

ORIGINAL ARTICLE

The Results of Percutaneous Fixation in the Treatment of Undisplaced Pott's Fractures: A Prospective Study

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Objective	To analyze the results and functional outcome in patients with Pott's fracture managed by percutaneous fixation.
Design	This study is a prospective case series study.
Subjects and Methods	This was a prospective, single-arm, non-randomized clinical trial, conducted at the orthopedic surgery department at Al-Hussein University Hospital and Syed Jalal University Hospital. The study was conducted on patients receiving ozone chemonucleolysis treatment in herniated lumbar discs. The follow-up duration was 6 months. The Oswestry Disability Index (ODI) questionnaire and Visual analogue scales were used to assess pain impairment and physical performance as the main outcome (VAS). IBM SPSS 25 Windows software was used to conduct the statistical analysis.
Results	The main findings of this study were that Pott's fractures are more common in males and that the commonest fracture site was bi-malleolar. The main postoperative findings included swelling only at evening, pain while walking and impaired stair climbing. Meanwhile, post-operative complications included prominent hardware, infection and non-union. 42.3% of the studied patients had excellent Olerud Molander Ankle Score.
Conclusions	Percutaneous fixation of Pott's fracture showed satisfactory outcomes with minimal post-operative complications.
Keywords	Ankle, Fractures, Intramedullary, Percutaneous, Pott's.

INTRODUCTION

A Potts fracture is a type of ankle fracture characterized by a break in one or more prominent bones on either side of the ankle, called the malleolus. It is also known as an ankle fracture [1]. It is the most common type of fracture treated in hospitals, with an estimated incidence of 100 fractures per 105 person-years [2]. The mechanism of injury causing a Potts fracture varies from a simple fall to a high-intensity motor vehicle accident, and there are many types of fractures [3]. Early evaluation of the patient is necessary to determine whether the problem is due to a strain (sprain), a torn ligament, a ruptured bone ligament, or a true fracture [4]. Most ankle fractures are complex injuries that are difficult to treat. These injuries are of particular importance because the ankle transmits the weight of the entire body and the stability of the

ankle joint determines mobility [5]. They can lead to significant long-term disability and complications in the form of pain, instability, and early osteoarthritis [6], which makes it necessary to choose an appropriate treatment method to restore function to the patient after the fracture. Surgical treatment is the mainstay of management. To date, conventional open reduction and internal fixation have been the standard methods for treating ankle fractures [7, 9]. It provides complete exposure, simple manipulation, effective fracture reduction, and good fixation. However, open surgery and internal fixation result in significant surgical trauma and high complication rates, mainly due to the thin layer of soft tissue and skin covering the bone in this area [9, 10]. Percutaneous fixation is an emerging effective fixation method for Pott

fractures in recent years [11]. It is considered a minimally invasive procedure and is widely used in clinical practice today due to its low trauma and other advantages [12]. It requires minimal soft tissue dissection, which reduces wound complications and painful hardware sites that are sometimes encountered after open techniques [13]. Many clinicians have investigated alternative methods include minimally invasive internal fixation with plates (MIPO) and intramedullary devices to reduce trauma to soft tissue aiming to reduce the high risk of complications with the traditional open reduction and internal fixation of unstable fibular fractures with fragile soft tissue in patients with multiples comorbidities. Bankston *et al.*, [14] in 1994 used a single intramedullary screw for the first time which was more stable than the smooth nail especially against shortening due to its threads and head and they reported that the intramedullary screw is biomechanically effective as the standard neutralizing plate and lag screw This study aimed at analyzing the results and the functional outcome in patients with Pott's fracture treated with percutaneous fixation.

SUBJECTS AND METHODS

The study included 26 patients with Pott's fracture admitted to the Department of Orthopedics surgery of Kasr Alainy hospital, patients were recruited to the study after excluding patients with open fractures, pilon fractures, ipsilateral tibial shaft fractures, displaced or pathologic fractures. The aim and the methodology of the study were explained to the selected group, and an informed written consent was obtained before being included in the study. On admission, the patient's demographic data was noted. Local examination of injured ankle for fractures. Post-operative radiographs were examined for adequacy of reduction. The abbreviated version of the Olerud and Molander Score (OMS) questionnaire was answered by all living patients following their index procedure. This outcome measure is specific for symptoms and function of the foot and ankle (Table1).

