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Original article

COMPARATIVE STUDY ABOUT THE OUTCOME OF COMMINUTED FRACTURE SHAFT TIBIA FIXED WITH INTERLOCKING NAIL AND BIOLOGICAL PLATING

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Abstract

Incidence of tibial diaphyseal fractures (26 per 100,000 persons per year in an average population) is the highest among long bone fractures. Now-a-days closed reduction with intramedullary interlocking nailing is generally accepted by surgeons to be the most popular method for fixation of tibial fractures in adults. To compare the outcome of fixation of comminuted tibial fractures following minimally invasive plating and nailing. It is prospective study of adult patients admitted to orthopedic department of Sohag university hospitals suffering from comminuted fracture Shaft tibia. The study will be approved by Scientific and Ethical committees at Sohag Faculty of Medicine. An informed written consent will be obtained from all participants. This study is being done on 30 patients of comminuted fracture shaft tibia. The average follow up time was thirty- three weeks (range from 19 to 54 weeks). The average time of union in all our 30 patients was about 13 weeks (range from 8 to 16 weeks). Three of the thirty patients had post operative fracture angulation was less than 5 degrees in the coronal and sagittal planes and one patient had post operative valgus angulation of about 5 degrees. As regard intraoperative exposure to radiation it was less in cases of biological plating There was two patients infected and they required removal of the nail and plates and treated by external fixation they represent about 10% of patients. Out of the 30 fractures managed by this method 24 fractures showed uncomplicated healing within a reasonable period of time. The complication rate was considered minimal. Only one case of non-union, two cases of delayed infection and 4 patients of malunion in valgus or varus malalignment, however we passed through a learning curve during performing this study, with most of the complications occurring in the early cases. So MIPO could attain satisfactory results in uncomminuted tibia shaft fractures, and locked intramedullary nailing is more appropriate in comminuted fractures.

Keyword: *Comminuted fracture shaft tibia, ILN, MIPO*

1. Introduction

The tibia is the most commonly fractured long bone**.** Tibia is a subcutaneous bone, so tibial shaft fractures are frequently open fractures**.** Most of these fractures are found in young males. It represents 0.2% of all injuries. Motor vehicle accidents, skiing accidents, high-energy falls and sports are the commonest causes. The mechanism of

injury determines the fracture configuration (e.g., skiing injuries typically cause spiral fractures). Most fractures are comminuted. The second peak of incidence among elderly patients whose injuries likely resulted from a simple fall [1]. Tibial shaft fractures are often the result of high-speed trauma but can also be insidious in onset such as stress fractures in active individuals [2]. During the initial evaluation, the patient with a tibial shaft fracture should be evaluated carefully for open wounds at the fracture site, neurovascular sufficiency, and elevated compartment pressures. Abnormalities in any of these areas constitute a surg ical emergency [3]. Surgical treatment of displaced tibial fractures can improve alignment and provide stability to the bone and the surrounding soft tissues [4]. Stable fixation allows early motion of the adjacent joints, helping to maximize overall function. Plating tibial shaft fractures was the treatment of choice 2-3 decades ago, plates and screws were once routinely treated with plate and screw constructs [5]. These tools are reserved for fractures in which intramedullary nailing may not be possible or optimal, such as certain fractures that extend into either the knee or ankle joints. During this type of procedure, the bone fragments are first repositioned (reduced) into their normal alignment. They are held together with special screws and metal plates attached to the outer surface of the bone. Intramedullary nailing and external fixation have replaced fracture plating because they are associated with decreased technical difficulty, lower infection rates, and less damage to local soft tissues. Intramedullary nailing has become the standard of care for many displaced tibial shaft fractures. However, proximal and distal shaft fractures can be difficult to control with a medullary device, leading to increased rates of malalignment [6]. Although intramedullary nailing has been the treatment of choice for diaphysealtibial fractures [7], its role in the management of fractures occurring at the proximal tibial metaphysis remains controversial, as high complication rates that mostly refer to unsuccessful reduction and malalignment have been reported [8]. The cause of malalignment has been attributed both to displacing muscular forces and residual instability [9] as there is a large difference between the size of the implant and the metaphyseal diameter with no nail-cortex contact, the nail may translate laterally along coronally placed locking screws. To overcome these problems and improve outcomes, certain modifications to the standard operative technique have been proposed, such as the use of blocking screws **(BS)**, additional buttress plate, different patient positioning, and extended parapateller or retropateller approaches [10]. Poller screws acting as **BS**, placed adjacent to the nail, have been proposed as a possible solution by preventing translation in both the tibia and the femur. The term ‘Poller’ is derived from small metal devices placed in roads to block or guide traffic. These Poller screws decrease the width of the medullary cavity, physically block the nail, and increase the mechanical stiffness of the bone-implant construct.

