injury. Despite modern fixation techniques, distal femoral fractures particularly supracondylar fractures often result in disability and unfavorable clinical outcomes.

Therefore, it is crucial to recognize the associated factors of the outcome of fixation. Therefore, the purpose of this study was to analyze the complications and clinical outcomes of locked plating for supracondylar femur fractures so that improvements can be made in many aspects to ensure optimal postoperative outcome, promote excellent healing, better functional outcome and patients' quality of life.

Chapter 2

OBJECTIVES OF THE STUDY

2.1 GENERAL OBJECTIVE

2.1.1 To study outcomes of supracondylar fracture of femur treated with distal femur locking plate among adult patients in HSNZ and HUSM.

2.2 SPECIFIC OBJECTIVES

2.2.1 To determine the percentage of union, and infection in supracondylar fracture femur treated with distal femur locking plate among adult patients in HSNZ and HUSM.

2.2.2 To determine associated factors for outcomes in supracondylar fracture of femur treated with distal femur locking plate among adult patients in HSNZ and HUSM.

Chapter 3

MANUSCRIPT

3.1. TITLE: THE OUTCOME OF SUPRACONDYLAR FRACTURE OF FEMUR TREATED WITH DISTAL FEMUR LOCKING PLATE

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3.2 Abstract

Introduction: Supracondylar fractures of femur is a relatively uncommon presentation and carries significant morbidities. Locked plate of distal femoral fracture is widely used. However, the literature reports on the outcome of treatment are variable. The purpose of this study was to study and analyze union and infection of supracondylar fracture of femur treated with distal femur locking plate among adult patients in HSNZ and HUSM.

Methodology: This was a retrospective cohort study involving 92 adults patients with supracondylar fracture of femur treated with distal femur locking plate evaluated from 2014 till Jun 2018 from two trauma centers. The data were retrieved from the patient's record. Radiological union and infection were used as outcome variables. Demographic data, fracture classification (33A and 33C), fracture type (open and closed), associated injury that can alter rehabilitation, injury mechanism, diabetes, and smoking status were regarded as associated factors.

Result: Sixty eight (73.9%) of patients with supracondylar femur fractures achieved union while 24 (26.1%) developed non-union. Ten (10.9%) patients were diagnosed with infection. There was no significant association between fracture classification (either 33A or 33C) of fracture including both open and closed fractures with union and infection outcomes. Diabetes mellitus (OR 1.35) was found to increase risk to get non-union but not statistically significant (p=0.60). For infection, diabetes (OR 8.9, p = 0.02), smoking (OR 10.84, p = 0.008) and patient with associated injury that alter rehabilitation program (OR 6.56, p = 0.04) were found to be significant.

Conclusion: Our study showed that the union and infection rate in fracture distal femur type 33-A and 33-C are overall satisfactory. Having diabetes, smoking and associated injuries that alter rehabilitation were the associated factors that have significance effect on infection.

Keyword; *Outcome, Supracondylar fracture femur, distal femoral locked plate, union, infection*

3.3 Introduction

Supracondylar fracture of femur; accounted about six percent of femur fractures [1, 17], is one of challenging aspects of femoral fractures that favors operative treatments. It occurs commonly among two populations, young patients involved in high-energy accidents and older patients, often osteoporotic, sustaining low-energy fall fractures.

Recent advances in techniques and implants has made the current trend moves toward periarticular distal femoral locking plates [3] except in extreme circumstances. Successful care is possible with principles of anatomic reduction, restoration of alignment, stable fixation and early motion[4].

There is lack of data on outcome of this fracture following surgical fixation in our local setting. Our study aims were to assess the union and infection following fixation with distal femur locking plate and to evaluate the factors that might influence the fracture union and infection in our local setting. The findings would enable local surgeon to improve the outcome when the contributing factors to fixation outcome are known.

3.4 Material and method

This was a retrospective study conducted at two Level 1 trauma hospitals providing orthopedic services which are Hospital Sultanah Nur Zahirah, Kuala Terengganu and Hospital Universiti Sains Malaysia, Kelantan.

Ninety four medical records of adult (18 years old and above) patients with supracondylar fracture of femur treated at both centers from 2014 to 2018 were reviewed. The data was collected by using convenience sampling. The inclusion criteria for the study were Type A including extra-articular fractures and Type C fractures according to AO (Arbeitsgemeinschaft Osteosynthese) Classification system [18] which were treated with distal femur locking plate including open and closed fractures. Those who are diabetics and smoker are also included. Patients with grade I and II open fracture, vascular injury at presentation, Type B distal femur fracture, previous trauma to the ipsilateral lower limb, intramedullary fixation, metastatic disease, on chemotherapy or steroid medications, HIV patients impaired lower extremity motor or nerve function prior to injury, and usage of supplemental methods for bone healing at first surgery were excluded. Ninety two patients who fulfilled inclusion and exclusion criteria were included in the study.