Operative techniques:

The supine position was used with a pillow below the upper thigh to rotate the ankle and foot internally. Appropriate antibiotics according to the local guidelines was administered before the tourniquet was applied. Fluoroscopy was placed in the opposite side to allow easy access to the surgeon. The fibular fracture was closely reduced. Reduction was confirmed with fluoroscopy in the anteriorposterior and lateral view. The reduction was maintained by pressure over the fracture site. An incision was made about 2cm distal to the tip of lateral malleolus and then blunt dissected by mosquito so a slave can be placed to control the drill bit (Figure 1), to pass through the distal fibula and make an entry for the screw without passing beyond the fracture site. A 6.5mm, fully or partial

threaded, self-tapping cancellous bone screw was used. The screw inserted close to the lateral cortex while passing to maintain the reduction of the fracture. The length of the screw varies between 100mm and 120mm, depending on the fracture location and pattern, if the medullary canal is narrow, a 4.5mm cortical screw or cancellous, is inserted instead of 6.5mm cancellous screw. The shaft of the screw correcting the talar shift, and the purchase of the screw maintained the length. The wound was irrigated with normal saline and closed in layers.

Table 1: Olerud and Molander Scoring of Symptoms After Ankle Fracture

Parameter	Degree	Score
1. Pain	None	25
	While walking on uneven surface	20
	While walking on even surface outdoors	10
	While walking indoors	5
	Constant and severe	0
2. Stiffness	None	10
	Stiffness	0
3. Swelling	None	10
	Only evenings	5
	Constant	0
4. Stair Climbing	No problems	10
	Impaired	5
	Impossible	0
5. Running	Possible	5
	Impossible	0
6. Jumping	Possible	5
	Impossible	0
7. Squatting	No problems	5
	Impossible	0
8. Supports	None	10
	Taping, wrapping	5
	Stick or crutch	0
	Same as before injury	20
9. Work, ADL	Loss of tempo	15
	Change to simpler job/part time work	10
	Severely impaired work capacity	0

After the fibular fixation, the medial malleolus fracture was addressed. The foot manipulated to reduce the fracture and the reduction was maintained by digital pressure or reduction forceps then two or three guide wire were inserted perpendicular to the fracture line then 1cm incision was made allowing entry of the cannulated 2.5mm bond then two or three partially threaded 4mm cannulated cancellous screws were utilized (Figure 2) and the limb is placed in a

below knee slab. The patient remained non-weight-bearing or toe touch weight bearing for 6 weeks post operatively. After 2 weeks the cast changed, wound checked and the sutures were removed. The patients were followed up radiologically by x ray and clinically by examination and (OMS).

