Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 13576 – 13589
Received 10 March 2021; Accepted 22 March 2021.

Functional Outcome Following Fixation of Extra Articular Distal Tibial Fracture with Locking Compression Plate Using Minimally Invasive Percutaneous Technique

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Abstract

Background: Distal tibia fractures are challenging injuries. They are often caused by high energy axial compressive, direct bending or low energy rotation forces. These fractures constitute less than 10% of all tibial fractures.Locking plates provide excellent stability compared to a conventional plate and better protection against loss of reduction and minimization of bone contact. Preservation of vascularity of fracture fragments, fracture hematoma and minimal soft tissue damage favors minimally invasive percutaneous plating osteosynthesis for distal tibia fractures.

Aim of the study: The aim of this study was to improve the outcome of surgical treatment of extra articular distal tibial fracture.

Patient and methods: Eighteen patients with distal tibial extra articular fractures were included in this nonrandomized controlled clinical study. This study was conducted in zagazig university hospital in period between April 2020 to April 2021. The cases were classified using the method of AO classification.Patients admitted to hospital with distal tibia fractures after meeting the inclusion and exclusion criteria, the underwent full history general, local, radiological examination were done and the laboratory investigations. In this study two different shapes of precountred anatomical locked distal tibial plates were used for technique of surgery was MIPP (minimally invasive percutaneous plate osteosynthesis).After operation follow up was done 2, 6, 12 weeks by clinical and radiological assessment.

Results: mean age was 36.72±9.71, 72.2% were males and 27.8% were females, 9 patients 50.0% were smokers. 33.3% had associated injury, 55.6% were left and 44.4% were right, majority were A1 with 77.8% and 50% were accidental and 50% fall from height. mean time since operation was 4.22±1.35 days, mean operation time was 108.33±26.12 minutes. Mean hospital stay was 3.50±0.85 days. AOAFS scores were 35.55±6.15, 45.61±4.0, 9.16±1.91 respectively regarding pain, ROM and alignment and mean total AOAFS was 90.33±10.87. Mean union time was 16.94±3.33 weeks and mean time of full weight bearing was 20.83±3.48 weeks. Eleven patients (61.1%) were excellent, four patients (22.2%) were good, two patients 11.1% were fair and one patient (5.55%) was poor. F our patients 22.2%had Superficial infection one case (5.55%) had stuffiness, two cases (11.1%) were delayed union.

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Conclusion: Minimally invasive plate osteosynthesis by locking plate have shown a reliable method of fixation for distal tibial fractures

Keywords: Distal Tibial Fracture,Minimally Invasive Percutaneous (MIPPO), Locking plates.

Introduction:

Distal tibia fractures are challenging injuries. They are often caused by high energy axial compressive, direct bending or low energy rotation forces. These fractures constitute less than 10% of all tibial fractures. The aim of treating the fracture is to preserve normal mechanical axis, ensure joint stability and restore a near full range of motion. This is a difficult task to accomplish in each and every case due to compromised soft tissue condition, variable bone quality and associated medical conditions **(1).**

Distal tibia fractures are devastating injuries that are usually due to high-energy mechanisms such as falling from heights or motor vehicle accidents. They may also occur from low-energy mechanisms, which are seen in rotational injuries around the ankle **(2).**

Distal metaphyseal fractures differ from pilon fractures in terms of the mechanism of injury, management, and prognosis of the displaced bones. The proximity of these fractures to the ankle joint leads to more complications than are seen with diaphyseal or middle-third injuries. Thus, the treatment of distal tibia fractures remains problematic **(3,4).**

Conservative management can be done in selected cases whenever fractures are stable with minimal shortening. High rate of complications like malunion, limb length discrepancy, decreased range of motion and early osteoarthritis of the ankle have been reported following conservative treatment of these fractures **(5).**

Surgical fixation is considered for most distal tibia fractures which require meticulous preoperative planning. Available options for stabilizing fractures are external fixators, interlocking nails and locking plates. The factors determining the fixation methods are pattern of fracture, quality of bone and condition of soft tissues **(6).**

Results of conventional osteosynthesis with plates have been suboptimal with reported complications of wound infection, skin breakdown and delayed union or non-union, requiring secondary surgical intervention. Locking compression plating has gained popularity and is being used frequently for fixation of distal tibia fractures. With the use of minimal invasive techniques excellent results are obtained in complex fractures **(7).**

