

Role of Pie Crusting Technique on Soft Tissues in Preventing Soft Tissue Complications Compared to Conventional Closure of Wound in Fractures of Distal Tibia (PILON) and Fibula

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ABSTRACT

Objective: To demonstrate the effect of performing pie crusting on skin bridging two incisions used for open reduction and fixation to reduce wound complications compared to conventional wound closure.

Study Design: Quasi-experimental study.

Place and Duration of Study: Department of Orthopedics and Trauma, Combined Military Hospital Rawalpindi from Jan to Nov 2020.

Methodology: Forty-seven patients, managed primarily with open reduction and internal fixation for type-43 fractures per AO/OTA classification, were studied. Group-1 comprised patients in whom the pie crusting technique was used during the closure of the wound. Group-2 included patients in whom conventional closure of the wound was performed. Evaluation of complications in the presence or absence of superficial and deep infection and necrosis was done. The time from injury to surgery was 6 hours to 72 hours. Patients were followed for an average of 12 weeks.

Results: In group-1 (pie-crust technique), there were 23 patients, whereas group-2 (classic wound closure) comprised 24 patients. In group-1, only 1 (4%) patient had a superficial infection, and no deep infection was reported. Whereas in group-2, six patients (25%) had superficial infection, and two patients (8%) had the deep infection.

Conclusion: Results indicated that pie-crust technique significantly reduces the risk of superficial and deep wound complications compared to classic wound closure because it reduces skin tension and allows the drainage of subcutaneous fluids.

Keywords: Conventional closure of wound-deep wound infection and necrosis-fractures of distal tibia/pilon-open reduction and internal fixation [ORIF]-pie crusting technique-superficial wound infection and necrosis.

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INTRODUCTION

Fractures of distal tibia metaphysis and intra-articular (pilon) constitute 5-10 % of fractures of the tibia.^{1,2} Comminuted distal tibia fractures are termed as pilon fractures. This word was first used in the literature of orthopaedics in 1911 by E' tienne Destot. He described these fractures as fractures occurring within 5 cm of the ankle joint. Owing to articular tibiotalar cartilage involvement Bonnin in 1950 termed these as "plafond fractures".³ These fractures are challenging and complex to treat. Because these are mostly intra-articular and damage to the soft tissue envelope is very extensive in these fractures. Treatment options are controversial for operating surgeons as results are mixed.⁴ Complications like post-operative infections (Figure-1), wound breakdown (Figure-2), mal-united fractures, non-union and ankle osteoarthritis (post-traumatic) are tough to avoid even after successfully

treating such injuries.

Closure under the tension of a surgical wound is commonly encountered in distal tibia fractures managed with ORIF and contributes to wound complications.^{5,6} It compromises the microvascular circulation of the skin, which results in the breakdown of the wound. Complications and infection risk increase when operating through edematous tissue and closing wounds under tension. Multiple incisions along the long axis of the wound, so-called "pie-crusting" (Figure-3), relaxes the skin around surgical wounds through the edematous field. These incisions have been utilised as it reduces complications and allows tension-free closure. It is reported that the pie-crusting technique is beneficial in the closure of wounds in fractures of the distal tibia and fibula, as it relaxes tension on the wound and subcutaneous fluids are allowed to leak out. Hence wound complications are prevented.^{7,8}

In common practice, two skin incisions are utilised for open reduction and internal fixation, post-

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erolateral for fibula fixation and anteromedial incision for fixation of the distal tibia. It is recommended to maintain a minimum of 5-7 cm skin bridge between two wounds as it is essential for viability of the skin bridge. The objective of the current study was a comparison of wound complications using pie crusting on the skin between two surgical incisions and conventional wound closure in patients managed with open reduction and internal fixation (ORIF) for fractures of the distal tibia (pilon) and fibula.



Figure-1: Superficial skin necrosis.



Figure-2: Wound dehiscence.



Figure-3: Pie crusting technique.

METHODOLOGY

This quasi-experimental study was carried out at the Department of orthopedics and Trauma, Combined Military Hospital Rawalpindi from Jan 2020 to Nov 2020, after approval from the Hospital Ethical Committee [121/11/2020]. Consecutive non-probability sampling was carried out. The sample size was calculated by using the WHO calculator at the level of significance was 5%, and the power of the test 80%. The expected Population proportion with wound

complications like infections and necrosis in group-1 (pie crusting technique) was 0%, in contrast, the population proportion with wound complications like infections and necrosis in group-2 (conventional wound closure) was 27.77%.⁸

Inclusion Criteria: Patients aged between 20 to 60 years with isolated fracture type 43 of distal tibia and fibula as per the AO/OTA coding system were included in the study.

Exclusion Criteria: Patients with staged management, patients with other associated fractures, and open fractures or haemorrhagic blisters at the incision site were not included in the study. Patients with peripheral vascular disease, diabetes mellitus, and active smokers were also excluded from the study.

Forty seven patients with isolated fracture type 43 of distal tibia and fibula as per the AO/OTA coding system were included. All these patients presented with closed fractures. They were managed with primary open reduction and internal fixation using plates and screws.

Patients were followed for a minimum of 12 weeks, and patients who failed to follow up for four weeks were excluded from the study. The time from injury to surgery was from 12 to 72 hours. All surgeries were performed under spinal anaesthesia using a tourniquet. Two skin incisions were used with a minimum of 5 cm of bridge between two incisions. The fibula was fixed first with a postero-lateral incision using 1/3rd tubular plate and screws. The anteromedial incision was used to fix the tibia using a pre-contoured distal tibia locking anatomical plate.