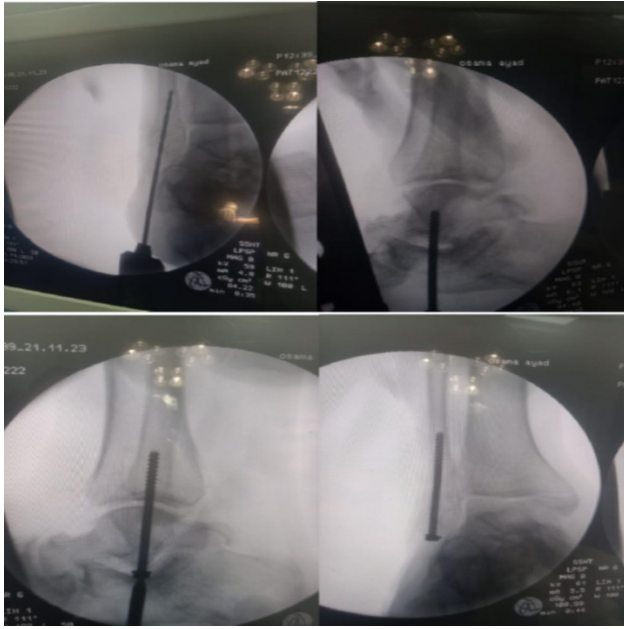


Figure 1: Percutaneous fixation of lateral malleolus

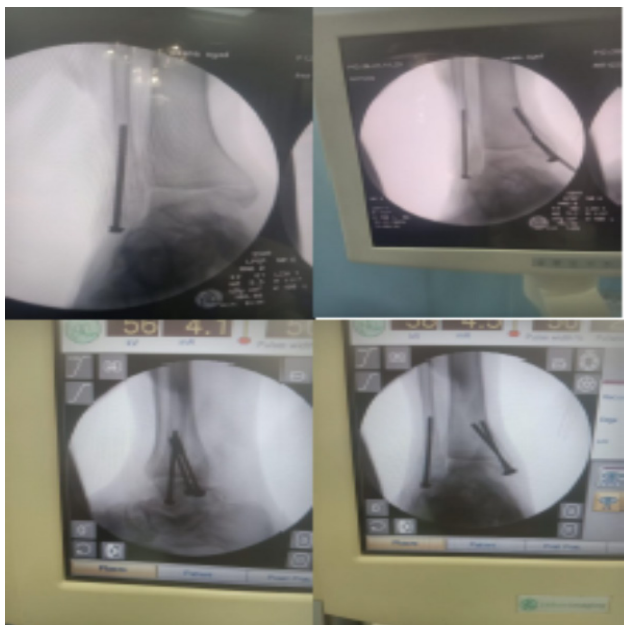


Figure 2: Percutaneous fixation of medial malleolus

Statistical analysis:

Data collected, tabulated, and statistically analyzed using an IBM compatible personal computer with Statistical Package for the Social Sciences (SPSS) version 26. Statistics divided into two parts; Descriptive statistics:

in which quantitative data presented in the form of mean, standard deviation (SD), median and range and qualitative data presented in the form numbers (N) and percentages (%). Analytic statistics: tests of significance which used: Chi-square test or Fisher's Exact test.

RESULTS

The study included 26 patients, 12 (46.2%) were female, their age ranged from 19-39 with a mean age of 27.7 years. Regarding the cause of injury, 10 patients (38.5%) were rolling on, 7 patients (26.9%) were landing from a jump, 4 patients (15.4%) were fall from height and 3 patients (11.5%) were motor bike accident. The fracture was bimalleolar in 11 patients (42.3%), 8 patients (30.8%) had medial malleolus fracture, 5 patients (19.2%) had a trimalleolar and 2 patients (7.7%) had lateral malleolus fracture (Figures 3, 4) (Table 2).

The mean of time of union was 5.88 with range from 4 to 8 weeks, the mean time of return to work was 7.35 with range from 5 to 10 weeks, the mean operative time was 42.31 min with range from 20 to 60 min and the mean of hospital stay was 17.31 hour with range from 12 to 24 hour. The mean of (OMS) was 83.08 with a range from 70 to 100, of which 11 patients (42.30%) were excellent, 6 (23.10%) were good, 9 (34.60%) were fair (Table 3, 4).

Regarding the postoperative complications, 19 patients (73.1%) didn't have complications, 3 patients (11.5%) had prominent hardware, 2 patients (7.7%) had infection and 2 patients (7.7%) had non-union, of which one case was lateral malleolus and treated by open reduction and plating with graft, the second case was the tip of the medial malleolus and treated by removal of the hardware only (Table 5).

Table 2: Preoperative data.

		No	%
Sex	Female	12	46.2%
	Male	14	53.8%
Age	Mean $\pm$ SD	27.77 $\pm$ 5.49	
	Range	19 - 39	
Mode of trauma	Fall from height	4	15.4%
	Landing from a jump	7	26.9%
	Motor bike accident	3	11.5%
	Motor car accident	2	7.7%
	Rolling on	10	38.5%
Fracture site	Bimalleolar	11	42.3%
	Lateral malleolus	2	7.7%
	Medial malleolus	8	30.8%
	Trimalleolar	5	19.2%

Table 3: time of union, return to work, operative time and Hospital stay among studied group

	Min	Max	Mean	SD
Operative time	20	60	42.31	14.16
Hospital stay	12	24	17.31	5.45
Time to union	4	8	5.88	1.40
Return to work	5	10	7.35	1.57

Table 4: Olerud & amp; Molander score among studied group

	Min	Max	Mean	SD
Olerud & amp; Molander score	70	100	83.08	9.70
	No		%	
Exellent	11		42.30%	
Fair	9		34.60%	
Good	6		23.10%	

Table 5: Post-operative complications

		No	%
Complication	Infection	2	7.7%
	No complication	19	73.1%
	Non union	2	7.7%
	Prominant hardware	3	11.5%

