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ORIGINAL ARTICLE

Outcome of Internal Fixation of Acute Ankle Fractures in Diabetic Patients

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ABSTRACT

Background: Ankle fractures are a common injury among diabetics. Fixation of this type of fracture by plate and screws is an efficient method for treating diabetic patients with ankle fracture. So, we aimed to evaluate how diabetic individuals with firm internal fixation fared with the treatment of recent ankle fractures. **Methods:** 30 diabetic patients with ankle fractures participated in this randomized clinical trial, which was conducted at the orthopedic emergency room of Zagazig University hospitals. The outcome of internal fixation of acute ankle fractures was assessed. **Results:** Age and operating time have a statistically significant relationship with postoperative complications (both were significantly higher among complicated patients). Postoperative problems and AOFAS had a statistically significant relationship (good and excellent scores were obtained by 73.9% and 21.7% of non-complicated patients, respectively, compared to 14.3% and 14.3% of complicated patients). Postoperative problems are not statistically significantly correlated with neuro-vascularity, side of lesion, mechanism of injury, gender, occupation, smoking, or time preceding surgery. **Conclusions:** Patients with diabetes who are uncontrolled and have a high HBA1C level experience more complications than those who have their diabetes under control. The recommended course of action for people with controlled diabetes who have unstable ankle fractures is open reduction and internal fixation using standard procedures. Soft-tissue and osseous problems, such as delayed union and nonunion, are more common in patients with uncontrolled diabetes and high HBA1C levels.

Keywords: Internal Fixation; Patients with Diabetes; Acute Ankle Fractures.

INTRODUCTION

About 1 in 8 individuals receiving surgical care for fractures of the rotational ankle are diabetes. Studies on diabetic patients have revealed that complications following ankle fracture repair range from 26 to 47 percent, while matched control groups of non-diabetic patients experienced complications at a rate of about 15 percent [1].

According to a recent large-scale study, diabetics are more likely to experience infection and other serious surgical complications, which can lead to amputation following ankle fracture fixation than any other risk factor. Additionally, diabetics are more likely to require secondary operations and have worse outcomes regarding activity limitation score [2].

Some had previously thought that non-operative treatment of acute ankle fractures in diabetics was a safer alternative. However, more recent research indicates that because an ankle injury can set off the process of charcot neuroarthropathy, which results in joint degeneration, bone loss, and deformity, taking a

conservative approach may actually increase the risk of problems and make catastrophic outcomes more severe [3].Prior research highlights the necessity of operational stiff fixation for rotational ankle fractures in patients with diabetes. It identifies the risk factors associated with complications and offers recommendations regarding preoperative assessment and management of ankle fractures in diabetic patients, taking into account the pathophysiology associated with the disease and recent literature regarding treatment outcome [4].

METHODS

This randomized clinical trial was done in orthopedic emergency room, Zagazig University hospitals on 30 diabetic patients with Ankle fractures. Every patient gave their informed permission as well. The Zagazig University Faculty of Medicine's Ethical Committee approved the study (IRB number 11250-19-11-2023).

Inclusion criteria included recent isolated ankle fracture, adults Patients (Patients aged 20 years or older), diabetic Patients and bimalleolar or trimalleolar ankle Fractures.

Exclusion criteria included open fractures, patients with acute Charcot fracture, patients with Charcot arthroneuropathy, patients with Peripheral Vascular Disease, pathological fractures and patients with dementia or other mental health illness prevented the ability to adequately complete questionnaires.

Preoperative care :

Full history was taken from the patients including: age, Sex, Occupation, Residency, timing and mechanism of the trauma, history of previous Trauma, history of previous Treatment, history of diabetes, its duration & treatment and complications. Clinical Examination was done for assessment of pain, localized edema, localized Erythema./ hotness, temperature of extremities, skin condition (Ecchymosis, abrasions, and bullae), deformity/ amputations and contralateral limb.

Ankle fractures were categorized using the Denis-Weber and Lange-Hansen classifications in the antero-posterior, lateral, and mortise views. When necessary, computed tomography was ordered.

Preoperative routine lab examinations included the following tests for the patients: HBA1C, random blood glucose levels obtained during fasting, complete blood count, bleeding profile, liver and kidney function tests, and preoperative HIV, HBV, and HCV screening.