2. Patients and Methods

It is a prospective study of 30 adult patients with comminuted tibial shaft fractures admitted in orthopedics and traumatology dep. Sohag Univ. hospital. An informed written consent was obtained from all participants. The study was approved by scientific and ethical committees at Sohag faculty of medicine. Follow up of the study was allowed to the scientific and ethical committees. After the end of the study, the

study was approved by scientific and ethical committees. The study was conducted on thirty patient's tibial shaft fractures attending at department of orthopedics and traumatology, Sohag university hospitals, Sohag University.

2.1. *Criteria for included participants*

Skeletally mature patients with comminuted tibial shaft fracture either (proximal or distal) presented to the department early within 24 hours. Failure of conservative treatment for malalignment. Generally well patients and not associated with other skeletal fractures.

2.2. *Exclusion criteria*

Skeletally immature patients, closed tibial shaft fractures, Proximal or distal intra articular tibial fractures, Immunocompromized patients, Pathological fractures, Polytraumatized patients.

2.3. *Types of interventions*

Surgical fixation of the fracture with intramedullary nail (Interlocking nail) or using or plates and screws. Patients aging 20 years and above were selected. Majority of the fractures were treated with closed method of reduction followed by operation either by Interlocking nail or Plates and screws. In all the patients along with personal data, mode of trauma, type of fracture, type of surgery, intra operative & post-operative complications, follow up examination, timing of full weight bearing were considered.

3. Results

The present study included 30 patients having comminuted tibial shaft fractures surgically internal fixation done by either interlocking nail or plates and screws in the Department of Orthopedics and Trauma Surgery at Sohag University Hospital. The patients had been followed up for 9 months. Results were evaluated at 6 weeks also at 3, 6 and 9 month post-operative from the date of discharge.

3.1. *Rotational malalignment*

Three of the thirty patients had postoperative fracture angulation that was less than 5 degrees in the coronal and sagittal planes and one patient had postoperative valgus angulation of about 5°, tab. (1).

Table (1) post-operative alignment

Alignment	Frequency	Percent
Neutral	26	80
Varus	1	5
Valgus	3	15
Total	**30**	**100**

3.2. *Fracture healing*

The thirty patients were followed up in the outpatient clinic for assessment of fracture healing or the establishment of a nonunion. The average follow-up was thirty-three weeks (range 19 to 54 weeks). Union was defined as healing of at least 3 of 4 cortices on biplane radiograph. Nonunion was defined as lack of any healing within 6 months. Malunion was defined as any angular deformity, in any plane, of greater than 5°, translation or shortening greater than 5 millimeters, or rotational malalignment of greater than or equal to 10°.

3.3. *Alignment at Last Follow-up*

Eighteen patients achieved union and maintained the alignment of their fractures. One patient had post-operative valgus of 5°, two patients had 2°residual varus and another patient had about 3° varus postoperatively

3.4. *Implant related intra operative and post-operative complications*

Complications included mechanical instability leading to a fracture nonunion, new fracture lines through the blocking screw holes, nail failure resulting from drilling-related nail damage. Intramedullary nailing related complications such as compartment syndrome, infection, rotational malalignm-

ent, and interlocking screw breakage, as well as nerve injuries. There are two patient infected and they required removal of the nail and plates and treated by external fixation, they represent about 10% of the patient Another patient had fissure fracture at the site of placement of the blocking screw so we delayed weight bearing and put aback slab to him.

3.5. *Average time of fracture union*

Average time of union in all our 30 patients was about 13 weeks (Range: 8 to 16 weeks). There is some controversy regarding criteria for time of fracture union in different studies. Some use radiological while some use radiological and clinical union. We have used criteria for union as presence of bridging callus at fracture site (radiological union). Most of the fracture circumference with density similar to adjacent cortical bone. Clinically absence of pain at fracture site and weight bearing.