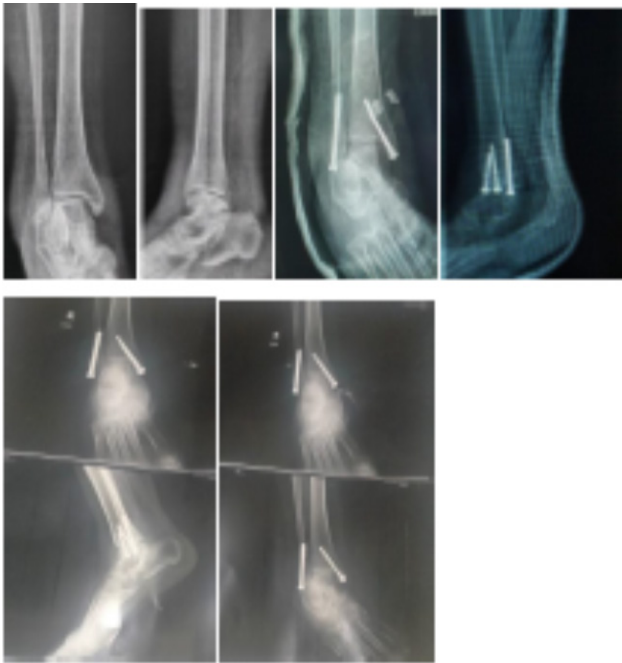


Figure 3: Male patient. 24 years, Right ankle fracture (bimalleolar). Skin condition was normal with intact neurovascular. Percutaneous fixation was done, one year postoperative OMAS score is 100. Patient condition is excellent.

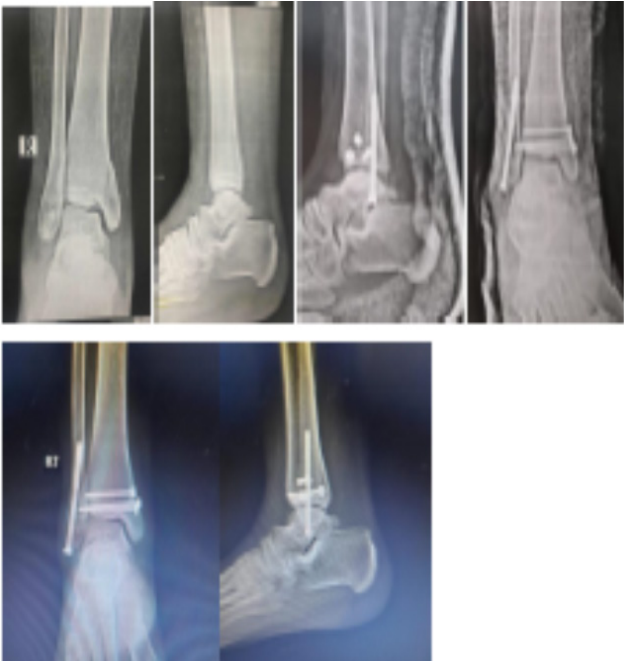


Figure 4: Female patient. 25 years old. Right ankle fracture (bimalleolar). Skin condition was normal with intact neurovascular. Percutaneous fixation was done, one year postoperative OMAS score is 100. Patient condition is excellent.

DISCUSSION

Recently, there has been a trend toward less invasive techniques for the treatment of ankle fractures such as distal fibula fractures. Various techniques have been described, ranging from minimally invasive plate osteosynthesis to closed reduction and internal fixation with nails and screws. These minimally invasive techniques allow for smaller incisions with less dissection and soft tissue damage. Due to limited visualization of the fracture, a thorough understanding of the mechanism of injury and fracture morphology is required. In addition, the correct choice of repositioning maneuvers and fixation devices is also required. Minimally invasive techniques preserve the blood supply of the fracture fragments, often allowing early ankle joint mobilization and providing favorable clinical outcomes, especially when treating complex ankle fractures in patients with soft tissue problems [15]. Percutaneous cannulated screws with medial or lateral malleolus fixation and intramedullary nailing for the treatment of ankle fractures in elderly or diabetic patients have been proposed as effective intramedullary techniques [16]. The aim of our study was to analyze the outcome and functional outcomes in patients with Pott's fractures treated with percutaneous fixation.

We used the (OMS) to assess functional outcome, we found that the mean score was 83.08 with a range of 70 to 100, which is an excellent to moderate score. Similar reports have achieved similar results. Smith M. *et al.*, described inserting a 100mm intramedullary screw as a

minimal invasive technique for stabilizing unstable fibular fractures, with percutaneous screw fixation of the medial malleolus if necessary. In their retrospective analysis of 23 patients, the mean age was 70 years (range 29-89) and 74% had significant comorbidities. The (OMS) outcome score was 70 [17].