Operative care:

❖ **Surgery planning and technique**

Operative Fixation is done through ORIF by plate and screws or tension band according to AO principles of periarticular fracture fixation. In all cases, operations were done under spinal anesthesia, with the patients in supine position (except patients with trimaleolar fractures surgery was done in prone position), on ordinary table, and pneumatic tourniquet used around the midthigh without exsanguination in diabetic cases and tourniquet deflation before wound closure and start hemostasis. One-third tubular plate (in 26 patients) or anatomical distal fibular locked plate (4 patients) were used to fix the lateral malleolus in ORIF cases involving the distal fibula, while direct lateral approach was used in 24 cases and posterolateral approach in the cases involving trimaleolar fractures [5]. The direct medial approach is employed in ORIF of the medial malleolus. The medial malleolus was repaired with two 4-mm cancellous lag screws in 21 patients, a tension band in 7 patients, and an antiglide plate in 2 patients. 6 patients had trimalleolar fracture, only two of them underwent ORIF of posterior malleolus with screws. 15 patients had syndesmosis injury fixedby ORIF by screws .

***Description of the surgical technique* :**

1)Lateral malleolus fixation:

Given the significance of this component in maintaining tibiotalar alignment, the most crucial step in the operational therapy of a malleolar fracture is secured anatomic repair of a displaced lateral malleolus fracture.

Approach:

The accepted method for minimizing and internally mending distal fibula fractures is a direct lateral approach over the fibula. The

peroneus longus and brevis posteriorly and the peroneus tertius anteriorly should be dissected. When the anterior syndesmosis needs to be fixed, the incision is advanced slightly anterior.
Distal fibula avulsion fractures were reduced, stabilized with a lag screw or a tension band wiring (TBW) method, and retained with reduction forceps. A short oblique screw or a tension band wire are the best options for fixing a bigger avulsed fragment of the distal lateral malleolus, which is typical of AO type A injuries. One or two lag screws positioned perpendicular to the fracture's line were used to fix an AO type B fracture. A third semi-tubular plate that was shaped to match the concave, somewhat spiral lateral surface of the fibula allowed for a more stable fixation. To strengthen the fixation, the fracture site was compressed using an anterio-posterior interfragary lag screw. A third tubular plate was used to minimize and stabilize AO type C fractures. The position of the plate is determined by the degree of comminution, the state of the soft tissues overlaying the fracture, and the level of fracture.

2)Medial malleolar fixation

Approach:

The medial malleolus is the focal point of the medial approach to the ankle, which can be moved anteriorly for improved joint access or posteriorly to expose the rear of the tibia. Depending on the required exposure, either a longitudinal or a curvilinear incision was made.
The most effective method of minimizing medial malleolus avulsion fractures is to have a periosteal elevation with connected fascia that exposes the anterior and medial portions of the fracture. Using one wire and a 2.0- or 2.5-mm drill bit, a hole for a 4.0-mm partially threaded cancellous screw or malleolar screw is made in the intermediate-sized fragments. When dealing with large-sized shards, temporary fixing calls for two of these drills, each of which is swapped out for a 4-mm partly threaded screw. By crossing their threads over the fracture and aligning them perpendicular to the fracture plane, one can achieve a lag effect. Fixation was accomplished by Kirschner (K)-wires with a figure-of-eight tension band when the medial malleolar fragment was too tiny for screws or if it had been comminuted.

Postoperative care:

All patients were immobilized with short-leg posterior slab, antibiotics and anticoagulants were prescribed to all patients and postoperative x-ray was done for all patients to assess the reduction and fixation, and the patients were discharged within 2-3 days postoperatively.

Follow Up :

In the First follow up, all patients reviewed at 14 days for stitch removal, and changed the immobilization into short-leg cas for 6 to 8 weeks. In the second follow up, at 6 weeks after surgery, clinical & radiological examination was done. The beginning of weight bearing started when there were clinical and radiological evidences of union. Clinically, radiologically, and after 3 and 6 months following surgery, all patients were monitored.

Patient evaluation:

All patients were asked a single question regarding their level of pain, while the alignment category, the function category, consists of 5-7 questions and requires completion by both the patient and the physician. The results were assessed using the American Orthopedic Foot and Ankle Score (AOFAS), which is a scoring system that includes a variety of questions and covers three categories: pain (40 points), function (50 points), and alignment (10 points). These are all scored together for a total of 100 points.

