RESULTS

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Results were graded into: *satisfactory* and *unsatisfactory*. satisfactory were those cases assessed as excellent and good, while unsatisfactory were the fair and poor cases.

Table (10) shows the final assessment of the results.

Result	Number	Percentage
Excellent	23	44.3
Good	18	34.6
Fair	6	11.5
Poor	5	9.6
Total	52	100

Union Time :

All the fractures united without further surgical interference (dynamization being considered as part of the original management plan).

The union time ranged from (12-48) weeks, with only one patient taking 60 weeks. The mean time of union was (20.3) weeks.

Delayed union more than six months occured in six cases (11.53%) only one case (10.9%) of non-union was reported it was treated by exchanging the nail with a shorter one of the same diameter dynamically locked and allowing immediate post-operative full weight bearing. It united after a further ten weeks. In our series, the successful use of the intramedullary tibial nail after reaming of the medullary canal was especially evident in the treatment of delayed union and nonunion of the etibial fractures. All ten fracture that had been nailed secondarily after failure of the primary procedure, united in a mean time (27.2) weeks . In all of these cases, a fibular osteotomy was performed at the time of nailing to allow correct alignment of the tibia as well as to provide compressive force on the unhealed tibial fracture during weight bearing. we agree with Bohler that" to heal a non union it is necessary to immobilize the ends of the nonunion, to create a local stimulus for transposition of the tissues into bony callus and to disturb the vascularization as little as possible".

Weight - bearing :

Immediate full weight-bearing was allowed in eight of the dynamically locked nails (66.7%) of the dynamic nails, (15.4%) of the series, that is those with a transverse or short oblique fractures in the middle third of the tibial shaft, with good rotational control of the nail and cases of delayed or nonunion.

All the other patients were allowed immediate post-operative partial weight - bearing except for four patients with an ipsilateral fracture femur.

Full weight - bearing for the whole series raned from (immediate to thirteen) weeks, with one patient taking eighteen weeks, this was the

case of controlateral above knee amputation. The mean weight - bearing duration was (6.3) weeks.

The range for the static nails was (8-14) weeks with a mean of (9.9) weeks, while for the dynamic nails the mean weight - bearing duration was (5.2) weeks.

The marked difference between the time to weight - bearing in the dynamically and the statically locked fractures is due to the difference of the fracture configuration which is inherent to the choice of type of nailing.

Dynamization:

Dyamization of the statically locked nails was done when sufficient callus was felt to be formed giving the fracture enough stability. Of the twenty-nine statically locked nails in the series, six (20.6%) were dynamized. The period between the static nailing of the fracture and dynamization ranged from (8-12) weeks, (The mean 9.8 weeks). The screws were removed under local anaesthia on a day - patient basis.

Operation and Radiation time:

The operating time ranged from (40-160) minutes, the mean time was (62) minutes. This time varied with the requirement of cross-screws as indicated in table (11). The time of operation did not affect the course or results.

Radiation times were recorded for the last thirty cases the mean radiation time was (42) seconds, the longest being (74) seconds.

Table (11) shows the operating time related to the use fo screws

Mode of locking	Number of cases	Mean duration of surgery (min.)
No cross screws (unlocked)	11	47
Proximal screw(s) only	5	58
Distal screw(s) only	7	62
Static lock	29	61
Total	52	62

Analysis of the results :

In our series the mean time of union was (20.3) week Table (12) shows analysis of time taken for union in 52 tibial shaft fractures.

Time taken for union (weeks)	Number	percentage
9-12	3	5.8
13-16	23	44.2
17-20	13	25.0
21-26	7	13.5
over 26	5	9.6
Mean time taken for union :20.3 weeks		
Non-union	1	2.0
Total	52	100

75% of all the cases united within the first (20) weeks, most of the cases united after 20 week were those nailed for established delayed union or nonunion after failure of another procedure.

Rate of union in relation to age:

There was no significant difference in the mean time of union in relation to age.

Table (13): shows the rate of union in relation to age.

Age	Number	Percentage	Mean time of union (WK)
19-30	19	36.5	21.0
31-41	17	32.7	20.6
42-52	6	11.6	15.7
53-63	10	19.2	21.2
Total	52	100	20.3

Rate of union in relation to fracture site:

Mean time of union was significantly lower in upper an dlower third fractures.