Locking compression plating is technically feasible and creates a stable, fixed angle device when locking screw heads lock itself with the plate. Locking plates provide excellent stability compared to a conventional plate and better protection against loss of reduction and minimization of bone contact. Preservation of vascularity of fracture fragments, fracture haematoma and minimal soft tissue damage favors minimally invasive percutaneous plating osteosynthesis for distal tibia fractures **(8-9).**

Patients and Methods:

Eighteen patients with distal tibial extra articular fractures were included in this non randomized

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controlled clinical study. This study was conducted in zagazig university hospital in period between April 2020 to April 2021 the cases were classified using the method of AO classification **(10).**

Written informed consent was obtained from all participants patients and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans

All patients in this study were adult aged above 18 years,all fractures are closed fracture or open fracture gustillo type 1, all fractures are extra-articular without intra-articular extension and duration of injury must be less than 3 weeks.

Any Patients are below 18 years old or more than 70 years, any fractures with intra-articular extension, segmental fractures or pathological fractures, any polytrauma patients, associated ipsilateral fractures, any open fractures gustilo type II and III, any infected fractures, time of injury more than three weeks, any associated neurovascular injury or compartment syndrome, severe soft tissue injury with fracture blisters, and chronic medication by corticosteroids were excluded.

Patients admitted to hospital with distal tibia fractures after meeting the inclusion and exclusion criteria were selected for the study then all the following were done for all patients:

Personal history was taken: (name, age, sex, address)

Present history and complaint: (date of trauma, mode of trauma and date of admission) **Medical history:** All patient were asked about past medical history if had any medical problems before accident.

General examination:

For all patients temperature, pulse, blood pressure, heart, respiration and other body system was assessed.

Local examination:

The affected limb was examined about the type of fracture if closed or open (all were closed), skin condition, swelling and tenderness, deformity of the injured limb, leg length discrepancy, compartmentassessment and neurovascular assessment.

All Patients were initially treated with a plaster splint with elevation until definitive fixation.

Surgery was delayed more than two days only to eleven patients because had soft tissue swelling.

Radiological examination:

The initial radiographic evaluation was done for all patients anteroposterior (AP) and lateral radiographs to entire length of both the tibia and fibula including knee and ankle joints, and the fractures was classified according to AO classification.

Investigation:

The routine laboratory investigations were performed to assess the fitness of the patient for surgical interference as complete blood picture, blood grouping, blood sugar, bleeding profile, ECG (Electro cardio-gram), renal and liver function tests, viral screen.

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Implant used for internal fixaion Implant description:

The locked anatomical medial distal tibial plate 3.5mm is part of the synthes small fragment LCP system that merges locking screw technology with conventional plating techniques. The combi-holes in the LCP plate shaft combine a dynamic compression unit hole with a locking screw hole. Combi-holes provide the flexibility of axial compression and locking capability throughout the length of plate shaft. Fixation with the 3.5mm locked anatomical medial distal tibial plate has many similarities to traditional plate fixation methods. locking screw provide the ability to create a fixed angle construct while using standard AO plating techniques. Locking capability is important for fixed angle construct in the osteopenic bone or multifragment fracture where screw purchase is compromised. These screws do not rely on plate to bone compression to resist patient load, but function similarly to multiple, small, angled blade plate.

In this study two different shapes of precountred anatomical locked distal tibial plates were used (figure 15)

Figure (1): Two different shapes of precountered anatomical locked distal tibial plates

Surgical procedure:

Spinal anesthesia was used to all patients. All patients were put in supine position on the radiolucent operating table and prepared after applying of pneumatic tourniquet. The leg left freely movable. Visualization of the distal tibia under fluoroscopy in both the lateral and AP views was done. the knee was supported with towels to flex it into the appropriate position.

Technique:

The technique of surgery was MIPPO (minimally invasive percutaneous plate osteosynthesis).

All cases were performed through medial approach to the tibia. A vertical or curvilinear incision was made at the level of medial malleolus with the care not to injure great saphenous vein and saphenous nerve. Subcutaneous plane was made with hemostat without striping periosteum and disturbance to fracture haematoma. Fracture was reduced under C-arm control.

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Figure (2): Photographs demonstrate incision and great saphenous vein secured

Where the reduction is difficult despite of repeated attempt, a small incision was made using a kirschner wire (3mm) as a joystick to aid in fracture reduction and towel clip or reduction clamp to hold reduction. Varus valgus angulation < 5 degree and antroposterior angulation < 10 degree and shortening of <15 mm was considered acceptable criteria for reduction. The plate was tunneled into the subcutaneous plane and its position is reconfirmed with C-arm. Before fixing the plate with screws, sagging of the distal fragment is prevented by placing a towel roll under the fracture site.

