Management of Tibial Fractures by percutaneous wiring or Minimally Invasive Reduction Osteosynthesis System

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Abstract: Background: This prospective study was done to evaluate the management of tibial fractures by a new system for percutaneous osteosynthesis with wires technique called MIROS (Minimally Invasive Reduction Osteosynthesis system). **Objective**: The aim is to study the management of tibial fractures by percutaneous fixation with MIROS (Minimally Invasive Reduction Osteosynthesis system). **Patient and Methods**: In this study we treated 10 patients percutaneously with MIROS system, on a prospective study, ages of our patients range between 21-75 years with a mean age 45 years, obviously because males are engaged more in vigorous activity, they are more susceptible to injury. It is demonstrated in our study that 60% of our patients were males while 40% were females. According to mode of injury, road traffic accidents continue to play a major role in causing disability. In our series it is responsible for more than 60% of cases, while the twisting trauma represented 20 % and 20% caused by fall from a height. Percutaneously using atransversewire (subchondral) to which are anchored intramedullary wires with two side clips, getting so that stable synthesis for its shape is precisely called" Synthesis Delta". Such a system puts you to make multiple combinations ranging from classical elastic fixation, the external fixation, in summary complex such as hybrid (internal and external) and is therefore considered a multi-purpose fixer. **Results**: All patients were followed up for a period of 12 weeks at least, with an average follow up time of 16 weeks. The longest follow up was 12 months. The results were as follows: 7 cases showed full union at a period of 8-12 weeks, 2 cases had valgus deformity, 3 cases showed delayed union at 12 weeks (1 case was diabetic and 2 cases were heavy smokers and 2 cases had pin tract infection. **Conclusion**: In conclusion from this prospective study and statistics show how the MIROS system has demonstrated safety in use, speed of surgery execution, rapid discharge of a patient with savings in costs for the hospital. This study needs for follow up and evaluation.
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1. Introduction

The management of tibial fractures have always been a challenge to the surgeon, specially in comminuted fractures. The traditional surgical techniques aiming at anatomical reduction and rigid internal fixation has raised a lot of complications, probably due to devitalization of the fracture fragments that renders healing markedly jeopardized. The introduction of the concept of closed reduction and percuteneous fixation aims to improve the chances of healing as it utilizes the importance of the soft tissue envelope and preserves the vitality of the involved bony segments. **(Rockwood et al, 1996)**

Recent trends are away from open reduction and massive internal fixation towards closed reduction and percutaneous fixation as this method is less invasive and causes less soft tissue damage. **(Thomas et al, 2007)**

Percutaneous pinning (miros system) seems to be a suitable alternative to other operative techniques such as intramedullary nailing or open/mini open reduction and internal fixation using wires or plates. **(Tangari et al, 2005)**

The presenting study on the use of the MIROS (Minimally Invasive Reduction Osteosynthesis System) in the management of tibial non-articular fractures.

2. Patients and Methods

After obtaining the Research/Ethics committee approval and written informed consent, prospective study involved 10 patients with tibial extra-articular fractures coming to the emergency department of Al-

Azhar University Hospitals between the periods of September 2014 till April 2016.

Operative technique:

Patients were positioned supine on the operative table. Patients were operated on under general or regional anaesthesia, no tourniquet was done, on a standard radiolucent orthopedic table, under image intensifier guidance. One gram of 3rd generation cephalosporin was given with induction of anaesthesia.

Surgical technique:

The fracture is reduced as much as possible with indirect maneuvers like traction.

MIROS used as a joystick, to achieve any reductions or combinations of avulsed fragments after satisfactory alignment of the abutments, is mounted such a 3mm wire for the tibia; this making a curvature with convexity in line with the mouthpiece of a flute, which ideally reproduces the future trajectory that the wire will have to travel in the medulla.

Placing the wire pierce the skin under vision by fluoroscopy of the exact point of entry and, if satisfied, with the aid of the impact mechanism it is advanced along the medulla, to the opposite metaphysealcancellous bone, exerting small circular movements, to avoid any perforation.

