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ORIGINAL ARTICLE

TREATMENT OF COMPLEX INJURIES OF PROXIMAL TIBIA BY ILIZAROV APPARATUS: A PROSPECTIVE STUDY

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ABSTRACT: **BACKGROUND:** The fractures of proximal tibia present complex problems for the treating surgeon. They are usually high velocity injuries and are associated with extensive soft tissue injuries apart from comminuted fractures. The main cause for these high energy injuries is RTA and fall from height also contributes to these injuries. In our study we chose to fix these complex fractures with the versatile Ilizarov apparatus. The results are quite gratifying and the complications are few. **MATERIALS & METHODS**: In our series we have included 12 patients who are treated with Ilizarov apparatus during the period Feb 2009 to June 2010, in Gandhi Hospital, a tertiary care hospital attached to Gandhi Medical College, Secunderabad. Out of these patients 11 are male and 1 female, and the age of the patients varied from 25-56, the commonest cause of these fractures in our series is RTA (11 out of 12 patients). Most of our patients are of Schaztker's type IV. **RESULTS:** The patients are evaluated using Knee Society Scoring system, Functional evaluation system and Rasmussen radiological criteria. Out of12 patients, 11 had excellent knee score and functional results. 1 patient had a fair knee score and poor functional results. **CONCLUSIONS:** TheIlizarov method in fixing the proximal tibial fractures which are often comminuted and are associated with extensive soft tissue injury scores over other types of fixation. The fractures united readily and the complications like infection and joint stiffness are less comparatively in this method. Our results are comparable to other studies in this regard.

KEYWORDS: Proximal tibial fractures, High velocity injury, Tension stress.

INTRODUCTION: High-energy proximal tibial fractures are difficult to treat, as they entail articular depression, condylar displacement, dissociation of comminuted metaphysis from diaphysis, and open wounds or extensive closed de-gloving injuries. Injury mechanisms involve a combination of axial loading and valgus forces. The outcome is usually poor with high rates of complications, such as wound problems, infections, varus collapse, knee stiffness, and articular malreduction. The treatment goals are to anatomically reconstruct the proximal tibial articular surface, restore limb axial alignment, and fix metadiaphyseal comminution to allow early knee mobilization and weight bearing, and minimize further morbidity to an already traumatized soft tissue envelope.

Whenever incisions are poorly placed and the dissection is extensive, open reduction and internal fixation using dual plating may compromise the soft tissue envelope and cause soft tissue necrosis and deep wound infections. Although such complications are salvageable with local or free flaps, knee function and movement remain limited. Minimally invasive techniques using periarticular fine wires allow rigid fixation of small pieces of cancellous bone and intra-articular fractures, easy wound surveillance, early joint mobilization and weight bearing, and minimal soft tissue disruption. We therefore evaluated the clinical results of high-energy tibial plateau fractures treated with a small wire external fixator.

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AIMS OF THE STUDY: This study of management of complex fractures of proximal tibia by Ilizarov ring fixation was conducted at the Department of Orthopaedics and Traumatology, Gandhi hospital, Secunderabad from January 2009 to November 2010.

The aims of the study are:

1. To classify the proximal tibial fractures as per Schatzker's classification and evaluate the results of surgical treatment with small wire ring fixation (Ilizarov).
2. To study the rate of union.
3. To study the post-operative complications such as infection, deformity/malunion.
4. To assess the knee function.

Principles of Ilizarov Fixation: The following principles of fracture treatment were formulated by Dr. Ilizarov [1] in his dissertation, which revolutionized the approach and treatment of fractures.

1. Preservation of the blood supply.
2. Preservation of the osteogenic tissue.
3. Complete anatomic reduction.
4. Stable fixation.

It was discovered by Dr. Ilizarov that limited elasticity type of fixation from the wires had a particular advantage that it generated more rapid callus formation and maturation. Research showed that restricted elasticity of tensioned wires activated the piezoelectric phenomena in the cells of bone marrow and compact bone and also in newly formed regenerate in cases of distraction osteogenesis. Electric currents in the cell can stimulate ion channels selectively.