From the medical records, the clinical history, radiological imaging, operative findings and progress of the patients during follow up visits from nine months up to one year were reviewed. All the information regarding patient's age, sex, type of fracture, mechanism of injury (high or low energy), presentation with associated injuries, postoperative complications and time to fracture union (healed with union or nonunion) were recorded on specifically designed case proforma. Pre-operative and post-operative radiographs consisting of anteroposterior (AP) and lateral views of the distal femur were examined digitally and evaluated by researcher. Complications were recorded concerning healing was recorded. Non-union was defined as absence of any clinical

or radiological evidence of fracture healing for 6 months after the expected time for healing **[19]** or there is no visibly progressive signs of healing, i.e., no change in the fracture callus, for the final three months [20]. Infection was defined as either deep or superficial. Deep infections were defined as those that required operative treatment. Superficial infections were defined as those that were treated only with local antibiotics and wound care, and no operative treatment for the infection [21].

Independent variables known at the time of the index procedure were gender, diabetes, smoking, mechanism of injury, fracture classification (according to AO), and type of fracture (open or closed fractures). Open fractures were classified according to Gustilo and Anderson classification [22].

Descriptive statistics including percentage, standard deviation, mean and range were completed. . Logistic regression models, using variables having a P-value of 0.25 in the univariate analysis, were used to identify independent risk factors for fracture union and infection and the odds ratio (OR) and 95% confidence interval were calculated for significant predictors. The fitness of the models was confirmed using the Hosmer–Lemeshow test. Receiver operator characteristic analysis was used with continuous variables to identify thresholds for use in the calculation of outcome frequencies for independent risk factors. Data entry and analysis were performed by using SPSS version 24. Statistical significance was set at $p < 0.05$.

This study was done following ethical approval of Research Ethics committee (Human), Universiti Sains Malaysia (JEPEM:USM/JEPeM/17110603), and National Medical Research and Ethics Committee (MREC) of the Ministry of Health (MOH), Malaysia via the National Medical Research Registry (NMRR) (NMRR-17-2607-38311 (IIR)).

3.5 Results

3.5.1 Patient's characteristics

The mean age of the patients was 53.12 years old, ranging from 18 up to 85 years old. The prevalence of males (51.1 %) was slightly higher compared to females (48.9%). Most of the patients were Malay (96.7%). Patients with diabetes and smokers were 26.1% and 30.4 % respectively. 57.6% of patients had 33A as their fracture classification compared to patients with 33C classification. All of open fracture were Grade IIIA according to Gustilo and Anderson classification. There was no patient classified as Grade IIIB fracture. For the factor of associated injuries that alter rehabilitation programme, only 27.2% (n=25) had injury while the other 72.8% (n=67) were not altered the rehabilitation programme. There was no patient who was on chemotherapy or steroid medications, and HIV patients. Other details of patients' characteristics are presented in Table 1.

3.5.2 Outcome Measures

3.5.2.1 Fracture union

Among patients evaluated in this study, 68 (73.9%) achieved union. Meanwhile, 24 (26.1%) ended up with non-union. The result was presented in Table 2. There were six non-union cases seen in patients with open fracture in which three cases of 33A classification and three cases of 33C classification of femur fracture.

Besides, there was no significant association between 33A (X^2 (1) = 0.45, p = 0.67) and 33C (X^2 (1) = 0.95, p = 0.71) classification of fracture including for both open and closed fractures with union outcome. The result was presented in Table 3.

Considering the diabetic status of the patient, there was also no significant association between the type of fracture with the union outcome (X^2 (1) = 0.00, p = 1.00). Result were presented in Table 4.

There was no significant association between all factors evaluated in this study and fracture non-union. After analyzing using simple logistic regression (SLR), three variables were included in multiple logistic regression (MLR) as shown in Table 5. Diabetic patient has 1.35 times the odds to get the non-union outcome compared to a non-diabetic patient (95% CI (0.45, 4.05), p = 0.60). A patient who has associated injury that alters rehabilitation program has 1.26 times the odds to get the non-union compared to a patient with no associated injury (95% CI (0.42, 3.76), p = 0.68). Meanwhile, a patient with infection has 2.73 times the odds to get non-union as compared to non-infection (95% CI (0.63, 11.95), p = 0.18). However, all selected factors studied in the MLR analysis were not statistically significant.

3.5.2.2 Infection complication

Only a single case of infection was noticed as part of the complication of open fracture with 33A classification in this study. On the other hand, two cases of infection were identified as complication involved with type 33C classification and open fracture.

Besides, there was no significant association between 33A classification (X^2 (1) = 0.19, p = 0.54) and 33C classification (X^2 (1) = 0.20, p = 0.88) of fracture including both open and closed fractures with infection outcome. The result was presented in Table 6.