K-wires used preliminarily through the plate to assess its position before fixation.

Figure (3) plate was inserted and fixed to tibia with two K wires

Provisional non locking screw was applied to bring the plate on the bone. Compression osteosynthesis was achieved in simple fracture by using a non-locking screw proximal to the fracture site as a hybrid fixation. Then 2 of the 5 distal locking screws were applied before applying the proximal locking screws. With separate incision, at least three locking screws were applied on the either side of fracture. Securely all screws were tightened again prior to closing was done after removing the preliminary K-wires. At the end of the procedure, closure was done in

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layers with nonabsorbable sutures, good dressing of the incision.

Post-operative care:

IV antibiotics, IM analgesia and limb elevation over pillows started once the patients in the ward. Below knee plaster splint were applied in neutral position to some patients as analgesia. One day post-operative X- ray leg was done including ankle joint in both AP and lateral view. Patients were discharged from hospital once their general and their wound conditionallowed. Limb elevation over pillows and IV antibiotics were given for 5 days postoperatively. Switching over the oral antibiotics was done 5th postoperative day. Analgesics were given, skin sutures were removed on the 14th postoperative day.

Mobilization:

Active toe movement after recovery from anesthesia was started. The patients were allowed intermittent ankle mobilization depending on the wound healing and posterior splint removed. Patients were progressed to full weight bearing depending on radiological fracture consolidation; usually after 8 -10 weeks, with full weight bearing usually after 3 months but not before there is radiological evidence of callus formation.

Follow-up:

Clinical and radiological follow-up was recommended after1, 2, 6 and 12 weeks, then intermittent clinical and radiographic follow-up is advisable every 2-4 weeks until recovery reaches a plateau, typically 6-12 months after injury.

Clinical assessment:

On each follow-up patients were asked about subjective symptoms such as pain, limping, need for support when walking, the walking distance, and the return to pre-fracture activities. The patients were examined for range of active and passive movements as well as shortening and rotational deformities. Examination to assess union of the fractures performed.The fracture was considered united clinically when there is No pain, No tenderness & No abnormal mobility.

Radiological assessment:

The fracture was considered united radiologically on the following criteria: disappearance of fracture line, reestablishment of bone continuity and good callus formation.

At the final follow-up at least six months after operation, clinical examination was made in the hospital where the procedure was performed, and all subjects gave their informed consent prior to their inclusion in the study. Range of motion (ROM) was assessed with a goniometer and the American orthopaedic foot and ankle society (AOFAS) ankle score determined.

This scoring system classified the evaluating items into three major categories: pain function and alignment. In this scale, 50 points have been assigned to function, 40 points to pain, and 10 points to alignment. Usually, a score between 90 and 100 is excellent, 75 – 89 good, 50 – 74 fairs and < 50 poor **(11).**

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Statistical analysis:

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) **(**Statistical Package for the Social Sciences) software for analysis. According to the type of data qualitative represent as number and percentage , quantitative group represent by mean ± SD , the following tests were used to test differences for significance;. difference and association of qualitative variable by Chi square test (X2) . Differences between quantitative independent groups by t test or Mann Whitney, multiple by ANOVA or Kruskal Wallis, correlation by Pearson's correlation or Spearman's . P value was set at <0.05 for significant results &<0.001 for high significant result

Results:

Age was distributed as **36.72±9.71**. the youngest patient 24 while the oldest 55 years, regarding the sex distribution males were the majority 13 males (72.2%) and 5 females (27.8%) 50.0% were smoker (Table 1).

In this study there were 6 patients 33.3% had distal fibula fracture and 12 patient (66.7) had no associated injury, 5 patients (55.6%) were left side affected and 8 patients (44.4%) were right side affected, according to AO classification 14 patients (77.8%) had type A1 fracture and 4 patients (22.2) had type A2 fracture and regarding to mechanism of injury 50% were accidental and 50% fall from height (Table 2).

Time interval between admission and definitive fracture fixation was distributed as 4.22±1.35 with minimum one day and maximum 8 days (Table 3).Operation duration was distributed as 108.33±26.12with minimum 85 minutes and maximum 180 minutes (Table 4).Hospital stay was distributed as 3.50±0.85 with minimum 3 days and maximum 6 days (Table 5).

