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Functional outcome of rotational malalignment of tibia following closed intramedullary nail fixation

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Abstract

Background and Objective: Malrotation is defined as a tibia torsional difference of greater than 10° (range $5-15^\circ$) compared to the unaffected limb. Common complication associated with tibia nailing procedure is tibial malunion which may lead to gait (in toeing gait and other) abnormalities, mechanical pain and early secondary osteoarthritis. Our study is focus on the functional outcome of tibial malrotation post tibia nailing.

Material and Method: Progressive Cohort study Patients of K.R HOSPITAL going to undergo surgical treatment of fracture of diaphysis and metadiaphysis of tibia. A study population for our clinical study was 40 cases in the duration between Sep 2019 and Sep 2020. Postoperative tibial torsion is assessed by Thigh foot angle assessment and plumb line alignment of leg methods. 6months and 1 year follow up outcome assessed under lower extremity functional scoring.

Result: out of 40 cases 12 cases found to have malrotation under clinical method in post tvlosed ibia nailing. Incidence of 30 % (mean $=7.8^\circ$ SD $= +/- 5.2$) of malrotation more than 10° tibial torsion in our study under Thigh foot angle assessment. All the patient surgery conducted in figure 4 position. We did follow on 6 months and 1 year post surgery. Functional Assessment done conducted using lower extremity functional score found to have mean= 70 (SD= $+/-1.6$) in 6 month follow up and 69(SD= $+/-2.2$) 1year among malrotation tibial (torsion more than 10°) whereas 73 (SD $= +/-2.1$) in 6 month follow up and 72(SD= $+/-2.2$) in one year follow up in less than 10° tibial torsion. Tibial malrotation in distal 1/3 more compared to other level of tibia fracture with incidence 66 % (SD $= +/- 4.3$) with average lower extremity score is 70 in 6 months and 67(SD $= +/-1.6$) in 1 year follow up.

Conclusion: Our study show there is no significant change in functional outcome among the tibial malrotation and normal rotation alignment in post tibial nailing in 6 month and 1 year follow up. Our study suggests of need further long study for better understand in the functional outcome among the malrotation. There is significant decline in functional outcome among the malrotation of distal 1/3 fracture patients.

Keywords: Arthroscopy, MRI, knee injuries, ligament tear

Introduction

Fractures of the tibial diaphysis are the one of most common long bone fracture^[1].

Various methods of treatment of tibia fracture such as plate osteosynthesis, intramedullary nail system, and external fixators even can treat with cast immobilization^[1-5].

Often tibia nail is preferred for closed injuries and type 1 or 2 Gustilo Anderson classification mainly decided by the surgeon himself rather than no précised method or surgical technique available.

Tibial nail complication rate is very less but often un-noticed. Post tibia nailing there are complications can possible are anterior knee pain, non-union, infection, vascular injury, deep vein thrombosis, compartment syndrome, hardware breakage, and Malunion^[6].

Rotational Malalignment may leading to malunion includes various tibial deformities such as frontal plane deformities such as varus or valgus angulation, shortening, and rotational deformity^[6]. Tibial torsion is defined by the anatomical twist of the proximal versus distal articulated axis of the tribal bone in the tibial bone in the transverse plane around the longitudinal axis. Any change in tibial torsion, either can be internal or in the external direction, is considered to be malrotation.

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Rotational malreduction is defined as a torsional difference of greater than 10° (range $5-15^\circ$) compared to the unaffected limb [2].

Limited studies shown tibia mal-alignment with poor functional outcomes. Still may leads into gait (in toeing gait and other) abnormalities, mechanical pain and early secondary osteoarthritis [6].

Clinical assessment can be done by thigh foot angle and transmalleolar axis and plumb line alignment.

Tibia is present between two hinge joints, knee and ankle, which not allow adjustment for rotatory deformity after a fracture. Rotational alignment correction plays a key factor in the outcome of the surgery. Hence special attention should be taken while treating tibial fracture. The goal of treatment of tibia is to attain rapid union with acceptable axial and rotational alignment, while initial bone length is preserved.