For the diabetic status of the patient, there was also no significant association between the type of fracture with the infection outcome (X^2 (1) = 2.40, p = 0.26). Results were presented in Table 7.

There were significant associations between male sex (Crude OR 10.42, 95% CI (1.26, 86.1), p = 0.03), diabetes status (Crude OR 5.33, 95% CI (1.36, 20.97), p = 0.02), smoking status (Crude OR 12.4, 95% CI (2.43, 63.25), p = 0.002), and associated injury that alters rehabilitation program (Crude OR 4.97, 95% CI (1.27, 19.48), p = 0.021) with infection in the SLR test.

However, only factors including diabetes status, smoking status and injury associated after rehabilitation program have significant associations with infection complication in the MLR analysis. A patient with diabetes has 8.9 times increased odds to get the infection compared to a non-diabetic patient (95% CI (1.52, 51.93), p = 0.02). Meanwhile, a smoker has 10.84 the odds of getting the infection as the complication compared to a non-smoker (95% CI (1.86, 63.32), p = 0.008).

Moreover, a patient with associated injury that alter rehabilitation program has 6.56 times the odds to get the infection compared to a patient without associated injury (95% CI (1.15, 37.6), p = 0.04).

There was also no significant association regarding infection and union outcome. The summary of the MLR analysis was presented in Table 8.

3.6 Discussions

Most of the patients in this study were involved with motor vehicle accidents (63%). This was expected as Malaysia has a high number of road traffic accidents; accounting for almost half of a million cases per year based on Malaysia Trauma Registry 2018. The remaining group (37%) presented with low energy trauma indicates fragility fracture and consistent with the prevalence of incidence of osteoporotic fracture in Malaysia that occurs among individuals above 50 years of age was 90 per 100,000. Most of the patients were Malay (96.7%) due to the nature of demographics in the East Coast of Peninsular Malaysia with Malay is the predominant race.

Our study found that the fracture pattern of 33-A was the most common. This finding echoes with Smith et al. that determined 33- A1 and 33-C1 to be the most common of 105 distal femoral fractures across four major trauma centers in United Kingdom [23]. Pietu et al. and Khan et al also agrees with type 33-A1 being the most prevalent [15, 24]. Our experience of intra-articular involvement (42.4%) is similar to what has previously been described elsewhere [23-25].

Our study showed that union after the index procedure was 73.9% each for open and closed fractures. This finding was lower as compared to previous studies. Ricci et al found 81% of his entire cohort achieve union that included patients with open fractures. The union rate increased to 90% in the group of closed fractures. These results are consistent with the existing literature for locked plating of these fractures where union rates have been reported to be in between 81% and 100% [5, 9, 16]. Additionally a systematic reviews on healing of distal femur fractures by Henderson et al was reported to be 17% in non-union rate [2] as compare to 26% in our study.

In fracture healing, diabetes (OR 1.35) was found to increase the risk to get non-union. This is supported by Loder *et al* that shown healing of fractures in diabetic patients is prolonged by 87% [26] and has a 3.4 fold higher risk of complications including delayed union, non-union, redislocation or pseudoarthrosis [27]. Clinical studies in humans indicate that diabetes delays fracture healing [28]. A study of spontaneously diabetic animals yields the characteristic of diabetic fracture healing by decreased bone apposition and mineralization [29]. Diabetes will cause hyperglycemia, enhanced and prolonged inflammation, advanced glycation end-products (AGEs) formation and generation of reactive oxygen species. Thus, it caused dysregulation, as well as reduced insulin signaling may adversely affect osteoblasts and reduce bone formation and bone quality.

All analyzed factors associated with non-union were not statistically significant and it is comparable with Karam *et al* who also look into risk factors associated with non-union in distal femoral fractures [30] including diabetes and smoking factors.

In regard to infection, ten patients (10.9%) of our entire cohort were complicated with infection with no significance difference between open and closed fracture. This number is slightly higher than Bai et al who found that incidence of infection was 3.6 percent in their series. They also found out that diabetes, smoking and open fracture are significant risk factors for developing infection. However, in our study, only having diabetes and smoking were significant. This might be due to small number of open fractures in our series. Nevertheless, all infection in our series were only superficial except one that required surgical debridement. There was also no osteomyelitis in our series. Therefore, we speculate that increased number of superficial infections in our cohort could be due to surgeon experience which was widely variable in our cases that may influence tissue handling during surgery.

Regarding association of smoking factor with infection, our finding is similar to Bai et al [31]. The mechanism of smoking that caused an increased risk of infection appears to be due to decreased immune functions. Previous laboratory studies proved that nicotine reduces vascularization at bone healing sites, and this is associated with delayed healing in animal models [32]. Other studies also produced link evidence between smoking and delayed healing, nonunion and infection [33, 34].