Scores were distributed as 35.55±6.15, 45.61±4.0, 9.16±1.91 respectively among Pain, ROM and Alignment with range of (20-40), (36-50) and (5-10) respectively and total AOAFS was distributed as 90.33±10.87 with range of (61-100) (table 6).

Union time was distributed as 16.94±3.33 with range of (13-24) and Time of full weight bearing was distributed as 20.83±3.48 with range of (17-28 weeks) (Table 7).Favorable outcome was majority with 83.3% (15 cases) (11 cases excellent and 4 good) and unfavorable 16.7% (3 cases) (2 fair and 1 poor) (Table 8).

In this study 4 cases (22.2%) had superficial infection, 1 case (5.6%) had stiffness, delayed union in 2 cases (11.1) and overall complication was in 22.2% (Table 9).

Assessing the functional outcome of using locking compression plate with minimal invasive technique in management of extra articular distal tibial fracture; the mean ± SD age of favorable outcome patients was (36.33±9.49) younger than unfavorable outcome patients (38.66±12.85), but the difference is statistically insignificant p= 0.716. Regarding operation duration the mean ± SD of favorable outcome patients was (98.66±12.88) shorter than unfavorable outcome patients (156.66±20.81), the difference is statistically highly significant p= 0.0001.

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About hospital stay the mean ± SD of favorable outcome patients was (3.20±0.41) shorter than unfavorable outcome patients (5.0±1.0) days, the difference is statistically highly significant p< 0.001. Pain score of favorable outcome patients mean± SD was 37. 33±4.higher than unfavorable outcome patients (26.66±5.77) the difference is statistically significant p=0.003. Also, ROM of favorable outcome patients mean± SD was 47.0±2.47. higher than unfavorable outcome patients (38.66±2.51) the difference is statistically highly significant p<0.001. In addition, Alignment of favorable outcome patients mean± SD was 10.0± 0. higher than unfavorable outcome patients (5±0) the difference is statistically highly significant p<0.001. Moreover, total AOAFS of favorable outcome patients mean± SD was 94.33±5.6. higher than unfavorable outcome patients (70.33±8.14) the difference is statistically significant p=0.008. While union assessment of favorable outcome patients mean± SD was 16.06±2.68 faster than unfavorable outcome patients (21.33±3.05) the difference is statistically significant p=0.032. Also, time of full weight bearing was faster among favorable outcome patients compared to unfavorable outcome patients but the difference statistically insignificant p=0.716. There was statistically insignificant relation between sex, smoking habit and outcome of using locking compression plate with minimal invasive technique in management of extra articular distal tibial fracture p=0.099, p=0.058 respectively. Additionally, there were statistically insignificant relation between clinical parameters as: Associated injury, the side affected, mechanism of injury and outcome p=0.18, p=0.67, p=0.52 respectively.

Moreover, majority of favorable outcome patients (86.7%%) and (33.3 %) in unfavorable outcome patients had AO classification(A1) the difference statistically significant p=0.043. Finally, almost of favorable outcome patients (93.3%) had no complications in contrast all unfavorable outcome patients had complication the difference statistically highly significant p<0.001. (Table 10).

Table (1):Demographicdataamongstudiedgroup

		Age	
Mean± SD		**36.72±9.71**	
Median(Range)		**34.0(24-55)**	
		N	**%**
Sex	**Male**	**13**	**72.2**
	Female	**5**	**27.8**
Smoker	**Non**	**9**	**50.0**
	Smoker	**9**	**50.0**
	Total	**18**	**100.0**

Table (2): Injury characters distribution among studied group

		N	%
Associated injury	**No**	**12**	**66.7**
	Yes	**6**	**33.3**
Side affected	**Left**	**10**	**55.6**
	Right	**8**	**44.4**
AO classification	**A1**	**14**	**77.8**
	A2	**4**	**22.2**

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Mechanism of injury	**Accidental**	**9**	**50.0**
	FFH	**9**	**50.0**
	Total	**18**	**100.0**

Table (3): Time interval between admission and definitive fracture fixation distribution among studied group

	Time interval
Mean± SD	**4.22±2.23**
Median (Range)	**4.0 (1-8)**

Table (4): Operation time distribution among studied group

	Operation duration
Mean± SD	**108.33±26.12**
Median (Range)	**100.0 (85-180)**

Table (5): Hospital stay duration distribution among studied group

	Hospital stay
Mean± SD	**3.50±0.85**
Median (Range)	**3.0 (3-6)**

Table (6): AOAFS items and total score distribution

Pain score	**Mean± SD**	**35.55±6.15**
	Median (Range)	**40.0 (20-40)**
ROM score	**Mean± SD**	**45.61±4.0**
	Median (Range)	**47.0 (36-50)**
Alignment score	**Mean± SD**	**9.16±1.91**
	Median (Range)	**10.0 (5-10)**
Total AOAFS	**Mean± SD**	**90.33±10.87**
	Median (Range)	**94.0 (61-100)**