Patients were grouped into two groups. Group- 1 included 23 patients; the pie crusting technique was applied before the wound closure in this group. Group-2 included 24 patients with conventional closure of the wound. Patients were followed for a minimum of 12 weeks, and outcomes in the form of superficial and deep wound infections and necrosis were recorded.

SPSS version 26.0 was used for the data analysis. Quantitative variables were summarized as mean \pm SD and qualitative variables were summarized as frequency and percentages. Chi-square test was applied to find out the association. The *p*-value of ≤ 0.05 was considered statistically significant.

RESULTS

Forty-seven patients were included in the study. 39 (83%) patients were males, and 8 (17%) were

females. In group-1 [pie-crust technique],¹⁹ patients were males, and 4 were females. Their mean age was 37.52 ± 13.41 years. Whereas in group-2 [classic wound closure],²⁰ patients were males and four were females, with a mean age of 41.62 ± 12.71 years (Table-I).

Table-I: Differences between treatment groups on Age, Gender, and complication post treatment

Parameters	Pie-Crust Technique (n=23)		Classic Wound Closure (n=24)	
	M	SD	M	SD
Age in years	37.52	13.41	41.62	12.71
Range	40	20	40	20
Gender (%)				
Male	19 (83%)		20 (84%)	
Female	4 (17%)		4 (16%)	
Complication (%)				
No Complication	22 (96%)		16 (67%)	
Superficial	1 (4%)		6 (25%)	
Infection	-		2 (8%)	
Deep Infection				

Furthermore, in group-1 [Pie-Crust Technique], 96% of the cases healed without complication, only 1(4%) patient had superficial infection, and no deep infection was reported. Whereas in group-2 [Classic Wound Closure], 67% of cases healed without complication, six patients (25%) had superficial infection, and two patients (8%) were reported to have a deep infection. The results indicated that pie-crust technique significantly reduced the risk of superficial and deep wound complications compared to classic wound closure in primary open reduction and internal fixation of fractures distal tibia/pilon and fibula (Table-II).

Table-II: Comparison of procedural complications in the two groups.

Procedures	Complication			p-value
	No-Complication	Superficial Infection	Deep Infection	
Conventional Closure	16 (34)	6 (12.8)	2 (4.3)	0.039
Pie Crusting	22 (46.8)	1 (2.1)	-	
Total	38 (80.9)	7 (14.9)	2 (4.3)	

There was a significant relationship between the two treatment conditions. Patients having conventional closure of surgical wounds were more likely than patients having pie crusting technique on skin before wound closure to have superficial as well as deep infection ($p=0.039$).

DISCUSSION

Our results showed that pie-crust technique significantly reduces the risk of superficial and deep wound

complications compared to classic wound closure because it reduces skin tension and allows the drainage of subcutaneous fluids. Fractures involving distal Tibia (Pilon) are mostly articular that result from high-energy axial loading. Often the damage to soft tissue is as traumatic as the associated bony injury. As in most orthopaedic management of fractures, knowledge about important anatomical structures and dissipation of energy will provide the basis for the treatment of these high-energy fractures.⁹ Optimal reduction of articular fractures and reconstruction of the distal tibia is achieved by open reduction with internal fixation. However, complications of wounds such as deep wound infections have plagued this management.¹⁰ Timing of surgical intervention is still controversial. Despite modern advancements in managing fractures of the distal tibia, the risk of complications of soft tissue is still high.⁸

In short, management of these complex fractures needs experienced surgeons, and soft tissue care should be of utmost priority while performing surgery.¹¹ Although there is a high risk of complications in these fractures, the optimal treatment protocol is still lacking. Therefore, a suitable procedure and proper schedule of management need to be formulated.¹² Multiple studies were done to find appropriate management for distal tibia fractures and to minimize wound complications. Table-III showed the results of a few major studies regarding management and associated complications.

With the advancement in surgical techniques and new implant designs, early open reduction and internal fixation (ORIF) is possible for high-energy intra-articular fractures of the distal tibia. This allows anatomical and optimal reconstruction of the articular surface while soft tissue is spared.¹⁸ Complications associated with conventional ORIF, especially in high-risk patients, can be minimized using minimally invasive plate osteosynthesis (MIPO). Furthermore, gently retracting soft tissue, shorter duration of tourniquet use, skin bridge of 5 to 10-cm between incisions, use of low profile implants, closure without tension, delaying fibular incision closure, and vacuum sealing drainage postoperatively are recommendations that avoid surgical wound complications.¹⁹ Considering the above-quoted evidence role of pie crusting was studied in preventing wound complications in treating distal tibia and fibula fractures.

We concluded from the current study that the minimum of 5cm bridge between two incisions com-

bined with the pie crusting technique drastically reduces the incidence of wound complications like superficial and deep infection and necrosis in fractures of distal tibia and fibula managed with primary open reduction and internal fixation.

CONCLUSION

Results indicated that pie-crust technique significantly reduces the risk of superficial and deep wound complications compared to classic wound closure because it reduces skin tension and allows the drainage of subcutaneous fluids.

Conflict of interest: None.

Authors' Contribution

RSA: Conception, data collection, literature search, article drafting, MSA: Article drafting, proof reading, BH: Data entry and analysis, article drafting, MOR: Data collection, article drafting, proof reading, MR: Literature search, article drafting, data entry, MJ: Data collection, article drafting, proof reading.

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