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RESEARCH ARTICLE

SHORT TERM FUNCTIONAL OUTCOME OF CLOSED REDUCTION AND FIXATION OF TIBIA SHAFT FRACTURES USING UNREAMED ENDER'S NAIL IN ADULT POPULATION - A PROSPECTIVE STUDY

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Abstract

Most of the tibial shaft fractures are the result of high energy trauma. There are various non surgical and surgical methods for managing tibial shaft fractures ranging from conservative casting, tubular external fixator, ring external fixator, open reduction and plating, reamed intramedullary interlocking nailing and unreamed intramedullary nailing. Aim of the study was to evaluate the functional outcomes of closed reduction with unreamed ender's nailing as a definitive treatment option for closed tibial shaft fractures in adult population. In the study we included 150 adult patients who had sustained closed tibial fractures and underwent closed reduction and fixation with unreamed ender's nailing within 12 hours of the injury. Eye of the nail, present at the distal end of the nails was locked. Total surgical time was averaged to 27.6 minutes. Evaluation was done by the time of clinical union, time of radiological union and VAS score. Ten patients had a delayed union. Two patients developed infection which was managed with oral antibiotics. In the conclusion, we found out that unreamed ender's nailing procedure preserves the periosteum and its blood supply due to minimal exposure and improves the healing of fracture and decreases the incidence of infection. This method reduces the operative time, has a relatively less learning curve, reduces fluoroscopic exposure, reduces blood loss, reduces infection rate, doesn't expose the joint thus maintaining its congruity, reduces the cost of implant, reduces patient hospital stay, reduces the antibiotic usage and the implant removal at a later stage can be done as a day care procedure.

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Introduction:-

Tibia shaft fracture injuries result from high energy trauma in most of the times. There is a direct external impact force that causes injury to the soft tissue and fracture of tibia shaft.^[1] These fractures may be simple or comminuted, closed or open, displaced or undisplaced which is dependant on the force of impact of trauma. Due to lesser soft tissue around the tibia, the trauma usually results in open fractures that exposes the bone to external environment.^[2] It leads to non union, infection or delayed union due to its precarious blood supply. Various non-surgical methods like casting or bracing can be used as conservative method for management of tibia shaft fractures, many cases require a surgical intervention that can be in the form of intramedullary nailing, plating or external fixator application.^[3-7] In past times, use of Kuntschner nailing or K-nailing, as a definitive management that allowed stable fixation and early weight bearing mobilization.^[8] The rotational stability of the fracture was insufficient with k-

nailing and hence the intramedullary interlocking nail was introduced that provided both rotational stability and early weight bearing mobilization.^[9] Functional casting was a method of choice in earlier times where the fracture was undisplaced, and it allowed for early weight bearing to prevent non union and delayed union. Plating provides a rigid stability but it is not preferred as method of choice in tibia shaft fractures due to subcutaneous nature of tibia bone. Ender's nail is an unreamed intramedullary implant that is elastic in nature and can be bent according to the curvature of the bone and fracture pattern desired.^[4-7, 10] It is available in different sizes and diameters. We preferred ender's nailing as a definitive management for closed tibia fractures as it does not require opening up of the knee or ankle joint, thus maintaining the joint congruity. The procedure requires less operative time, has a relatively less learning curve, reduces fluoroscopic exposure, reduces blood loss, reduces infection rate, reduces the cost of surgery, reduces patient hospital stay and also reduces the antibiotic usage.^[11-13] In our study, we treated 150 adult patients who presented with a closed tibia shaft fracture within 12 hours of trauma. Our objective of lesser use of antibiotics, lesser cost of surgery and lesser hospitalization with a good stable fixation of fracture was achieved in this method. It is mentioned that early mobilizing the joint leads to synthesis of synovial fluid which helps in healing of the soft tissues and dynamization of fracture that naturally help in reparative process, which we were able to achieve in the procedure.