Table (7): Union time assessment and time of full weight bearing distribution

	Union assessment	**Time of full weight bearing**
Mean± SD	**16.94±3.33**	**20.83±3.48**
Median (Range)	**16.0 (13-24)**	**20.0 (17-28)**

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Table (8) : Overall outcome assessment distribution

		N	%
Outcome	**Favorable(good&excellent)**	**15**	**83.3**
	Unfavorable(fair&poor)	**3**	**16.7**
	Total	**18**	**100.0**

Table (9): Complications distribution among studied group

		N	%
Superficialinfection	**-VE**	**14**	**77.8**
	+VE	**4**	**22.2**
Stiffness	**-VE**	**17**	**94.4**
	+VE	**1**	**5.6**
Delayunion	**-VE**	**16**	**88.9**
	+VE	**2**	**11.1**
Overall	**-VE**	**14**	**77.8**
	+VE	**4**	**22.2**
	Total	**18**	**100.0**

Table (10): Relation between outcome and parameters

			Favorable	Unfavorable	t/X2	P
Age			**36.33±9.49**	**38.66±12.85**	**0.370**	**0.716**
Operationduration			**98.66±12.88**	**156.66±20.81**	**6.495**	**0.00****
Hospitalstay			**3.20±0.41**	**5.0±1.0**	**5.427**	**0.00****
Pain			**37.33±4.57**	**26.66±5.77**	**3.556**	**0.003***
ROM			**47.0±2.47**	**38.66±2.51**	**5.306**	**0.00****
Alignment			**10.0±0.0**	**5.0±0.0**	**6.347**	**0.00****
TotalAOAFS			**94.33±5.6**	**70.33±8.14**	**3.046**	**0.008***
Unionassessment			**16.06±2.68**	**21.33±3.05**	**2.347**	**0.032***
Timeoffullweightbearing			**20.06±3.1**	**24.66±3.0**	**0.370**	**0.716**
Sex	**Male**	**N**	**12**	**1**		
		%	**80.0%**	**33.3%**		
	Female	**N**	**3**	**2**	**2.71**	**0.099**
		%	**20.0%**	**66.7%**		
Smoker	**No**	**N**	**6**	**3**		
		%	**40.0%**	**100.0%**		
	Yes	**N**	**9**	**0**	**3.60**	**0.058**
		%	**60.0%**	**0.0%**		
Associtedinjury	**No**	**N**	**11**	**1**		
		%	**73.3%**	**33.3%**		
	Yes	**N**	**4**	**2**	**1.80**	**0.18**
		%	**26.7%**	**66.7%**		
Side affected	**L**	**N**	**8**	**2**		
		%	**53.3%**	**66.7%**		
	R	**N**	**7**	**1**	**0.18**	**0.67**
		%	**46.7%**	**33.3%**		

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AOclassification	**A1**	**N**	**13**	**1**		
		%	**86.7%**	**33.3%**		
	A2	**N**	**2**	**2**	**4.11**	**0.043***
		%	**13.3%**	**66.7%**		
Mechanismof injury	**Accidental**	**N**	**8**	**1**		
		%	**53.3%**	**33.3%**		
	FFH	**N**	**7**	**2**	**0.40**	**0.52**
		%	**46.7%**	**66.7%**		
Complication	**Not**	**N**	**14**	**0**		
		%	**93.3%**	**0.0%**		
	Complicated	**N**	**1**	**3**	**12.60**	**0.00****
		%	**6.7%**	**100.0%**		
Total		**N**	**15**	**3**		
		%	**100.0%**	**100.0%**		

Discussion:

Unstable fractures of the distal tibia with or without intra-articular fracture extension can present a management challenge. High rates of associated complications have been reported with conventional methods of fixation. Intramedullary nailing is generally not considered suitable for distal periarticular tibial fractures. Conventional open reduction and internal fixation of such injuries results in extensive soft tissue dissection and periosteal injury, compromising the blood supply, and may be associated with high rates of infection, delayed union, and nonunion. Minimally invasive plate osteosynthesis (MIPPO) may offer biological advantages. Reduced soft tissue dissection results in low surgical trauma and thus preservation of the blood supply is one of the main advantages of MIPPO. Biological fixation is achieved with lesser evacuation of osteogenic fracture hematoma. Locking compression plates provide stable construct **(12)**.

