

RETROSPECTIVE COHORT STUDY OF FUNCTIONAL OUTCOME OF FRACTURE OF SHAFT OF TIBIA TREATED WITH TIBIAL INTRAMEDULLARY NAILING UNDER FIGURE OF FOUR TECHNIQUES FOR 10 YEARS

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ABSTRACT

BACKGROUND

Intramedullary nailing became a standard modality of treating fractures shaft of tibia. Inserting nail by usual technique poses difficulty to surgeons for correcting rotational instability, so in this study our aim is to insert nail in freehand *Figure of Four* technique, which is easier for the surgeon to correct rotational instability and for intra operative imaging.

MATERIALS AND METHODS

This study was carried out at department of orthopaedics, Aarupadai Veedu Medical College and Hospital, Puducherry. Subjects included in this study were patients who approached our department with fracture shaft of tibia and were treated with free hand *Figure of Four* technique. This study was carried from January 2008 to September 2016. Inclusion criteria is Fracture middle and distal 1/3rd shaft of tibia (closed and compound fracture until Gustilo and Anderson classification grade II). Exclusion criteria are <Age 17 yrs. and >60 yrs., associated fracture in tibial condyle and proximal 1/3rd of shaft of tibia, patient lost for follow-up, pathological fracture, terminally ill patient. Data will be collected based on patients coming to outpatient department and records from medical records department. Results were assessed by Johner and Wruh's criteria, which evaluated pseudoarthrosis, osteitis, amputation, neurovascular disturbance, deformity in frontal plane, deformity in sagittal plane, rotational deformity, shortening of limb, knee and ankle mobility, pain, gait and heavy activity.

RESULTS

Results were assessed by Johner and Wruh's criteria.

CONCLUSION

Intramedullary nailing for shaft of tibia fracture by freehand *Figure of Four* technique is easier for surgeon in correcting rotational instability and varus and valgus deformity of the limb and for intra operative imaging and this technique doesn't pose any new risk compared to other technique.

KEYWORDS

Intramedullary Nailing, Figure of Four, Distal 1/3rd Shaft of Tibia, Johner and Wruh's Criteria, Rotational Instability, Varus and Valgus Deformity Correction.

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BACKGROUND

During Second World War intramedullary nailing method was introduced by Gerhard Kuntsher, which made soldier

recovery fast and resume their duties early. Kuntsher invented this technique during Second World War in 1939 and used it on soldiers but it was not recognized by other surgeons.¹ Post-world war his technique was accepted by others and is still used with some modifications. Intramedullary nailing became a standard modality of treating shaft fractures of tibia and femur. During early period, nail was inserted in tibial shaft fracture by making patient lie in supine position and applying traction using calcaneal pin or foot holder with hip and knee joints in flexion on the traction table.² Later traction using calcaneal pin and foot holder was omitted from this technique and traction was given by the assistant surgeon by hanging the

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limb at the edge of table.³ This technique was soon abandoned because of its toughness, difficulty in using intraoperative radiography, and maintaining asepsis during the procedure. This problem was overcome by using radiolucent operative table with knee flexed over the padded bar or radiolucent triangle which results in getting limb in near vertical position and traction can be easily given by just pulling the distal end of the limb.⁴

But some studies i.e. Tischenitto and G.J. Goodman, MOED and Strom support against traction as it leads to compartment syndrome.^{5,6} Some surgeons support supra-patellar, intra-articular approach, but generates higher contact pressures in the patella-femoral joint as compared to infra-patellar approach.⁷ Most common complaint after this procedure was knee pain^{8,9,10,11} which was due to the transection of the infra-patellar branch of saphenous nerve with vertical incision. So some surgeons suggest this could be avoided by horizontal incision. Many studies were carried out and new methods were added to overcome the demerits of this technique i.e. positioning, incision line, approach and traction.^{12,13} We here studied functional outcome of fracture shaft of tibia treated with intra medullary nailing by using freehand *Figure of Four* technique.¹⁴

Aim of the Study

To determine the functional outcome of tibia treated with intra-medullary nailing by free hand figure of four technique with follow-up until union or less than 9 months (whichever is earlier).