Materials and Methods:-

The study was done in Suvidha Hospital and Research Center Pvt. Ltd., Jabalpur, M.P. , India, which included sample size of 150 patients. The patients included were the ones who presented within 24 hours of trauma and were aged from 25 years to 65 years. Patients who presented with open compound fracture injuries, who were previously operated on the same bone for same fracture and patients who presented after 24 hours of injury were not included. After written and formal informed consent, medical fitness and the pre-anesthetic checkup, patients were shifted to the operating room and were given spinal anesthesia. One dose of intravenous antibiotic ceftriaxone was given pre-operatively and two doses post-operatively. Patients were positioned supine on a normal orthopedic table. Under fluoroscopic guidance, incision was made over the medial aspect of the tibia with a stab knife and blade (number 11) directly reaching the bone cortex. Following this an awl was passed under C-arm guidance into the shaft of tibia from medial aspect and entry for ender's nail was made. 4.5mm pre-measured ender's nail was passed through this entry and reduction of the fracture was confirmed with fluoroscopy. Similarly, a lateral entry over the lateral tibial condyle was made and a pre-measured 4.5mm ender's nail was passed and reduction confirmed under fluoroscopy. A stab incision for nail entry was made one inch proximal to medial malleolus under fluoroscopic guidance and awl passed to make the entry of nail which when locked, does not disturb the integrity ankle joint. All the three nails were locked with 2.7mm screw. A thorough wash done with betadine and suture were applied. Sterile dressing was done. Patellar Tendon weight Bearing (PTB) cast was applied. Patient was advised for a non weight bearing mobilization from next day. After two weeks, suture removal was done. PTB was continued and patient was advised for non-weight bearing mobilization with walker along with static quadriceps exercise and ankle pump exercises under physiotherapy guidance. Two weeks following this patients were reviewed and were evaluated. PTB cast was removed at six weeks following surgery and patient was advised to full weight bear mobilize with walker at three months following surgery under physiotherapy guidance. Gait training and muscle strengthening was taught and carried out by the patient at home. Followup x-rays were done at two weeks, one month, three months, six months and one year. Patients were evaluated by accessing the time of clinical union, time of radiological union and VAS scores.

Results:-

73.33% (110 patients) were aged 35 years and above and mean age of the sample size patients was 43.63 years (range of 25 years to 65 years). 70% (105 patients) were male gender and 30% (45 patients) were female gender. Proximal third shaft tibia was involved in 33.33% (50 patients), 50.66% (76 patients) had mid-shaft tibia fracture and 16% (24 patients) sustained a distal third shaft tibia fracture. The mode of trauma in all the patients was road side accident. Total surgical time was averaged to 27.6 minutes. A minimum of three ender's nail were implanted in all the patients. 23.33% (35 patients) had four ender's nail implanted due to younger age and wide intramedullary space. 6.66% (10 patients) had a delayed union with a union time of 12.3 weeks. Two patients developed superficial suture site infection which was managed with oral antibiotics for 5 days according to culture sensitivity report. One patient had a re-trauma at nine weeks following surgery that led to implant breakage and was managed surgically by implant removal and re-implant insertion. A plain radiograph was done on every review to assess for clinical and radiological union up-til one year. In 73.33% (110 patients), radiological union was seen at 12 weeks.

Discussion:-

The history dates around 16 years back when the start of ender's nailing was introduced for management of tibia shaft fractures.^[14] Initially due to a newer technique and lack of expertise there were rotational and bending deformities, along with were associated some complications of delayed union and non-union. As the technique advanced, the results started to show a good achievement and were quite satisfactory.^[5,7,8,10] There are many studies that illuminate the use of ender's nailing as a definitive management in adult tibia shaft fractures. The studies have also shown use of multiple entry points and use of multiple nails, both proximal and distal for different level of fracture of tibia shaft. The use of three nail technique in our study group enhanced the fixation of tibia shaft fracture, creating a stable X-shaped geometry, dynamising starting from day one and a rigid stable fixation. It leads to a rigid three-point fixation.^[15] This procedure is advantageous as it leads to minimal periosteal stripping thus preserving the periosteum and its blood supply.^[2] There are many advantages of this procedure such as, it required very less C-arm exposure, maintained the joint integrity, low cost of the implant, lesser hospital stay for the patient and hence lesser cost of the procedure, lesser use of antibiotics and most importantly the dynamization started from day one as the patient bends his knee and ankle.^[2,9,16]