(13) reported that the age distribution was 41.96±15.81 years (21- 66), as regard sex distribution there were 16 patients (64%) males and 9 patients (36%) females, 10 patients (40%) of MIPPO group were smokers.

(14) reported that in the study with 11 patients (52.38%) having left tibia involvement and 11 patients (47.68%) having right tibia involvement. Extra articular distal tibial fractures were classified according to AO classification, the most common type 43A1 which accounts 10 patients i.e.(47.61%) followed by 9 patients (42.85%) type 43A2 and 2 patients (9.52%) type 43A3. regarding Mechanism of injury; Road traffic accidents in 14 patients (66.67%), Falls in 3 patients (14.28%), Assault in 3 patients (14.28%) and Sports injury in one patient (4.76%).

(15) found that the most common mode of injury was road traffic accident in 10 patients (50%), fall from height in 5patients (25%), Self-fall in 4 patients (20%) and Contact sports in one patient (5%), regarding Side of injury, Fracture were more frequent on right side tibia i.e., 13 patients (65 %) and 7 patients (35%) were in left side.

The current study showed that Time interval between admission and definitive fracture fixation was distributed as **4.22±1.35** with minimum one day and maximum 8 days, while**,(12)** found that the median number of days between admission and definitive fracture fixation was three days

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(range 0– 14 days). **(15)** reported that the average time interval between injury and operation was 3.2 days (2-7 days). **(16)** reported that the time between injuries to operation was 5.0±3.7 (day). **(14)** reported that more than half (61.90%) were operated within 3 to 7 days of injury.

The current study showed that Operation time was distributed as **108.33±26.12** with minimum 85 and maximum 180 minutes, nearly to current result, which in agreement with the study of **(17)** who reported that the mean operative time was 108 min (range, 80-150 min), **(15)** reported that the mean duration of surgery was 98.80 ±11.09 minutes (range 61- 150).
The current study showed that the mean Hospital stay was distributed as **3.50±**0.85 with minimum 3 days and maximum 6 days, while **(16)** reported that the mean Hospital stay was 9.4±3.6 (day), **(17)** reported that the mean hospital stay was 11.4 days (range, 7-14 days)

(14) reported that according to AOFAS score the mean score was 96.52 ± 4.16. **(15)** reported that the mean total AOFAS score was 88 postoperative.
(18)reported that the mean AOFAS score was 94.4 with minimum 74 and maximum 99. Excellent score were noted in 51 (91%), good in 3 (5.4 %) , fair in 2 (3.6%).

The current study showed that Union time was distributed as 16.94±3.33 weeks with range of (13-24 weeks) nearly to the current study, **(19)** reported that Union time in locking plate groups was 15.95 ± 3.879 weeks. **(16)** reported that the mean Union time was 15.1±1.8 (weeks), Return to work was 16.9±1.8 (weeks).
The current study showed that time of full weight bearing was distributed as 20.83±3.48 weeks with range of (17-28 weeks), nearly to the current study, **(13)** reported that the time of full weight bearing was 19.29±8.05(12-50) weeks.

(14) reported that the functional results, showed that majority 52.38% of the patients in the study had excellent functional results and 28.57% had good results.
(20), reported that the in their study of 20 cases, 10 (50%) patients had excellent outcome, 6 (30%) patients had good outcome, 2 (10%) patients had fair outcome and 2(10%) patients had poor outcome.

(16) reported that Wound infection was found in one patient (5%), nonunion was found in one patient (5%), malunion was found in one patient (5%) and delayed union was found in 2 patients (10%).

(18), reported that of the 14 patients treated, only 2 (14.29%) cases were having ankle stiffness followed by superficial skin infection (7.14%) and deep infection (7.14%). **(19)** reported that Implant irritation (23.80%), ankle stiffness (23.80%) and infection (19.04%) were the main complications noted amongst patients.

Conclusion:

Minimally invasive plate osteosynthesis by locking plate have shown a reliable method of fixation for distal tibial fractures. MIPO with locking plates for distal tibia fractures is associated with

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 13576 – 13589
Received 10 March 2021; Accepted 22 March 2021.

good functional outcomes and is an effective treatment for distal tibia extra articular fractures.

Conflict of Interest: There was no fund or conflict of interest for any of the authors

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