Statistical analysis

SPSS (Statistical Package for the Social Sciences) version 28 was the software used for data analysis. Absolute frequencies were used to characterize the categorical variables, and the chi square test was used to compare them. A trend test using chi square was employed to compare ordinal data between two groups. Assumptions utilized in parametric testing were verified using the Shapiro-Wilk test. Standard deviations, medians, and means of quantitative

data were used to describe them. An independents sample t test was employed (for normally distributed data) to compare quantitative data between two groups. ANOVA test (for normally distributed data) in one way and post hoc Bonferroni test (when p is less than 0.05) in the other are used to compare quantitative data between more than two groups. $P<0.05$ was chosen as the level of statistical significance. If $p\leq0.001$, a highly significant difference was detected.

RESULTS

Thirty patients, ages ranging from 25 to 69, with a mean age of 46.4, participated in this investigation. Male represented 46.7% of them. Ten patients were housewives (33.3%), and fourteen patients (46.7%) were manual workers. Seven patients (23.3%) were smokers (Table 1)

Eighteen patients (60%) had left-side lesion and 86.7% had twisting injury. Time before surgery ranged from 2 to 5 days with mean 2.67 days. Operative time ranged from 50 to 80 minutes with mean 62.83 minutes (Table 2).

AOFAS score was assessed postoperatively. As regard pain domain, cores ranged from 20 to 40 and 50% had no pain. Functional assessment showed that 46.7% had no limitation in daily activity and limitation only in recreational activity was reported. As regard maximum walking distance, 50% can walk from 4 to 6 blocks. Of the patients, 18% had some trouble with stairs, ladders, uneven terrain, and inclines, and 53.3% showed a clear irregularity in their gait. Seventeen patients (56.7%) had moderate restriction in sagittal motion, sixteen patients (53.3%) had moderate restriction in hindfoot motion and 83.3% had stable ankle hindfoot. On assessing alignment domain, 83.3% had good alignment. Total AOFAS score ranged from 40 to 100 with mean 80.63. One patient had poor score (3.3%), five patients (16.7%) had fair score, eighteen patients (60%) had good score while six patients (20%) had excellent score (Table 3).

Twenty-three patients (76.7%) had uncomplicated, and two patients (6.7%) had implant failure. Delayed wound healing, ankle osteoarthritis, charcot injury, non-union and implant failure + Charcot injury prevailed in one patient each (3.3%) (Table 4).

Age and operating time have a statistically significant relationship with postoperative complications (both were significantly higher among complex patients).

Postoperative problems and AOFAS had a statistically significant relationship (good and excellent scores were obtained by 73.9% and 21.7% of non-complicated patients, respectively, compared to 14.3% and 14.3% of complicated patients). Postoperative problems are not statistically significantly correlated with neuro-vascularity, side of lesion, mechanism of injury, gender, occupation, smoking, or time preceding surgery (Table 5).Increasing age and operative time independently increase risk of complications by 1.106 and 1.13 folds respectively (Table 6).The AOFAS score and the amount of time before surgery have a statistically significant relationship (the difference is significant before poor/fair and each other group on a posthoc test).The AOFAS score does not significantly correlate with age, gender, occupation, smoking, neuro-vascularity, lesion side, damage etiology, or length of surgery (Table 7).

Table (1): Demographic data of studied patients

	N=30	%
Gender		
• **Female**	16	53.3%
• **Male**	14	46.7%
Occupation		
• **Barbar**	2	6.7%
• **Butcher**	1	3.3%
• **Carpenter**	1	3.3%
• **Driver**	1	3.3%
• **Tailor**	1	3.3%
• **Farmer**	3	10%
• **Employee**	5	16.7%
• **Engineer, teacher, lawyer**	6	20%
• **Housewife**	10	33.3%
• **Manual worker**	14	46.7%
• **Professional**	6	20%
Smoking		
• **Non-smoker**	23	76.7%
• **Smokers**	7	23.3%
	Mean ± SD	**Range**
Age (year)	46.4 ± 12.4	25 – 69

Table (2) :Distribution of studied patients according to injury-related data

	N=30	%
Side of lesion		
• **Left side**	18	60%
• **Right side**	12	40%
Mechanism of lesion		
• **Direct trauma**	4	13.3%
• **Twisting injury**	26	86.7%
	Mean ± SD	**Range**
Time before surgery (day)	2.67 ± 0.71	2 – 5
Operative time (min)	62.83 ± 6.39	50 – 80