The indications can be enlisted as a definitive procedure in adult tibia shaft fractures. In the locking ends or the distal ends, 2.7mm screws are used that gave dual advantage; firstly, they prevent the rotational element that can cause instability and, secondly, the nail eye was easier to locate when the nail removal was done at a later date.^[1,5,9,10] This procedure was found to be of a great help in patients who required a long term management with casts or slab and prolonged immobilization. It is not wrong to mention that there are other surgical and conservative methods to achieve a good union in transverse or long oblique type of fracture pattern, this procedure proved to be superior in aspects of minimal costing, minimal fluoroscopic exposure and ease of learning curve.^[1,3] Using a plaster cast for prolonged duration till the union of bone would lead to development of skin infections, joint contractures and patient depression, specially in adult population.^[8] This surgical procedure is a good indication in transverse or oblique fracture pattern of tibia shaft.

Since the ender's nail is a flexible nail, the fixation with ender's nail can be considered in two concepts. First concept, is by stacking or filling of the medullary canal enough so as to not cause distraction at the fracture ends, the fixation is considered as a solid fixation and the early weight bearing can be started. Second concept, states that the fixation is not solid but merely holding the fragments in place and aligning them to each other so as the healing starts to take place in a natural manner and weight bearing mobilization is delayed.^[5,9,12] It is considered as a semi-conservative method of treatment of tibia. The use of 2.7mm screws also prevented the slipping and migration of the nails in the shaft of tibia and also achieved the goal of dynamization of the fracture from day one of surgery. The use of a PTB cast helped as an external stabilization method that provided an additional support for mobilization and fracture healing.^[4]

In recent times there has been a boom in the use of ender's nailing as it is a faster, cost-effective and stable fixation method which has been seen to be advantage in faster fracture healing.^[1,3] We can say that ender's nailing procedure is a flexible stable fixation method for bone union. Using ender's nail there is a balance between the physiological tension at the fracture ends of bone and a mutual strain between the ender's nail inserted, the dynamization of the fracture starts at day one, when the patient starts to actively flex the knee and ankle, also the micro-movements at the fracture site cause reactive callus formation that aids in fracture healing and successful union of bone.^[4,7,10]

Küntscher described the principle of union by K-nail as stronger fixation leads to better callus formation and faster ossification at the fracture ends when immobilized. Using a thick k-nail, produces an element of rotational instability which was later manged b y using of screws in upper and lower end of the nail.^[1,8] We demonstrated the use of unreamed ender's nailing with a distal locking screw that did stabilize the bone in its rotational element also. Unreaming also proved to be advantageous as the medullary canal osteophytes did not get disturbed and hence the fracture hematoma was preserved which again enhanced the callus formation and healing of the bone.^[10] in the study we managed 150 patients and concluded that there is a low complication and a high level of satisfactory outcome. The patient was able to mobilize from day one of surgery and the overall procedural cost was reduced as there was no exposure of the joint and patient was able to return to activities of daily living.

The limitation of our procedure was that the surgery was performed by two different orthopedic surgeons in the same setup that could cause a bias due to the experience of the surgeons.

Concluding the discussion, our study interprets our method to be a much more effective, stable fixation method that has a low cost, lesser damage to the underlying soft tissues, having a lesser learning curve and a good functional outcome with a lesser complication rate.

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