The introduction of the wires takes place from both sides (bipolar), That is, by repeating the same operation it with the second wire fixture at the level of tibiofibularsendismosis. The wires are then flexed externally to 90° exact degrees, with respect to its own axis and to cortical and closed system with a third wire frame transverse offer out- the epiphysis in the subchondral and parallel to the emergency of the previous, to a mutual distance approximately 1 cm.

To this point are mounted the corresponding clips, one for side, making sure, before the final closing of gently pretension to intramedullary wires, so that they adhere to the inner cortical: this improves reduction and stabilization of the fragments. You make a simple dressing, while no bracing is not required.

Evaluation criteria and statistical analysis:

The follow-up wasclinical and radiological, prospective and continuous over a period of 1 year. The clinical assessment was completed by the Olerud and Molander score (Table 3). In this study the mean Olerud score was 83.2 points (range, 30-100points).

Radiological assessment on immediate postoperative period showed all 10 patients had the fracture reduced and fixed by miros system. No patient had revision post operatively. Clinical and radiological assessment at periods of one month, three monthes, sixmonthes and after twelve monthes.

Age and mean Constant score results:

The relation between age of the patients and the mean final result can be demonstrated in the following table and charts. Patients below 40 approach about 94% in the mean constant score while older patients had a lower figures (Table 5).

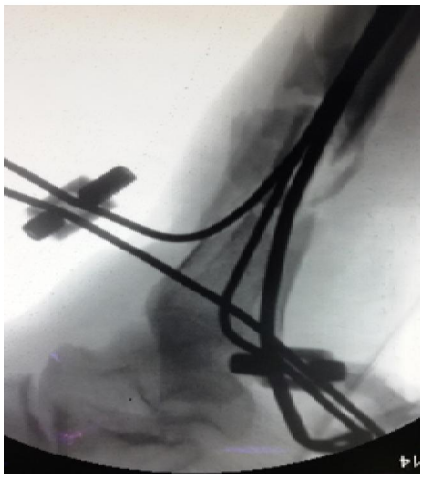
The day of return to work:

2 Patients returned to work after three month from surgery, 4 patients within 6 month and 4 patients within 12 months.

Patient demographics

Table (1): Patient Demographics:

Variable	**No.**
Total no. of fractures	**10**
Average age (range) years	**21-75 (average 41ys. old)**
Male	**6**
Female	**4**
Chronic heavy smokers	**3**
Patients with D.M	**2**

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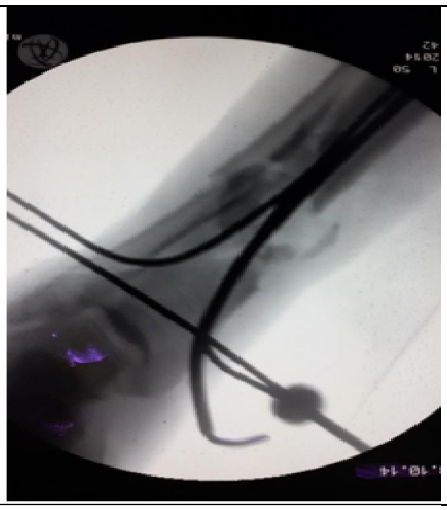