Table (3) :Distribution of studied patients according to AOFAS score

	Mean ±SD/n=30	Range /%
I. Pain		
Pain	2.67 ± 0.71	20 – 40
• **No pain**	15	50%
• **Mild, occasional pain**	14	46.7%
• **Moderate daily pain**	1	3.3%
II. Function		
Activity limitation	7.07 ± 1.99	4 – 10
• **No limitation, no support**	7	23.3%

	Mean ±SD/n=30	Range /%
• **No limitation in daily activity, limitation in recreational activities**	16	46.7%
• **Limited daily and recreational activity**	7	23.3%
Maximum walking distance	4.1 ± 0.96	2 – 5
• **>6 blocks**	11	36.7%
• **4 – 6 blocks**	15	50%
• **1 – 3 blocks**	4	13.3%
Walking surfaces	3.8 ± 1.0	3 – 5
• **No difficulty in one surface**	12	40%
• **Some difficulty on uneven terrain, stairs, ladder, inclines**	18	60%
Gait abnormality	5.87 ± 2.03	4 – 8
• **None, slight**	14	46.7%
• **Obvious**	16	53.3%
Sagittal motion	5.73 ± 2.02	4 – 8
• **Normal or mild restriction**	13	43.3%
• **Moderate restriction**	17	56.7%
Hind foot motion	4.4 ± 1.52	3 – 6
• **Normal or mild restriction**	14	46.7%
• **Moderate restriction**	16	53.3%
Ankle hindfoot stability	6.67 ± 3.03	0 – 8
• **Stable**	25	83.3%
• **Definitely unstable**	5	16.7%
Alignment		
Alignment	8.33 ± 3.79	0 – 10
• **Good**	25	83.3%
• **Poor**	5	16.7%
Total AOFAS score	80.63 ± 16.32	40 – 100
• **Poor**	1	3.3%
• **Fair**	5	16.7%
• **Good**	18	60%
• **Excellent**	6	20%

Table (4): Distribution of studied patients according to postoperative complications

	N=30	%
Complications		
• **NAD**	23	76.7%
• **Implant failure**	2	6.7%
• **Delayed wound healing**	1	3.3%
• **Ankle osteoarthritis**	1	3.3%
• **Charcot injury**	1	3.3%
• **Implant failure and Charcot joint**	1	3.3%
• **Non-union**	1	3.3%

Table (5) :Relation between incidence of postoperative complications and the studied parameters

	Non-complicated N=23 (%)	Complicated N=7 (%)	$\chi 2$	p
Gender				
• **Female**	10 (43.5%)	6 (85.7%)	Fisher	0.086
• **Male**	13 (56.5%)	1 (14.3%)		
Occupation				
• **Housewife**	5 (21.7%)	5 (71.4%)		
• **Manual worker**	9 (39.1%)	0 (0%)	2.694	0.101
• **Professional**	9 (39.1%)	2 (28.6%)		
Smoking				
• **Non-smoker**	16 (69.6%)	7 (100%)	2.779	0.096
• **Smokers**	7 (30.4%)	0 (0%)		
Neuro-vascularity				
• **Intact**	23 (100%)	6 (85.7%)	Fisher	0.233
• **Peripheral neuropathy**	0 (0%)	1 (14.3%)		
Side of lesion				
• **Left side**	16 (69.6%)	2 (28.6%)	Fisher	0.084
• **Right side**	7 (30.4%)	5 (71.4%)		
Mechanism of lesion				
• **Direct trauma**	4 (17.4%)	0 (0%)	Fisher	0.548
• **Twisting injury**	19 (82.6%)	7 (100%)		
Total AOFAS score				
• **Poor**	0 (0%)	1 (14.3%)		
• **Fair**	1 (4.3%)	4 (57.1%)	8.203	0.004*
• **Good**	17 (73.9%)	1 (14.3%)		
• **Excellent**	5 (21.7%)	1 (14.3%)		
	Mean ± SD	**Mean ± SD**	t	p
Age (year)	43.61 ± 12.18	55.57 ± 7.23	-2.541	0.021*
Time before surgery (day)	2.61 ± 0.72	2.86 ± 0.69	-0.804	0.428
Operative time (min)	61.52 ± 5.53	67.14 ± 7.56	-2.163	0.039*