4. Discussion

Tibial shaft fractures are more commonly seen in young people particularly in 2nd to 4th decades of life common mechanism of injury is seen following high energy trauma like road traffic accident (RTA), fall from height etc. In older patients apart from osteoporosis as major risk factor, anemia, cachexia, cognitive dysfunction, visual impairment, social dependence are some other factors which makes these people more prone for such fractures [11]. In this study an attempt was made to evaluate the management of those individuals by using interlocking tibial nail (IMN) and Plates and Screw. The stabilization of fractures of the proximal and distal tibia is associated with a high incidence of malalignment**.** This has been attributed to muscular forces which displace the fracture and to instability which results from the play of a nail along the interlocking screws [12]. Because of high complication rates after plating of open tibial shaft fractures [13], especially after high-energy injuries, IMN techniques were developed to minimize surgical insult to the fracture and adjacent soft tissues**.** IMN has become the standard of care for the majority of displaced tibial shaft fractures. However, proximal and distal shaft fractures can be difficult to control with an intramedullary device, leading to malalignment rates of 5%-50% [14]. Due to the proximal segment anatomy and its deforming muscle forces, coronal and sagittal plane malalignment is common**.** Malalignments have been reported as high as 50%-80% with apex anterior angulation, valgus angulation, and anterior displacement of the proximal segment documented as the most commonly encountered deformities [15]. The difficulties with IMN of proximal tibia fractures have been attributed to multiple factors**.** Apex anterior angulation occurs secondary to the extension moment induced by the patellar tendon, which is exaggerated with flexion of the knee. Valgus angulation may be due to a medial start site and continued eccentric positioning of the IMN within the proximal medial tibia and further worsened with a laterally directed nail insertion angle in the coronal plane [16]. Anterior displacement of the proximal segment can result from a posteriorly directed nail interacting with the posterior cortex during nail insertion and by influence of the proximal bend of the IMN [17]. Several techniques have been described to aid in the correction of these deformities. These techniques include the use of blocking screws, unicortical plates, percutaneous clamps, external fixators, and femoral distractors [15]. Poller screws, placed adj-

acent to the nail and perpendicular to the interlocking screw holes, usually in an AP direction, have been suggested as one possible method for improving the stability of metaphyseal fractures [7] and have been described as a reduction tool used to overcome the displacing forces at the time of introduction of the IMN.

5.1. *Age distribution*

Comparing the current study to the other studies signifies the fact that patients from this age group (2^{nd} to 4^{th} decade of life) is commonly involved in these fractures. An eight fold increase in tibial shaft fractures in men over 20 years and women over 40 years of age was reported [18]. Tibial shaft fracture is common in young adults as it is subcutaneous bone and over activities.

5.2. *Sex distribution*

The majority of the patients in this series were male as they are more outgoing and engaged in activities like agriculture, driving of motor vehicles, praying outside home and are more likely to be involved or prone to accidents/fall. Females play a more dormant role and are involved more in household activities [11]. Males were affected more because of their exposure to trauma during their day-to-day life was greater.

5.3. *Mode of injury*

High incidence of open tibial shaft fractures in young adults may be attributed to the following factors, over activities, road traffic accidents, motor vehicles, falling from hight. It was observed that 90% of tibial fractures in the elderly result from a simple fall.

5.4. *Type of fractures*

According to Gustillo-Anderson the open tibial shaft fractures Gustilo et al. [19] developed a classification system for open fractures that takes into account the skin wound, the extent of local soft tissue injury and contamination, and the severity of the fracture pattern. The Gustilo classification system originally included type I, type II, and type III fractures. However, this system was modified later to expand the type III open fractures into subtypes A, B, and C. It is important to note that the type III- C fracture is defined as any open fracture in which there is an accompanying vascular injury that requires repair. In our study we have studied on 30 patients with comminuted fracture shaft tibia.

5.5. *Time duration between hospital admission and surgery*

Urgent surgical intervention is necessary within 24 hours, as it not only avoids development of complications like wound infections, pulmonary embolism, hypostatic pneumonia, catheter sepsis, cardio respiratory failure, Decubitus ulcers, but also early rehabilitation and mobilization is possible which generate self confidence in patient. There by improvement in the general wellbeing of the patient occurs. According to Evans 30% mortality rate occurs in conservative line of treatment using long term immobilization. Active surgical approach decreases the mortality to less than 15%. In patients young age there are also appear socioeconomic problems, long lasting elimination from working process of even loss of job.

5.6. *Wound complications*

A study was done in surgery dep., Basel University of Switzerland and advised sufficient and early debridement of wound and the use of two doses of cephalosporin antibiotics preoperatively in the patients managed with internal fixation of open tibial shaft fractures. According to this study, antibiotic prophylaxis significantly reduced the incidence of wound infection [19].

5.7. *Implant related Intra operative and post-operative complications*

It was reported that the incidence of fixation failure to be as high as 20% in

open tibial fracture patterns. Osteoporosis and generally ill patients was found to be the most important predisposing factor for this complication.

5.8. *Average time of fracture union*

Comparing our current study to the other studies. No recorded cases of nonunion. None of the thirty cases in our study was subjected to reoperation during their follow up.