In our study, factor of associated injury that alter rehabilitation, was significantly associated with infection outcome. As far as we concern, there is no study done to support our finding. However, a study by Anandasivam et al showed that injuries associated with femoral shaft fractures were very frequent (46.4%) but it was not further analyze [35]. Apart from that, incidence of distal femur fracture are very rare [1, 25]; yet treated with distal femur locking plate; hence limit us to compare our finding.

The study limitation is related to retrospective design and involved a small sample size as most of the initial patients were excluded because of different operative techniques which have created selection bias. In addition, total duration of treatment evaluation was relatively short at nine months to one year period and no evaluation of the non-union group who requiring surgical intervention. Apart from that, although in this analysis the results of the multivariate analysis essentially confirmed the results of the bivariate analysis, it is still possible for residual confounding to persist, or that additional patient characteristics have not been accounted for in our study. However, our results do show some interesting trends which can inform clinical practice.

In order to improve the study, a prospective study with longer duration and larger sample size from multiple tertiary centers from different regions of country with more details assessment in terms of union including malunion, especially varus malalignment, reoperation rate to promote union, method of fixation (open reduction vs submuscular plating) and fixation constructs stability should be done. Furthermore, a proper assessment tool or scoring should be utilized to provide more meaningful functional outcomes. We feel that the results of this preliminary study can be used to initiate future research in our country.

Patients should be encouraged to quit smoking as early as possible. Although the modern operative technique used to treat distal femoral fractures, unwanted complications still happened. Thus, it is important to have good soft tissue management and further studies are needed to determine factors to improve the surgical outcome.

3.7 Conclusion

Our study showed that the union rate is 73.9% while infection rate is 10.9% in fracture distal femur. This findings were overall satisfactory and supported with current evidences. Having diabetes, smoking and associated injuries that alter rehabilitation were the associated factors that have significance effect on infection.

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3.9 Tables and figures

Table 1: Patient's characteristics (N=92)

Variable		Mean	(SD)	n	(%)
Age		53.12	(21.57)		
Sex	Female			45	(48.9)
	Male			47	(51.1)
Race	Chinese			3	(3.3)
	Malay			89	(96.7)
Diabetes Status	No			68	(73.9)
	Yes			24	(26.1)
Smoking Status	Non-Smoker			64	(69.6)
	Smoker			28	(30.4)
Fracture Classification (AO)	33A			53	(57.6)
	33C			39	(42.4)
Types of Fracture	Closed			69	(75.0)
	Open			23	(25.0)
Associated injuries that alter rehabilitation programme	Yes			25	(27.2)
	No			67	(72.8)
Mechanism of Injury	Fall			34	(37.0)
	MVA			58	(63.0)

Table 2: Descriptive results regarding union and infection (N=92)

		Entire Cohort N=92		Closed fractures n=69		Open fracture n=23	
Union							
	Yes	68	(73.9%)	51	(73.9%)	17	(73.9%)
	No	24	(26.1%)	18	(26.1%)	6	(26.1%)
Infection							
	Yes	10	(10.9%)	7	(10.1%)	3	(13.0%)
	No	82	(89.1%)	62	(89.9%)	20	(87.0%)

Table 3: Table of association between Classification of Fracture and Type of Fracture with Union outcome (N=92)

Independent Variables		Union Outcome		X^2 stat (df)	p value*
Classification of fracture	Type of Fracture	Had Union n (%)	Non Union n (%)		
33A	Open	6 (66.7)	3 (33.3)	0.45 (1)	0.67
	Closed	34 (77.3)	10 (22.7)		
33C	Open	11 (78.6)	3 (21.4)	0.95 (1)	0.71
	Closed	17 (68.0)	8 (32.0)		

*Fisher Exact test

There was a cell (50.0%) have expected count less than 5 for both classification of femur fracture cells. Thus, the assumption to perform Chi Square test was not met. Hence, we applied Fisher Exact test to analyze our data.

Table 4: Table of Association between Diabetic Status and Type of Fracture with Union outcome (N=92)

Independent Variables		Non-union Outcome		X^2 stat (df)	p value*
Diabetic Status	Type of Fracture	Union n (%)	Non-union n (%)		
Diabetic	Open	4 (100.0)	0 (0.0)	2.40 (1)	0.26
	Closed	12 (60.0)	8 (40.0)		
Non-diabetic	Open	13 (68.4)	6 (31.6)	0.95 (1)	0.35
	Closed	39 (79.6)	10 (20.4)		

*Fisher Exact test

There were 2 cells (50.0%) have expected count less than 5 for diabetic patient classification of cells Thus, the assumption for Chi Square Test was not met. Hence, we applied Fisher Exact test to analyze our data.