$\chi 2$Chi square test t independent sample t test *p<0.05 is statistically significant

Table (6): Binary regression analysis of factors associated with postoperative complications

	B	P	AOR	95% C.I.	
				Lower	Upper
Age (year)	0.101	0.084	1.106	0.986	1.241
Operative time (min)	0.122	0.168	1.130	0.950	1.345

AOR= adjusted odds ratio , CI= Confidence interval

Table (7) :Relation between total AOFAS score and the studied parameters

	Poor/fair N=6(%)	Good N=18(%)	Excellent N=6(%)	$\chi 2$	p
Gender					
• **Female**	5 (83.3%)	8 (44.4%)	3 (50%)	1.295	0.255
• **Male**	1 (16.7%)	10 (55.6%)	3 (50%)		
Occupation					

• **Housewife** • **Manual worker** • **Professional**	4 (66.7%) 1 (16.7%) 1 (16.7%)	4 (22.2%) 6 (33.3%) 8 (44.4%)	2 (33.3%) 2 (33.3%) 2 (33.3%)	1.037	0.308
Smoking • **Non-smoker** • **Smokers**	5 (83.3%) 1 (16.7%)	13 (72.2%) 5 (27.8%)	5 (83.3%) 1 (16.7%)	0	>0.999
Neuro-vascularity • **Intact** • **Peripheral neuropathy**	6 (100%) 0 (0%)	18 (100%) 0 (0%)	5 (83.3%) 1 (16.7%)	2.5	0.114
Side of lesion • **Left side** • **Right side**	1 (16.7%) 5 (83.3%)	13 (72.2%) 5 (27.8%)	4 (66.7%) 2 (33.3%)	3.021	0.082
Mechanism of lesion • **Direct trauma** • **Twisting injury**	1 (16.7%) 5 (83.3%)	2 (11.1%) 16 (88.9%)	1 (16.7%) 5 (83.3%)	0	>0.999
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	F	P
Age (year)	50.67 ± 14.18	45.83 ± 12.03	43.83 ± 12.06	0.498	0.613
Time before surgery (day)	3.33 ± 1.03	2.56 ± 0.51	2.33 ± 0.53	4.32	0.02*
Bonferroni	P1 0.048*	P2 >0.999	P3 0.035*		
Operative time (min)	66.67 ± 8.17	61.39 ± 5.89	63.33 ± 5.16	1.625	0.216

χ2Chi square for trend test , *p<0.05 is statistically significant , F One way ANOVA test , p1 difference between poor/fair and good p2 difference between good and excellent , p3 difference