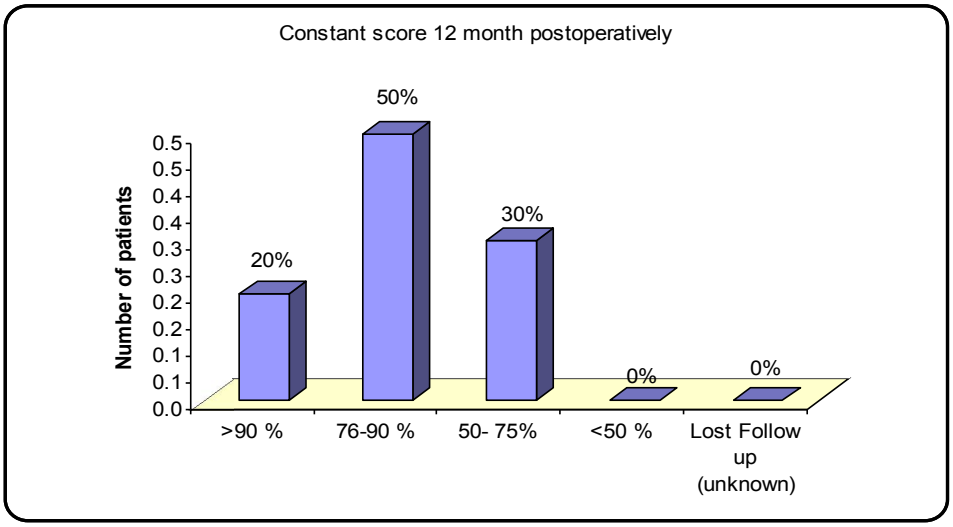

Figure (1): Chart of Constant score 12 month postoperatively.

Table (2): Olerud and Molander Score: graded out of 100, excellent result when 100 points obtained. **(Olerud C., Molander H., 1984)**

Parameter	Situation	Score
1. Pain	None	25
	When walking on irregular terrain	20
	When walking on any outdoor surface	10
	When walking indoors	5
	Constant and severe	0
2. Stiffness	None	10
	Stiff	0
3. Swelling	None	10
	Only in the evening	5
	Constant	0
4. Climbing stairs	Not a problem	10
	Asymmetrically	5
	Impossible	0
5. Running	Possible	5
	Impossible	0
6. Jumping	Possible	5
	Impossible	0
7. Squatting	Possible	5
	Impossible	0
8. Walking assistance	None	10
	Bandage ankle brace	5
	Cane or crutch	0
9. Work or daily life activities	Same as before the accident	20
	Less intensive	15
	Adapted work or part time work	10
	Severe disability	0

Table (3): Constant score 12 months postoperatively.

Functional outcome 12 month postoperatively	Number of patients	Percentages
>90 %	2	20%
76-90 %	5	50%
50- 75%	3	30%
<50 %	0	0%
Lost Follow up (unknown)	0	0%
Total	10	100%

Table (4): Relation between age and mean Constant score results.

Age Group in years	Number of patients	Mean Results of Constant Score after 12 months
<40	5	94%
41-50	3	82.72%
51-60	1	80.33%
71-75	1	78.4%

3. Results

In this study we evaluated the use of MIROS system in management of nonarticulartibial fractures. Out of the 10 fractures managed by this method 7 fractures showed uncomplicated healing within a reasonable period of time, about 6 weeks. The complication rate was considered minimal. Only two cases of delayed union and 2 cases of valgus deformity >5 degrees (one of them with delayed union). However we passed through a learning curve during performing this study, with most of the complications occurring in the early cases.

From analysis of the literature concerning the use of MIROS system, our results are considered satisfying results with mean Constant Score in our study 83.2% ranged between (60%-95%).

The functional outcome following surgical intervention and insertion of MIROS system was determined using the Constant Olerud Score (C.O.S.).

Functional recovery has improved up to 1 year after surgery, while, in relation to age, results have worsened progressively with increasing age.

Complications:

In this study, the complication rate was 30 %. No patient developed intraoperative or postoperative vascular injury. No patients suffered from nerve injuries and no patients suffered from nonunion.

Two cases had malunion in the form of valgus.

The complication rate in our study is comparable to the literature, in our study complication rate was 30 %. No patient developed intraoperative or postoperative vascular injury. No patient suffered from nerve injuries. Three patients suffered from delayed union (Cases No. 5, 6 and 9),

Two patients suffered from pin tract infection (20%) (Case No.6 and 9) and treated by oral antibiotics according to culture and sensetivity results. Two patients suffered from malunion in the form of valgus deformity (one case >5◦ No. 6 and the other case >10◦ No. 9).

Detailed Data of the 10 patients in this study:

Table (5): Detailed data of the 10 patients.