CT based assessment is the gold standard for assessment rotational Malalignment [8]. Because other mode assessment of tibial torsion like clinical method of has shown high intra-observer variability and low reliability compare to CT mode of assessment.⁸ CT method shown more accurate and précised value compared to other method [8].

But CT method of assessment is difficult because of cost and unavailability during intraoperative resulting into yield in more cases of malrotation. So still clinical method is used in daily bases.

Various methods of assessment of the functional outcome are present commonly used are Johner and Wrush's criteria, Lower extremity functional scoring system (LEFS), Olerud – Molander ankle scoring and Tegner Lysholam knee scoring scale. Lower extremity functional scoring system (LEFS) defined by Theriault *et al* scoring system is more commonly used because of its practical reason, is validated and addresses extensively all the daily activities a patient may face [9].

Method

Progressive Cohort study Patients of our hospital going to undergo surgical treatment for fracture of diaphysis and metadiaphysis of tibia. A proposed clinical study of 40 cases in the duration between Sep 2019 and Sep 2020. All patients selected would be examined according to protocol, clinical and laboratory investigations carried out to get surgical fitness.

Inclusion Criteria

All patients with fractures of tibial diaphysis and metadiaphysis that were Undergo reamed intramedullary nail fixation

Exclusion Criteria

1. Any current or prior fracture of the contralateral tibia,
2. Fractures that extended into the ipsilateral knee or ankle joint.
3. Segmented tibial fracture.

Thigh foot angle assessment done by Patient placed in prone position with both the leg hanging free from the bed from the level of knee, Knee is flexed 90 degree off bed, Femur axis is line along length of thigh, Ankle in neutral Foot axis is line from heel through 3rd web space. Angle between Thigh and foot axis gives the thigh foot angle. We used Goniometer instrument to measure angle between thigh and foot axis.

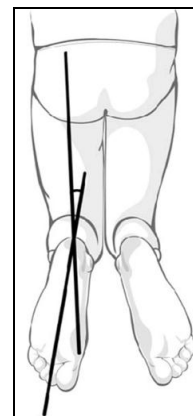


Fig 1: Ref. 14

Plumb line assessment of leg by drop a plumb line from the tibial tuberosity through the foot. This line normally passes through the second or between the second and third metatarsal's. If it falls medial to that it is external tibial torsion and lateral to that most likely internal tibial torsion.

After measuring the torsion we continued follow up till 6 months and 1 year functional outcome assessed under Lower extremity function scoring (LEFS).

Result

Out of 40 cases 12 cases found to have malrotation under clinical method in post tibia nailing. Proximal 1/3 incidence 3 cases, middle 1/3 is 6 cases and distal 1/3 is 3 cases got malrotation under thigh foot angle assessment. Incidence of 30 % (mean = 7.8° SD = ± 5.2) of malrotation more than 10° tibial torsion in our study under thigh foot angle assessment. In plumb line alignment assessment is just 10% for tibial malrotation. All the patient surgery conducted in figure 4 position. We did follow on 6 months and 1 year post surgery. Assessment done conducted using lower extremity functional score found to have mean= 70 (SD= ± 1.6) in 6 month follow up and 69(SD= ± 2.2) 1year follow up among malrotation tibial (torsion more than 10°) whereas 73 (SD = ± 2.1) in 6 month follow up and 72(SD= ± 2.2) in one year follow up in less than 10° tibial torsion. Tibial malrotation in distal 1/3 more compared to other level of tibia fracture with incidence 66 % (SD = ± 4.3) with average lower extremity score is 70 in 6 months and 67(SD = ± 1.6) in 1 year follow up.