Table (14) shows the rate of union in relation to site

Site	Number of patients	Number of Delayed union	Percentage	Mean time of union (WK)
Upper third	1	-	-	14.0
Junction Upper and Middle third	8	1	12.5	19.5
Middle third	16	3	18.7	22.2
Junction middle and Lower third	9	1	11.1	19.5
Lower third	10	-	-	18.2
Segmental	8	1	12.5	21.0
Total	52	6	11.5	20.3

Rate of union in relation to timing of surgery:

Mean time of union was lowest when surgery was performed within fourteen days after injury.

Table (15) shows the rate of union in relation to timing of surgery.

Time of surgery	Number	percentage	Mean time of union(WK)
0-24 hrs	32	61.5	19.1
1-14 days	10	19.2	18.4
2-6 months	7	13.5	20.7
More than 6 months	3	5.8	37.6
Total	52	100	20.3

Rate of union in relation to initial displacement :

The degree of initial displacement indicates the severity of trauma, so the mean time to union was markedly shorter in slight displacement than in moderate and severe displacement.

Table (16) shows the rate of union in relation to the degree of initial displacement.

Degree of initial displacement	Number	percentage	Mean time of union(WK)
Moderate to severe	38	73.1	21.8
slight	14	26.9	16.2
Total	52	100	20.3

Rate of union in relation to fracture morphology :

Mean time to union was lowest in transverse and spiral fractures while it was highest in comminuted and segmental fractures.

Table (17) shows the rate of union in relation to fracture morphology.

Fracture pattern	Number	Percenatge	Mean time of union(WK)
Transverse	13	25	17.8
Oblique	8	15.4	19.8
Spiral	6	11.5	18.0
Comminuted	17	32.7	21.5
Segmental	8	15.4	24.0
Total	52	100	20.3

Rate of union in relation to comminution :

The degree of comminution indicates the severity of the trauma, so the mean time to union was shorter in slight comminution than that in moderate and severe comminution.

Table (18) shows the rate of union in relation to the degree of comminution.

Degree of comminution	Number	Percentage	Mean time of union(WK)
Moderate to Severe	11	21.2	22.7
Nil to Slight	6	11.5	19.3
Total	17	32.7	21.5

Rate of union in relation to weight - bearing :

There was no significant difference in the mean time to union in relation to weight - bearing in primary nailed cases. While, in secondary nailed cases immediate postoperative full weight - bearing significantly shortened the mean time to union.

Table (19) shows the rate of union in relation to weight -bearing in primary and secondary nailing.

Weight-Bearing	Primary Nailing		Secondary Nailing	
	Number	Mean time to union	Number	Mean time to union
F W B	2	17.3	6	22.9
P W B	40	19.1	4	30.1
Total	42	18.9	10	25.8

Rate of union in relation to operating time and mode of locking :

The was no significant difference in the mean time to union in relation to the operating time.

Table (20) shows the mean time to union and the operating time related to the use of screws.

Mode of locking	Number of cases	Mean time to union (wk)	Mean duration of surgery (min.)
No cross-screws (unlocked)	11	18.7	47
Proximal screw (s) only	5	20.8	58
Distal screw (s) only	7	18.8	62
Static lock	29	21.1	71

Rate of union in relation to dynamization :

There was no significant difference in the mean time to union in relation to dynamization of the statically locked nails.

Table (21) shows the rate of union in relation to dynamization.

Mode of locking	Number	Mean time to union (WK)
Static	23	21.4
Dynamized	6	19.9
Total	2.9	21.1

Complications:

Malunion :

Most authors **(Zucman and maurer, 1969; Puno et al., 1986; Mayo and Benirschke, 1990)** define malunion of fractures of the tibia as one or more of the following deformities:

- Shortening of more than 1 cm.
- varus of more than 10 degrees.
-valgus of more than 15 degrees.
-Internal rotation of more than 5 degrees.
- External rotation of more than 10 degrees.

