

# **Comparative Study of Biological Tibial Fixation Intramedullary Versus Surface Fixation**

Thesis

For fulfillment of M.D. Degree in orthopedics

By

**Amir Nabil AbouZeid**

Under supervision of

**Dr. Talaat El-Hadidi**

**Professor of Orthopedics, Cairo University**

**Dr. wessam Gaber El-Anani**

**Professor of Orthopedics, Cairo University**

**Dr. Mohamed Omar Soliman**

**Professor of Orthopedics, Cairo University**

Cairo University

2015

## **Abstract**

Comparative study in biological fixation of fracture tibia between Minimal Invasive percutaneous plating osteosynthesis and intramedullary nail. This approach is described as 'biological internal fixation'. It involves the use of locked internal fixators which have minimal implant-to-bone contact, long-span bridging and fewer screws for fixation. Formerly, internal fixation with a plate aimed at absolute stability to avoid micromovement which could result in loosening of the implant and a delay in healing. The new technique of internal fixation, however, seems to tolerate and even require some degree of mobility of the interface of the fracture.

**Keywords: Biological- Intramedullary- TARPO- DCS- DVT**

## Acknowledgements

*First I would like to thank our **Almighty God** for his great help and support during this work the compassionate and merciful, whose help is the main factor in accomplishing this work.*

*I would like to express my appreciation and sincere gratitude and deepest thanks to **Prof. Talaat El-Hadidi** Professor of Orthopedic Surgery Department Faculty of Medicine –Cairo University, for his great help and encouragement and his help in reviewing the manuscripts of this work, which made this work possible.*

*And my respective gratitude to **Prof. Wessam Gaber El-Anani** Professor of Orthopedic Surgery Faculty of Medicine - Cairo University, for his supervision and enormous help, constant advise, constructive criticism.*

*And my respective gratitude to **Prof. Omar Soliman** Professor of Orthopedic Surgery Faculty of Medicine - Cairo University, for his supervision and enormous help, constant advise, constructive criticism.*

*Finally I would like to record my appreciation and thanks to everyone in my senior staff and colleagues helped me in my work.*

# ***Contents***

<b><i>Title</i></b>	<b><i>Page</i></b>
Acknowledgement	I
List Of Figures	II
List Of Tables	IX
List of Abbreviations	X
Introduction	1
Aim Of The Work	2
Biology Of Bone Healing	3
Principles Of Biological Fixation	26
Principles Of Locked Plate	55
MIPO	67
Intramedullary Nailing of Tibial Fractures	77
Patients And Methods	90
Results	104
Case Presentation	116
Discussion	122
Conclusion	144
Summary	145
References	147

## List Of Figures

Number	Title	Page
Fig ( 1 )	Diagram illustrating alternative methods of bridging a fracture by external callus	7
Fig ( 2 )	Unsplinted rib fracture in a sheep at three weeks	8
Fig ( 3 )	Blood vessels in external callus originating from the soft tissues	8
Fig ( 4 )	Part of the callus from a healing rib fracture in a sheep at two weeks showing the multifocal cellular and osteogenic activity	11
Fig ( 5 )	Radiograph showing pattern of early callus formation in a displaced fracture of the human femur	11
Fig ( 6 )	Formation of new Haversian system in normal cortical bone	13
Fig ( 7 )	Dead bone end in displaced fracture undergoing resorption	13
Fig ( 8 )	The left tibia at six weeks after traumatic amputation	15
Fig ( 9 )	The right tibia sustained a fracture in the same accident	15

Fig (10 )	Amputation stump at nine days showing” primary callus response”	17
Fig (11 )	Amputation stump at seventeen days showing Involution of the primary callus response that has begun.	17
Fig (12 )	Uniting fracture at seventeen days. Callus formation has progressed leading to formation of bridging external callus’	17
Fig (13 )	Formation of medullary callus in a fracture immobilized by compression plating.	22
Fig (14 )	Fracture immobilized by compression plating showing bridging of the fragments by a cutter head” and the filling of a non-contact area by medullary bone	22
Fig (15 )	Rib fracture in sheep with excision of a bone segment at four weeks the advance of medullary callus into the organized fibrous tissue provides a clear-cut line of demarcation	23
Fig (16 )	Radiographs showing the evolution of fracture treatment	28
Fig (17 )	Direct healing and induction of remodelling	30
Fig (18 )	Radiographs showing unstable plate fixation resulting in nonunion	31
Fig (19 )	Clinical and experimental observations regarding	34

	unstable interfaces	
Fig (20 )	The relation of gap width and instability producing strain	36
Fig ( 21)	Photomicrographs of strain-induced resorption of osteotomy surfaces and of initial bridging	38
Fig (22 )	Radiographs showing biological internal fixation of a simple spiral fracture of the tibia. Simple fractures can be successfully treated by biological internal fixation	42
Fig (23 )	The tolerance of instability of simple versus multiple fracture lines	43
Fig (24)	Principle of the locked screw	44
Fig ( 25)	The different effects of internal (Haversian) remodelling of cortical bone	46
Fig (26 )	The aetiology of early temporary porosity	47
Fig (27 )	Adverse effect of intensified early temporary porosis, the porosity is located between the living and the necrotic bone in close contact with the living bone	47
Fig ( 28)	Reduction of contact of a plate to bone can be achieved by appropriate selection of the radius of the plate undersurface or by undercutting the latter	48
Fig (29 )	Local resistance to infection	48