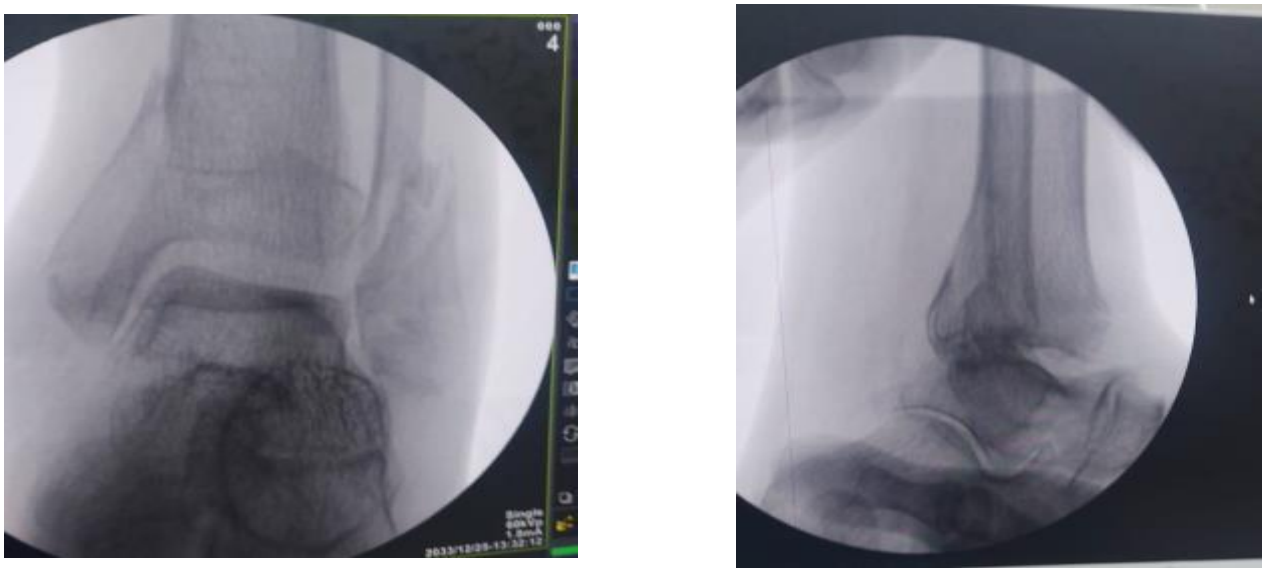

Fig. (1). Preoperative lat. and mortise x-ray.showing left bimalleolar fracture type B Denis-Weber

Fig. (2). Immediately postoperative x-ray A.P.views showing fixation of lat.mallelous with anatomical plate and med.mallelous with recon.plate and 2 navicular screws

Fig. (3). 6 weeks postoperative mortise and lateral view. x-ray A.P.views showing fixation of lat.mallelous with anatomial plate and med.mallelous with recon.plate and 2 navicular screws

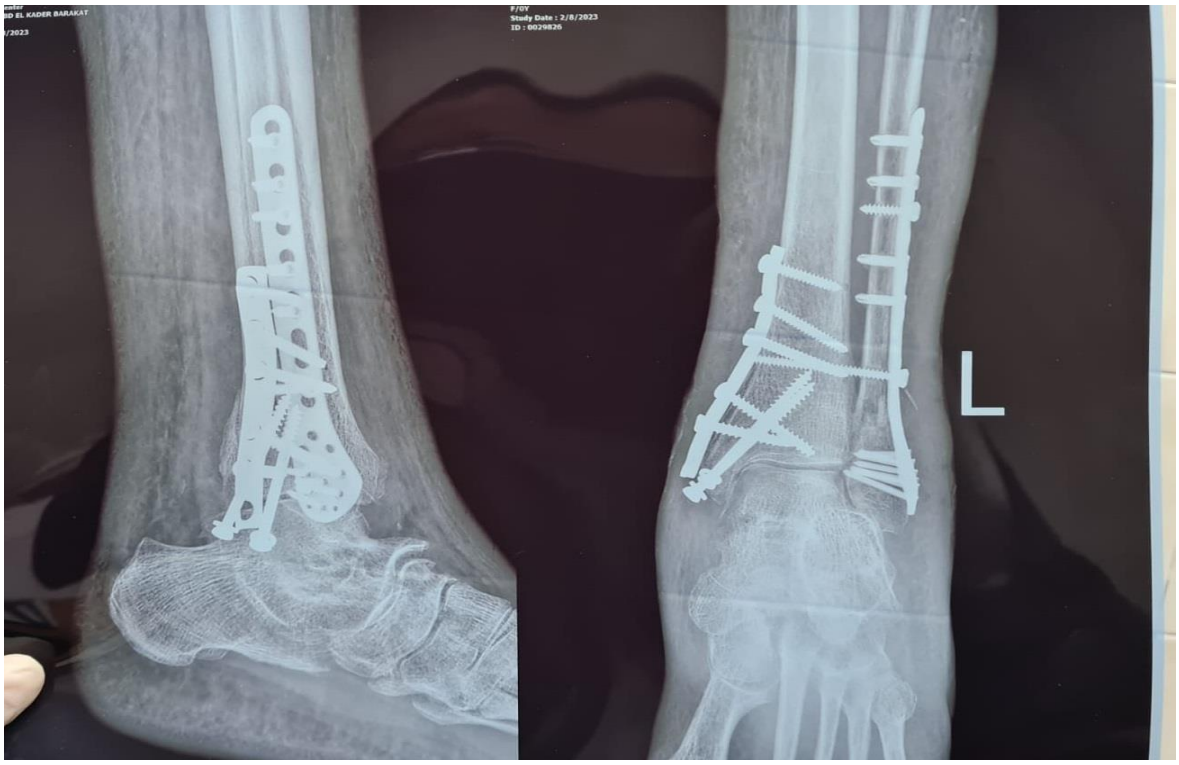

Fig. (4). AP & lateral views after 3 months follow up showing fixation of lat.mallelous with anatomical plate and med.mallelous with recon.plate and 2 navicular screws