MATERIALS AND METHODS

This study was carried out at department of orthopaedics Aarupadai Veedu medical college and hospital, Puducherry. Subjects included in this study were patients who approached to our department with fracture shaft of tibia and were treated with free hand figure of four technique. This study was carried from January 2008 to September 2016. The inclusion and exclusion criteria framed are mentioned below.

Inclusion Criteria

1. Fracture middle and distal 1/3rd shaft of tibia (closed and compound fracture until Gustilo and Anderson classification grade II).

Exclusion criteria:

1. <Age 17 yrs. and >60 yrs.
2. Associated fracture in tibial condyle and proximal 1/3rd tibial shaft.
3. Patient lost to follow-up.
4. Pathological fracture.
5. Terminally ill patient.

Surgical Method

Under spinal anaesthesia, patient in supine position, with tourniquet application to lower limb and aseptic precaution, part are painted and draped. Incision made on tibial tuberosity and bone accessed layer by layer, using bone

awl entry point made and medullary canal of tibia reached. The leg is then placed in position in figure of four with respect to thigh by assistant.¹⁵ Closed manipulation and reduction done under c-arm guidance, guide passed across fracture site, medullary canal reamed with flexible reamers serially and appropriate size nail is inserted with c-arm guidance. Locking screws applied, reduced bone with implant in situ checked in both lateral and AP view in c-arm.^{16,17,18,19} Wound is closed layer by layer. After complete hemostasis achieved and patient is shifted to ward.

Data will be collected based on patients coming to outpatient department and records from medical records department on detailed patient evaluation with respect to history, clinical examination and radiological examination followed by details of surgery, pre-operative and post-operative complications and duration of follow up till union or 9 months of fracture whichever is earlier. Following information were recorded such as active range of movement of knee such as flexion and extension, abnormal mobility of fracture site, any varus or valgus deformity, ankle active range of motion, any shortening or lengthening of limb (limb length discrepancy), neurovascular evaluation, gait and fracture union were observed by taking radiography during follow up.

Result were assessed by Johner and Wruh's Criteria.²⁰ Which evaluates pseudoarthrosis, osteitis, amputation, neurovascular disturbance, deformity in frontal plane, deformity in sagittal plane, rotational deformity, shortening of limb, knee and ankle mobility, pain, gait and heavy activity.

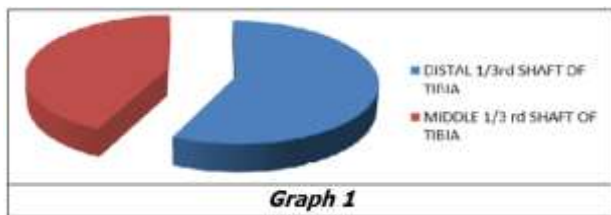
RESULTS

This study was conducted in Aarupadai Veedu Medical College and Hospital, Puducherry from January 2008 to September 2016 in Department of Orthopaedics with fracture shaft of tibia middle 1/3rd, distal 1/3rd and open communicated fracture shaft of tibia with 100 patients treated with Figure of Four Technique closed/open reduction and fixing with titanium nail.

Using this method for treating tibial shaft fracture, we achieved anatomical reduction and alignment by correcting varus and valgus tilt in all these cases. In these cases, one patient encountered common peroneal nerve injury due that he developed foot drop. We have not encountered any non-union, malunion, rotational instability, compartment syndrome and pseudoarthrosis. One patient had fat embolism syndrome which was treated in intensive care for 4 days and recovered well. Out of 100 patient 57 patients were distal end tibia fracture and 43 patients were middle 1/3rd tibia shaft fractures, 10 patients had comminuted open fracture and 90 patients had closed fracture of shaft of tibia. In 100 patients all achieved passive full range of motion in knee and ankle joint. According to Johner and Wruh's Criteria outcome are predicted as 38 as 38% excellent results, 49% good, 12% fair and 1% poor result.