Table 1

Malrotation	TFA	Plumb line
$>10^\circ$	12	4
$<10^\circ$	28	36

Table 2

Malrotation ($>10^\circ$)	
Prox 1/3	3
Mid 1/3	6
Distal 1/3	3
Total	12(30 %)

Table 3: LEFS

LEFS	6 month	12 month
$>10^\circ$	Mean= 70 (SD= ± 1.6)	Mean=69(SD= ± 2.2)
$<10^\circ$	Mean=73 (SD = ± 2.1)	Mean=72(SD= ± 2.2)

Table 4

LEFS(>10 ⁰)	6 month	12 month
Prox 1/3	69	69
Mid 1/3	72	70
Distal 1/3	70	67

Discussion

Tibia fracture is most common fracture we come across in emergency room. Most of cases commonly are treated surgically with tibia intramedullary device. Often rotational mal-alignment is un-detected by surgeon during surgery, because of sign of tibial malrotation are very subtle.

Most commonly used for assessment tibial rotational Malalignment is plumb line alignment but Sample size n>60 study show incidence of malrotation only 0.7% in most of the study assessment done by using plumb line technique [8].

The assessment of tibial torsion with CT was first reported by

Jakob *et al* in 1980 [9]. They compared the results to other methods of measurement and exhibited accuracy similar to that of cadaveric skeletal measurement. A similar method was proposed by Jend *et al* in 1981 [10].

Various method advocated for assessment for tibial malrotation including thigh foot angle (more than 10⁰), transmalleolar axis >15⁰, foot progression angle -5⁰ to 20⁰ and plumbline leg assessment. Unfortunately, most of these methods have been deemed unreliable and not reproducible [11].

A method of intraoperative assessment using standard fluoroscopy has been extensively described by Clementz and Magnusson. Unfortunately, its practical use and reproducibility has not been confirmed in the current literatures [12].

Still CT method assessment is gold standard for assessment of Malrotation [8].

Table 5: Ref 8

Study	N	Study Design	Malrotation	Parameter (°) Incidence (%)
Blachut <i>et al.</i>	154	Prospective	>15	0
Gregory and Sanders	142	Prospective	>10	0
Wiss and Stetson,	171	Prospective	>10	0
McKee <i>et al.</i>	84	Prospective	>10	0
Pintore <i>et al.</i>	61	Prospective	>15	0
Alho <i>et al.</i>	93	Retrospective	>15	2
Kyro <i>et al.</i>	64	Retrospective	>5	6
Total	801		>5 TO >15	0.7%

Incidence of 30 % (mean =7.8⁰ SD = +/- 5.2) of malrotation more than 10⁰ tibial torsion in our study under thigh foot angle assessment. In plumb line alignment assessment is just 10% for tibial malrotation. Both the method show significant higher number cases of Malalignment of malrotation.

LEFS score of our study suggest there is no significant difference among the malrotation and normal torsion in there functional outcome. Basically most of the cases don't affect normal day to day activity. But distal 1/3 fracture mal-alignment significant decline of functional activity.

Vishal S Patil in there study show At 6 months, the patients with tibial malrotation of >10⁰ found to have mean LEFS score of 63.68 which was less than patients with non-malrotation group with mean LEFS score 72.97. With significant impact in outcome of the patient [12].

Most of the study shows no significant decline of functional outcome in malrotation at least in our knowledge. But every limited study conducted on functional outcome in tibial malrotation. Study by Nikolaj Erin-Madsen *et al* on Knee pain and associated complications after intramedullary nailing of tibial shaft fracture which concluded that with a follow-up time of more than six years after receiving an IMN, patients in this study experienced more knee-specific symptoms, pain, limitations in sports and daily living than a reference population who had not undergone surgery. The study population also reported poorer quality of life outcomes than the reference population [13].

So need long term study to understand the functional outcome among tibial malrotation to draw conclusion. Also need practical standard methodology and reduction technique for tibial fracture to reduce the chance of tibial malrotation.

Conclusion

Tibial malrotation is most common malreduction among tibial fracture treated with intramedullary nail. Very limited study on functional outcome of tibial malrotation. Our study shows

no much of decline in functional outcome in tibial malrotation. Further research is required for develop methods of assessing and maintaining intraoperative rotational reduction and post fracture sequelae in the patients who suffer this tibial fracture.

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