In another study in 2017, the authors included 23 patients with medial malleolus fractures, of which 15 had bimalleolar fractures, 28 had transverse fractures, and 10 had longitudinal fractures who underwent percutaneous repair. According to the (OMS) criteria; 13 patients had excellent outcomes, 17 had good outcomes, and 8 patients ended up with a fair overall outcome [18]. Du *et al.*, [19], studied the outcomes of medial malleolus fractures in 19 patients who underwent closed reduction and percutaneous internal fixation. They used the Kaikkonen classification system and found that their outcomes were excellent in 5 patients, good in 10, moderate in 3 and poor in 1 patient [19].

This current study showed that the mean operative time of the study patients was 42.31 ± 14.16 minutes. A shorter mean operative time (29 minutes) was reported by Sleman in 2017 [20]. This difference may be due to differences in surgeon experience and the condition of Pott fractures. Shams *et al.*, in a study of percutaneous fixation 18, reported that the mean operative time was 35 ± 15 minutes, which was shorter than that required for the traditional open technique. Szczesney *et al.*, [21]. In their study on December 20, the operative time for the minimally invasive method was longer (50.1 ± 23.4 minutes vs. 77.8 ± 12.0 minutes for open reduction and internal fixation).

Regarding the time to union, we found that the mean time to union was 5.88 with a range of 4 to 8 weeks, the mean time to return to work was 7.35 with a range of 5 to 10 weeks, the mean hospital stay was 17.31 hours with a range of 12 to 24 hours. Similarly, in the study by Du *et al.*, [19] all patients achieved wound healing after initial surgery and the follow up was for 6 to 30 months, the mean was 18.7 months. There was no case of non-union, the union time range from 2.6 to 3.8 months, with a mean of 3.2 months. Meanwhile, in the study by Shams, the mean hospital stay was 2 ± 1 days. The patients were followed up for 21 months (range 12 to 30). There was no cases of non-union, the union time range from 8 to 16 weeks with mean of 10 weeks.

The closed method for the management of medial malleolus fractures reduces the surgical length, inpatient period, and wound troubles because it is a minimally invasive technique. It can achieve satisfactory clinical results. Due to this biological fixation and the excellent compression achieved at the fracture site, the consolidation

time (8 to 16 weeks) was less than that of Du *et al.*, (2.6 to 3.8 months) In addition, the inform that periosteum entrapment at the medial malleolus fracture site is the primary cause of nonunion suggests had no effect on bone union when using this technique.

The current study showed that no complications were noted in 73% of the patients studied. Hardware, infection, and prominent nonunion were noted in 11.5%, 7.7%, and 7.7% of the patients studied, respectively. Postoperative complications such as pain (9.4%), allergy (9.4%), infection (6.3%), and bursitis (6.3%) were also reported by Sleman in 2017 [20]. However, these complications were lower than those reported by Latif *et al.*, in 2013, who performed their study on 46 patients with displaced lateral malleolus fractures who underwent closed reduction and percutaneous internal fixation [13]. Percutaneous fixation of ankle fractures has been reported to have the lowest rate of postoperative complications; thus, this surgical technique is preferred for high-risk patients such as the elderly, severely ill patients, and complex open fractures. The reason behind the low complication rate of percutaneous fixation is that the fully threaded screw is superior than the smooth nail in control of displacement and rotation of the distal fragment as the lodge of the shaft of the 100mm screw along the medulla provides an inward force correcting the talar shift in the mortise. It also reduces anesthesia time as well as exposure to X-rays. It is considered a successful technique for management of transverse and oblique fractures. If a sufficient distal segment to retain the screw to some extent, multi-fragments fractures may be reduced because the screw thread prevents shortening and the screw curvature reduces the fibula and talus medially.

CONCLUSION

Intramedullary screw fixation of unstable fibular fractures with or without percutaneous medial malleolus screw fixation is an excellent technique for pott's fractures with compromised soft tissue when operative treatment is indicated. This technique minimizes subsequent skin and subcutaneous breakdown with good final radiological and clinical outcomes and low complication rates. Our study confirms that intramedullary screw fixation of the fibula is part of the surgeon's options for surgical treatment of these injuries.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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