Fig. (5). AP & lateral views after 6 months follow up.showing fixation of lat.mallelous with anatomical plate and med.mallelous with recon.plate and 2 navicular screwswith complete union is achieved

Fig. (6). Skin condition of lat incision with complete wound healing

Fig. (7). Skin condition of medial incision wih complete wound healing

DISCUSSION

Scientific material of this study: This prospective clinical series study involved 30 patients with ankle fractures coming to the orthopedic emergency department of Zagazig university hospitals . The study started in January 2023 and ended at January 2024Internal fixation and open reduction were the methods used to treat each patient.

The following program was used to evaluate and monitor the patients: In the first follow up, all patients reviewed at 14 days for stitch removal and changed the immobilization into short-leg case for 6 weeks. In the second follow-up, which took place six weeks following surgery, a clinical and radiological examination was conducted. All patients were also monitored three and six months after surgery, both clinically and radiologically. The American Orthopedic Foot and Ankle Scoring System was used to assess the final results.

To achieve the stated goal, we treat 30 cases of surgically treated ankle fractures, consisting of 14 (46.7%) males and 16 (53.3%) females. The patients' ages range from 25 to 70 years old (mean age at surgery: 46.4 ± 12.4 years), and they all fall within the inclusion criteria group. After surgery, the patients receive regular follow-up care for approximately six months.

In present study, Twisting injury was the most common mode of injury, The most common fracture type is supination-external rotation type, Linear regression model showing positive correlation in controlled diabetic patients with good functional score more than poor Diabetic control, The most common complications occurred with poor controlled diabetic patients .The high union rate occurs mainly at week 10 at higher percent 74% in controlled diabetic patients while union rate in uncontrolled diabetic patients was delayed at 6 months.

Orthopedic physicians treat ankle fractures more often than any other type of injury. The

incidence of diabetes mellitus has increased in this patient population, and ankle fractures are becoming more common. Of all the risk factors, diabetes mellitus had the highest rate of amputation and postoperative complications after ankle fracture repair. Despite obtaining appropriate surgical therapy, diabetics are also more likely to require follow-up treatments and have worse results regarding activity limitation scores. In spite of this, sustained outcomes are still unknown since studies frequently present contradicting findings [6]. The aim of the treatment is to restore the affected ankle's anatomy while facilitating fracture union and painless ankle mobility. Treatment with closed techniques is frequently insufficient to restore the ankle's morphology and biomechanics in cases with unstable fractures. On the other hand, open reduction combined with internal fixation is a great way to restore the joint's natural morphology. Internal fixation of displaced ankle fractures has been shown in several studies to have improved outcomes [7].

Our goal in this study was to enhance the prognosis of ankle joint fractures in individuals with diabetes who were receiving open reduction internal fixation.

Regarding to mode of trauma: Among our 30 patients the most common type of trauma was twisting injury in 14 (46.6%) cases then RTA in 9(30%) cases and the least mode of trauma was fall from height in 7(23.3%) cases.The majority of cases in the studies conducted by Motwani et al. [8] and Lee et al. [9] involved automobile accidents. The bulk of research studies in the literature indicated that falls, twisting injuries, and roadside accidents were the main causes of fractured ankles. Sports injuries, assaults, and industrial accidents can occasionally result in them [10].

Malhotr et al. [11] noted that the majority of patients (91.6%) had suffered twisting injuries or falls from heights, which were most likely caused by the difficult geographic location and mountainous terrain, as patients frequently slip and fall on uneven surfaces.

Regarding to fracture classification among our 30 cases the lauge Hansen classification showed that most of our patients26(86.7 %) were of twisting type, then 4 (13.3%) patients were of direct high velocity trauma.In agreement with our research, Motwani et al. [8] 68-patient study revealed that 42% of the patients had supination external rotation, 34% pronation abduction, 17% pronation external rotation, and 7% supination adduction fractures. Numerous researchers found similar results in their investigations, albeit there are some variations. For example, Beris et al. [12], Baird and Jackson [13] stated that supination–external rotation injuries accounted for 40% of all injuries, while pronation–external rotation injuries accounted for 27.5%.