6. Conclusion

In the present study which was carried out in Sohag Univ. hospitals, faculty of medicine, Sohag university from January 2017 to August 2018. Thirty patients with comminuted tibial shaft fractures were included. In our study we aimed to evaluate whether these theoretical advantages could be proved in practice by evaluation of the results of internal fixation for these types of fractures by IMN (interlocking tibial nail) and\or plates and screws (MIPO). The management of comminuted tibial shaft fractures has always been a challenge to the surgeon. The traditional surgical techniques aiming at anatomical reduction and rigid internal fixation has raised a lot of complications, probably due to soft tissues status, comminution and devitalization of the fracture fragments that renders healing markedly jeopardized. The introduction of the concept of internal 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

References

[1] Schmidt, A., Finkemeier, C., Tornetta, P. (2003). Treatment of closed and open tibial fractures. ***Instr Course Lect***. 52: 607-622.

[2] Gustilo, R., Anderson, J. (1976). Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: Retrospective and prospective analyses. ***J. Bone Joint Surge Am.*** 58 (4): 453-458.

[3] Brumback, R., Jones, A. (1994). Interobserver agreement in the classification of open fractures of the tibia. The results of a survey of two hundred and forty-five orthopaedic surgeons. ***J. Bone Joint Surg Am***. 76 (8): 1162-1166.

[4] Agrawal, A., Chauhan, V., Maheshwari, R., et al. (2013). Primary nailing in the open fractures of the tibia-is it worth?. ***J. Clin Diagn Res.*** 7 (6): 1125-1130.

[5] Riemer, B., Di Christina, D., Cooper, A., et al. (1995). Nonreamed nailing of tibialdiaphyseal fractures in blunt polytrauma patients. ***J. Orthop Trauma***. 9 (1): 66-75.

[6] Vallier, H., Le, T., Bedi, A. (2008). Radiographic and clinical comparisons of distal tibia shaft fractures (4-11cm proximal to the plafond): Plating versus intramedullary nailing. ***J. Orthop Trauma***. 22: 307- 311.

[7] Burc, H., Dursun, M., Orhun, H., et al. (2009) Treatment of adult tibial diaphysis fractures with reamed and locked intramedullary nailing. ***Acta Orthop Traumatol Turc***. 43: 7-13.

[8] Krettek, C., Rudolf, J., Schandelmaier, P., et al. (1996). Unreamed intramedullary nailing of femoral shaft fractures: operative technique and early clinical experience with the standard locking option. ***Injury***. 27: 233-254.

[9] Liporace, F., Stadler, Ch, Yoon, R. (2012). Problems, tricks, and pearls in intramedullary nailing of proximal third tibial fractures. ***J. Orthop Trauma***. 27 (1): 56-62

[10] Krettek, C., Miclau, T., Schandelmaier, P., et al. (1999). The mechanical effect of blocking screws ("Poller screws") in stabilizing tibia fractures

with short proximal or distal fragments after insertion of small diameter intramedullary nails. ***J. Orthop Trauma***. 13 (8): 550-553.

[11] Court-Brown, C., McBirnie, J. (1995). The epidemiology of tibial fractures. ***J. Bone Joint Surg Br***. 77 (3): 417-421

[12] Krettek, C., Schandelmaier, P., Tscherne H. (1995). Nonreamed interlocking nailing of closed tibial fractures with severe soft tissue injury. ***Clin Orthop***. 315: 34-47

[13] Coles, C., Gross, M. (2000). Closed tibial shaft fractures: Management and treatment complications, a review of the prospective literature. ***Can J. Surg***. 43 (4): 256-262.

[14] Obremskey, W., Medina, M. (2004). Comparison of intramedullary nailing of distal third tibial shaft fractures: Before and after traumatologists. ***Orthopedics***. 27: 1180-1184

[15] Nork, S., Barei, D., Schildhauer, T., et al. (2006). Intramedullary nailing of proximal quarter tibial fractures. ***J. Orthop Trauma***. 20: 523-528

[16] Ricci, W., O'Boyle, M., Borrelli. J., et al. (2001). Fractures of the proximal third of the tibial shaft treated with intramedullary nails and blocking screws. ***J. Orthop Trauma***; 15: 264-270

[17] Bono, C., Levine, R., Roa, J., et al. (2001). Nonarticular proximal tibia fractures: Treatment options and decisión making. ***J. Am Acad Orthop Surg***. 9: 176-186.

[18] Claes, L., Grass, R., Schmickal, T., et al. (2002). Monitoring and healing analysis of 100 tibial shaft fractures. Langenbecks. ***Arch Surg***. 387 (3-4): 146-152.

[19] Gustilo, R., Anderson, J. (1976). Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: Retrospective and prospective analyses. ***J. Bone Joint Surg Am***.; 58 (4): 453-458