Distal 1/3 rd Shaft of Tibia	57
Middle 1/3 rd Shaft of Tibia	43

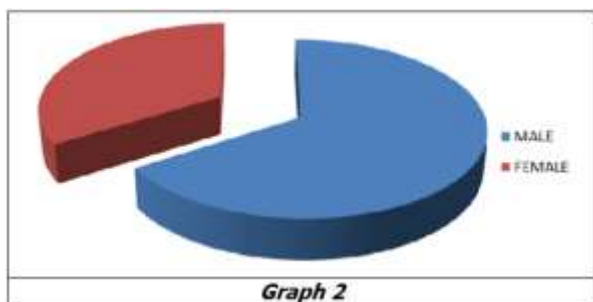
Table 1



Graph 1

Male	66
Female	34

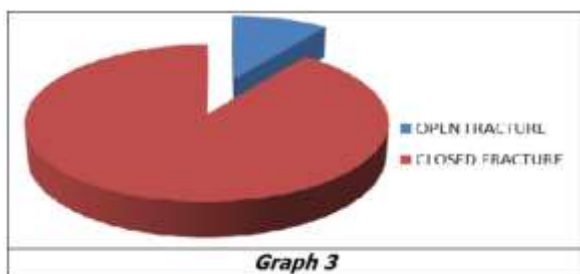
Table 2



Graph 2

Open Fracture	10
Closed Fracture	90

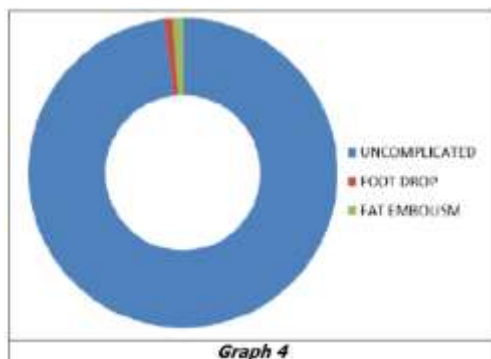
Table 3



Graph 3

Uncomplicated	98
Foot Drop	1
Fat Embolism	1

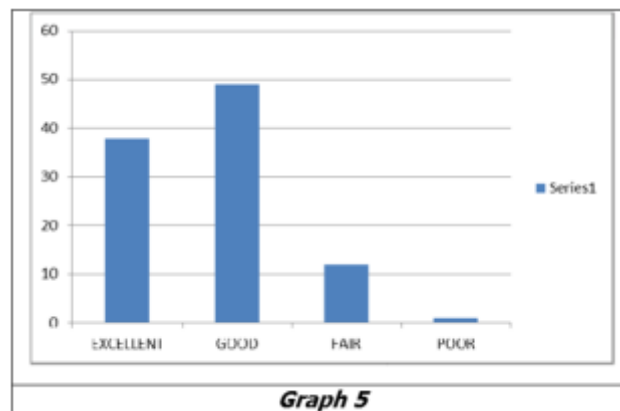
Table 4



Graph 4

Excellent	38
Good	49
Fair	12
Poor	1

Table 5



Graph 5

DISCUSSION

Treating distal end tibia fracture with intramedullary interlocking Nailing by hanging the knee in flexion and doing closed reduction by the surgeon in squatting posture using image intensifier is difficult. But using Figure of Four techniques it is very easy to reduce the distal end tibia fracture in standing posture itself.

While reducing the fracture the traction is been given in distal end of tibia by assistant and counter traction is been given by another assistant. The assistant who is giving traction in distal end tibia slightly external rotates the foot to correct varus deformity. In case of comminution we have opened the fracture site, and achieved reduction by manipulation.

We have done 90 cases in closed reduction and 10 cases by open reduction. In these 10 cases, one patient had Grade II compound fracture who obtained full union at 9 months.

Among these 100 cases all were evaluated according to Johner and Wruh's Criteria there is no evidence of non-union, varus or valgus deformity. There is no evidence of infection, Neurofibromatosis, or malunion and compartment syndrome. One case had foot drop due to proximal screw penetration, one patient had grade I compound fracture both bone leg. Post-surgery he developed fat embolism syndrome like picture and he was treated in intensive care unit. After 8 days he recovered fully from the fat embolism syndrome.



Figure 1



Figure 2



Figure 3



Figure 4



Figure 5



Figure 6

CONCLUSION

Figure of Four technique is a very good and surgeon friendly procedure to perform in cases of fracture both bones, distal one third fractures being treated with intramedullary and interlocking nailing for closed /open reduction with image intensifier. This Figure of Four technique prevents non-union and rotational instability and varus and valgus deformity. The fracture is reduced anatomically and stabilized with proper fixation. If there is no comminution, patient is allowed to be mobilized the very next day with full weight bearing as the fixation is more stable. This technique is mainly used to avoid soft tissue interposition and rotational instability.

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