Regarding the functional outcomes: As regarding the functional outcomes we found that the mean total score was excellent 87.3±12.1 .There was (6)patients with excellent outcome(20%),there was (18)patientswith good outcome(60%),there was(5)patients with fair outcomes (16.6%),there was (1)patient with poor outcomes (3.3%).In Colton's study [14], 50% of patients in group two and 75% of patients in group one both had good to excellent results. In their study of 132 patients with good diabetes management, Burnwell and Charnley [15] discovered that 102 (77.3%) had good results, 16% had fair results, and 6% had poor results. This explains why improved post-operative outcomes occur with more diabetes management. In the de Souza et al. [16] study, open reduction and internal fixation utilizing the AO/ASIF technique was used to treat 150 cases of ankle fractures, with 90% of the cases showing satisfactory results. Of the 144 patients with ankle fractures in the Beris et al. research, 105 (74.3%) had satisfactory to excellent outcomes [13].Regarding to diabetes control of our patients we found that most of our patient 20 were with good Hb A1C level(well-controlled DM) and 10 with elevated level of HBA1c level (not well-controlled DM).Our study also shows that there is statistically significant higher mean HBA1c among cases with complications than without complications (9.71 gm% versus 6.39 gm%, respectively).A study of the literature has demonstrated that

blood glucose management is necessary for diabetic patients to heal their wounds and fractures properly; hemoglobin A1c has historically been used as a standard to assess overall diabetes control [17]. According to Liu et al. [18] blood HBA1c levels appear to be predictive of risk and complication rates in diabetes patients with ankle fractures undergoing surgical treatment; problems occurred in 88.9% of patients with a HbA1c > 6.5% and 66.7% of patients with a HbA1c < 6.5%.

Regarding the complications: Of all studied patients we found that 23 patients had no complication. only 7 patients suffered from complications distributed as following: (2) patients had implant failure (6.7%),(1) patient had delayed wound healing(3.3%),(1)patient had charcot joint(3.3%),(1)patient had osteoarthritits (3.3%),(1)patient had non-union (3.3%)and (1)patient had charcot joint and implant failure(3.3%).In a retrospective study, Bibbo et al. [19] examined the surgical management of ankle fractures in 46 well-controlled diabetic patients and 13 poorly controlled diabetic patients. Of the 46 well-controlled diabetic patients, eight (17%) experienced complications, whereas six (46%) of the 13 poorly controlled diabetic patients experienced complications. These complications included six superficial infections, three cases of charcot neuroarthropathy, one delayed union, and one deep infection. When Flynn et al. [20] retrospectively compared the management of closed ankle fractures in 25 patients with uncontrolled diabetes mellitus and 73 patients with well-controlled diabetes mellitus, they discovered that the uncontrolled diabetic group had a four-fold higher risk of infection (32%) than the well-controlled group (8%). Blotter et al. [21] examined 44 surgically repaired ankle fractures in 46 diabetic patients under control and 21 patients with poorly controlled diabetes. Compared to the controlled diabetics (15%), the poorly controlled diabetic group had a statistically greater rate of complications (43%).42 patients with acute, closed, rotational ankle fractures and diabetes mellitus were examined retrospectively by Jones et al. [22] There were 21 patients without comorbidities and 21 with them. Patients were matched individually by age, sex, type of fracture, and surgical versus nonsurgical therapy with 42 nondiabetic control patients. The only notable difference in problems between the non-diabetic control patients and the diabetic patients without comorbidities was that the diabetic patients needed long-term bracing. Nonetheless, compared to the non-diabetic control individuals (14%), the diabetes patients with comorbidities experienced greater problems (47%).

CONCLUSIONS

Patients with diabetes who are uncontrolled and have a high HBA1C level experience more complications than those who have their diabetes under control. The recommended course of action for people with controlled diabetes who have unstable ankle fractures is open reduction and internal fixation using standard procedures. Soft-tissue and osseous problems, such as delayed union and nonunion, are more common in patients with uncontrolled diabetes and high HBA1C levels. A successful outcome depends on both stable, hard internal fixation and careful management of the soft tissues. For patients with diabetes who have had ankle fractures surgically treated, extended non-weight bearing and then protected weight bearing are advised.

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Competing interests

The authors declare that they have no competing interest.

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