In the present series we had the following deformities as shown in Table (22):

Deformity	Number	Percentage
shortening more than 1cm	2	3.8
varus more than 10°	1	1.9
valgus more than 15°	2	3.8
Anterior angulation more than 15°	–	–
posterior angulation more than 15°	1	1.9
Internal rotation more than 5°	–	–
External rotation more than 10°	1	1.9
Total	5	9.6

As a whole, there were five cases of malposition, the valgus and external rotation were combined in one case, while shortening and posterior angulation were combined in one case.

In the two cases of shortenting one of them had comminuted fracture of the middle 1/3 which was treated by statically locked nail, most of the shotening (2cm) occured after dynamization and full weight - bearing at 9 weeks. The other case had comminuted fracture of the lower third, the nail was long and not centered in the distal fragment, so it pushed the distal fragment into marked posterior angualtion (about 25 degrees.)

Delayed union :

Delayed uniion was considered as absence of compelete radiological union at six months, even though in some cases there was clincal union, this occured in five cases (9.6%) none of which needed any further surgical intervetion to achieve final union, except for the removal of the locking screws.

The union time ranged from (28-40) weeks; and the mean time of union was (34.4) weeks.

Only one of them had associated injury, in the form of fracture of the controlateral femur.

There were four males and one female of these five delayed union, none was of minor severity fracture type, two were moderate and three were major severity type

Two were closed fractures one was grade I and two were grade II open fractures.

Only one was double level fracture of the tibia.

In three cases the nails were statically locked, while in only one case the nail was dynamically locked who was allowed full weight - bearing immediately postoperative. one case was unlocked nail.

Non-union :

Only one case had nonunion, which required further surgical procedures to achieve union. This case had an intramedullary Dynamically locked nail after failure of plating and cast immobilization for the last 15 months to achieve union, 10 months after nailing there was'nt radological signs of union which was referred to the long nail causing distraction at the fracture site, so the nail was exchanged by another of the same diameter but shorter, with fibular osteotomy and immediate post operative full - weight bearing. The fracture united after 3 more months.

Infection:

The most significant compication in our series was infection. there was three cases (5.7%) of post-operative superficial wound infection. These were treated by appropriate antibiotics and repeated dressings. All cleared without further consequences.

There were two cases (3.8%) of deep infection. All had an intramedullary nail placed for an infected tibial nonunion. One of them had grade II open fracture, treated for six months by external fixator and cast. The other was treated for twenty-four months by plate osteosynthesis. The established infection cleared after bone union, removal of the nail and debridment of the medulallry canal by reaming with flexible reamers measuring 0.5 to 1.0 milimeter larger in diameter than the nail.

Compartmental syndrome :

No cases of compartmental syndrome were diagnosed but three patients (5.7%) eventually had a weakness of the Extensor Digitorum Communis. This was thought to be due to a missed compartmetal syndrome. All of them were cases nailed on the day of trauma.

Joint affection :

Affection of knee function was rare, except in the cases that had an associated injury to the knee. This was not considered to be due to the fracture of the tibia or to the consequent nailing.

The most common transient problem was a postoperative patellar tendon pain related to the incision and most probably due to a mild patellar tendinitis. Pain due to the upper end of the nail irritating the patellar tendon especially on kneeling occured in seven cases (13.5%). Three cases (5.8%) had a post-operative limition of the range of movment of the knee, the maximum being 90 of flexion,but none of these resisted to physiotherapy.

Affection of the ankle joint on the other hand was more common. This occured in eleven cases (21.1%). This ranged from slight pain on weight-bearing due to varus or valgus deformity, to stiffness and even one case of sudek's atropy.

Ankle oedema :

Post-operative ankle oedema lasting for up to six weeks was a common complication occuring in ten patients (19.2%). This was treated by elevation, compressive bandage and physiotherapy.

Pain :

unexplained pain at the fracture site after clinical and radiological union occured in two cases (3.8%)

Pain at the site of transverse screws occured in four cases (7.6%).

Muscle wasting :

Three cases (5.7%) had muscle wasting all of which involved the quadriceps muscle only. They recovered with physiotherapy.

Other complications :

Haematoma collecting at the fracture site after nailing occured in four cases (7.7%) with no consequences.

There were no cases of refracture after nail removal.