Fig (30 )	Refracture and plate contact	49
Fig (31 )	Diagrams showing improved anchorage of divergent locked screws	50
Fig ( 32)	Flexibility and length of plate with pull-out load	53
Fig ( 33)	Internal fixator and bone healing	53
Fig ( 34)	Minimally invasive percutaneous osteosynthesis (MIPPO)	54
Fig ( 35)	The forces that must be overcome by any method of fracture fixation	56
Fig ( 36)	Axial force is countered during compression plate fixation by the product of A (the normal force provided by screw torque) and B (the coefficient of friction between the plate and bone)	56
Fig ( 37)	Schuhli nuts turn a conventional dynamic compression plate into a fixed-angle device.  A Plate and screws with the central Schuhli nut expanded.  B Schematic of the Schuhli nut.  C Schuhli nut locks plate to screw, creating a fixed-angle device	58
Fig ( 38)	Locked screws are used when a bridge-plate technique is applied to span an area of comminution	59



Fig ( 39)	Deformation of the screw-hole track after application of a three-point-bending load to failure	61
Fig ( 40)	Guidelines for the appropriate use of standard or locked plates, or plates combining the two fixation modes	63
Fig ( 41)	A seventy-four-year-old man sustained a proximal humeral fracture in a fall	66
Fig ( 42)	MIPO proximal tibia - medial approach	70
Fig ( 43)	Diaphyseal tibial fracture type 42-C with proximal extension; internal fixation by MIPO technique	71
Fig ( 44)	Proximal tibia fracture C1/AO (C,D) MIPPO with LISS PLT	72
Fig ( 45)	Proximal tibia fracture (type C3/AO)	73
Fig ( 46)	Devices for MIPO technique	74
Fig (47)	MIPO of distal tibia by medial approach with fracture healing at 4 months	75
Fig (48)	Lateral illustration of appropriate positioning of the knee in 10° to 15° of flexion	86
Fig (49)	Photograph demonstrating the trocar placed through the incision  Lateral C-arm radiograph after the tibial nail has been placed in the medullary canal	87

Fig (50)	A pie chart showing the ratio between male and female in the MIPPO group.	91
Fig (51)	A pie chart showing the ratio between male and female in the interlocking group	92
Fig (52)	A pie chart showing the ratio between different mode s of trauma in the MIPPO group	93
Fig (53)	A pie chart showing the ratio between different mode s of trauma in the interlocking group	94
Fig (54)	A pie chart shows the ratio between closed and open fracture in the MIPPO group	95
Fig (55)	A pie chart showing the ratio between closed and open fractures in the interlocking group	95
Fig (56)	A pie chart showing the ratio between isolated and associated injuries in the MIPPO group.	96
Fig (57)	A pie chart showing the ratio between isolated and associated injuries in the interlocking nail group	97
Fig (58)	A bar chart demonstrating results of both interlocking nail and MIPPO groups.	105
Fig (59)	A bar chart demonstrating the rate of union in the MIPPO group.	107
Fig (60)	A bar chart demonstrating the rate of union in the interlocking nail group.	108
Fig (61)	A bar chart showing a comparison between results of both MIPPO and interlocking nail groups	112

Fig (62)	Comparison between radiographic results in the MIPPO and Interlocking nail groups	126
Fig (63)	Comparison between different studies for malalignment	127
Fig (64)	diagram shows a comparison between different studies in the need of open bone grafting.	132
Fig (65)	a pie chart shows a comparison between different studies in the need of open bone grafting.	132
Fig (66)	Diagram showing a comparison in infection rate between different studies	139
Fig (67)	A pie chart showing a comparison in infection rate between different studies.	139
Fig (68)	Case 1 ILN	116
Fig (69)	Case 2 ILN	117
Fig (70)	Case 3 ILN	118
Fig (71)	Case 1 MIPPO	119
Fig (72)	Case 2 MIPPO	120
Fig (73)	Case 3 MIPPO	121

## *List Of Tables*

<i>Number</i>	<i>Title</i>	<i>Page</i>
1	Specific indication for different technique	62
2	Master table	101
3	Classification system for the results of treatment	104
4	summarizes the outcomes in some of the published series of the MIPPO technique since 1997	124
5	Tagner and Lysholm score	128
6	Grading Tagner and Lysholm score	129

## List Of Abbreviations

Abbreviation	<i>Full Term</i>
<b>LC-DCP</b>	Low Contact Dynamic Compression Plate
PC-Fix	Point Contact Fixators
MIPPO	minimally invasive percutaneousplate osteosynthesis
LISS	Less Invasive Stabilization System
DCS	dynamic condylar screw
TARPO	Transarticular Approach and Retrograde Plate Osteosynthesis
LCP	Locked Compression plate
LISS-PLT	Less Invasive Stabilization System – proximal lateral tibia
AP	Anteroposterior
CBC	Complete blood count
RBS	Random Blood Sugar
PC	Prothrombin Concentration
PT	Prothrombin Time
RTA	Road traffic accident
MCA	Motor car accident
FFH	Fall from height
FTG	Fall to the ground
MBA	Motor bike accident
FDS	Fall down stairs
ATLS	acute trauma life support
DVT	Deep Venous Thrombosis

# ***Introduction***

It is study to introduce the concept of biological fixation; internal fixation of fractures has evolved with a change of emphasis from mechanical to biological priorities. More flexible fixation should encourage the formation of callus while less precise, indirect reduction will reduce operative trauma, With comparison between the minimal invasive percutaneous plating osteosynthesis and intramedullary nail.

## Aim of work

Change of emphasis from mechanical to biological priorities in internal fixation. More flexible fixation should encourage the formation of callus while less precise, indirect reduction will reduce operative trauma.

To compare results obtained from Minimal Invasive Percutaneous Plate Osteosynthesis and Intramedullary Nail in treatment of fracture tibia.