Case number	Age	sex	Mode of trauma	Fracture type	Other injuries	Medical history	Time of union	complication
1	42	F.	twisting trauma	Closed 43an	No	diabitic	12 WS.	None
2	55	M.	Falling from hight	Closed 43a	Ipsilateral superior and inferior pubic rami fracture	Non	10 WS.	None
3	28	M.	RTA.	Closed 43a	No	Heavy smoker	10 WS.	None
4	37	M.	RTA.	Closed 43a	No	Heavy smoker	30 WS.	None
5	75	F.	Twisting trauma	Closed 43a	No	Diabetic & HTN	25 WS.	Delayed union
6	21	M.	RTA.	Closed 43a	ipsilateral fracture fibula	smoker	9 WS.	Infection, delayed union and valgus deformity
7	32	M.	RTA.	Grade 2 open fracture	Distal radius	None	12 WS.	None
8	45	F.	Falling from height	Closed 43a	Fracture femur	None	15 WS.	None
9	40	M	RTA.	Closed 43a	ipsilateral fracture fibula	None	14 WS.	Infection, delayed union and valgus deformity
10	35	F.	RTA.	Closed 43a	No	None	12WS.	None

Table (6): Number and percentages of patients with complications.

Complication	Number of cases	Percentage
Infection	2 (case no.6 and 9)	20%
Delayed union	3 (the same cases of infection and case no. 5)	30 %
Valgus deformity	2 (the same cases of infection)	20 %
Total	3	30%

4. Discussion

MIROS is a multifunctional fixation system characterized by the possibility of using steel wires that have been modified in terms of length, edge and flexibility. Wires can be used in different arrangements (intramedullary, external, mixed system). **(Watson JT., 1994)**

(handpiece, blow back system, screw driver for wrenching, T-distractors).

The technical characteristics of the system (capacity, resistance, flexibility) have already been studied in Milan, at the Polytechnic's Labs. Its components are in Ergal and medical Inox steel. **(Solomon et al, 2001)**

It is polifunctional because it has a great easiness of use in various synthesis combinations (external, internal, hybrid). **(Park S, Ahn J, Gee AO, et al., 2009**)

The system has been used in Italy in more than one thousand fractured patients. In the beginning the fracture is reduced just by external manipulation; than metal wires are fixed into the bone by Mini open Wire Instruments and stabilized with clips on the outside without skin incision. The patient is rapidly discharge. To remove the system is not necessary a hospitalization, another operation and anaesthesia. **(Joshi et al., 2007)**

In this study we evaluated the use of MIROS system in management of tibial non articular fractures. Out of the 10 fractures managed by this method 7 fractures showed uncomplicated healing within a reasonable period of time, about 6 weeks. The complication rate was considered minimal. Only three cases of delayed union and 2 cases of valgus deformity >5 degrees as shown in table (6). However we passed through a learning curve during performing this study, with most of the complications occurring in the early cases.

According to mode of injury, road traffic accidents continue to play a major role in causing disability. **(Audigé et al., 2004)**

In this study it is responsible for more than 60% of cases, while the twisting trauma represented 20 % and 20% caused by fall from a height.

In our study we followed each patient for about 12 months after injury.

In comparison to other methods of fixation of tibial fractures, open reduction and internal fixation is not a popular method of fixation of these fractures due to the risk of wound dehiscence and infection which occurs as a consequence of the minimal soft-tissue cover over the anteromedial tibia. **(Kakar et al., 2007)**

However, results of randomised comparison of open plate fixation and intramedullary nail in 64 patients showed increased infective complications in the plate group. This is corroborated by extensive evidence from the management of pilon fractures with open reduction and internal fixation which has shown that the risks of soft-tissue complications, particularly infection, are potentially problematic and increased by the severity of the fracture). **(Sheerin et al., 2006)**

According to the results, we recommend that this method could be used in the management of tibial fractures. The procedure however is technically demanding, requiring the availability of appropriate tools and surgical implants.

Careful follow up of the patients is recommended. This technique confirmed by our results minimizes the complication rate and facilitates early return to normal activities of the patient. Achieving a good quality reduction at the level of the bone segment should be the objective for anatomical axis restoration.

Conclusion:

(1) The introduction of the concept of closed reduction and percuteneous fixation aims to improve the chances of healing as it utilizes the importance of the soft tissue envelope and preserves the vitality of the involved bony segments.

(2) In conclusion from the above statistics show how the MIROS system has demonstrated safety in use, speed of surgery execution, rapid discharge of a patient with savings in costs for the hospital, good tolerance of system during treatment, rapid healing with little need for physiotherapy and rapid recovery in the ordinary daily activities and work.

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