Elastic micromotion stimulates the tissues and nerve impulses are activated. The nerve impulses control the passage of electrically charged ions through the cells activating these ion channels. The activation of the ion channels results in rapid cellular mitosis. The exact mechanism of the elastic micromotion-cellular development interaction is not known. Dr.Ilizarov termed it as the law of 'Tension Stress'.[2]

MATERIALS AND METHODS: A total of 12 cases of fractures of proximal end of tibia were treated with Ilizarov ring fixator between February 2009 and June 2010. Out of the 12 patients, 11 are male and 1 patient is female. Age of the patients ranges from 25years to 56 years. Average age of the study group is 43 years.

11 patients gave history of RTA and 1 patient gave history of fall from height.

All the patients are examined closely to find out the associated injuries and to evaluate the general condition. Two of them had multiple fractures. One patient had associated ipsilateral supra-condylar fracture of femur and transverse fracture of tibia L 1/3rd on the same side. The second patient had fracture of patella on opposite side and fracture of olecranon on the same side.

X-rays of leg including knee, anteroposterior and lateral views were taken for all cases. Anteroposterior radiographs were used to determine the extent of medial and lateral plateau involvement, whereas lateral radiographs were used to gauge the extent of posterior displacement of condyles, degree of articular comminution, and joint depression. Fracture patterns were classified according to Schatzker's staging system.

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Above knee slab was applied initially for all cases immediately after they attended to the casuality. Open fractures were immediately irrigated and debridedprior to definitive fixation.

All cases were treated with Ilizarov ring fixator, using olive wires to achieve reduction of the intra articular fractures. The rings of different sizes were mounted on to the leg of the patient pre operatively in the ward and the ring of minimum size with a clearance of two finger breadths from skin is considered for construction of the apparatus. The patient was positioned on a radiolucent operating table. Fine wires were placed through safe tissue corridor. Two rings were used one above and one below the fracture if the fracture was stable. Third ring was added distally if the fracture was severely comminuted or if there was a second fracture distally. We constructed the frame preoperatively for all the cases after carefully studying the radiographs to plan the level of the rings.

The rings are connected to each other by four connecting rods.

Isometric quadriceps exercise and hip raising exercises were started from postoperative day 1. Partial weight bearing was started after 1 week. Serial radiographs were taken at the intervals of 2 weeks. After radiographic healing, full weight bearing was started and 2 weeks later frame dynamisation was performed by loosening proximal and distal rings. Radiographic healing was defined as obliteration of the major fracture line in both views.

Patients were evaluated with the Knee Society Scoring system[3,4] and the Rasmussen radiological scoring system.[5]

OBSERVATIONS: Age incidence: Out of 12 patients, 1 patient is 25 yrs old, 2 patients belong to 20 -30 yrs age group, 5 patients 30-40 age group and 4 are above 50 yrs age. (Graph 1).

Sex Incidence: Out of 12 patients, 11 were Male and 1 Female. (Graph 2).

Side Incidence: Seven patients had injury to right leg and five patients had injury to left leg (Graph 3).

Closed/Open: Out of 12 cases 8 cases had closed fractures and 4 had open fractures. (Graph 4).

Mode of Injury: 11 patients suffered injuries in RTA and 1 patient had history of fall from height. (Graph 5).

RESULTS: The patients are evaluated using Knee Society Scoring system, Functional evaluation system and Rasmussen radiological criteria. Out of12 patients, 11 had excellent knee score and functional results. 1 patient had a fair knee score and poor functional result. (Table 1, 2, & 3, Graph 6).

Complications: 3 patients out 12 in our study developed pin tract infection, which subsided with local antibiotic dressings. Among these, 1 patient had recurrence of pin tract infection just at the time of planned removal of fixator. The fixator was removed and local antiseptic dressings were applied. No other complications were observed in any of the patients (Table 4).

DISCUSSION: Treatment of high-energy tibial plateau fractures remains controversial. Traction and cast bracing provides poor results. In 1988 De coster et al[6] reported 61% of good to excellent results following conservative management. Duparac and Ficat[7] got good to excellent results in 62% of the patients with conservative management. Apley[8] in 1979 reported 80% good results by traction mobilization methods.

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Functional results after internal fixation were reported to be superior to conservative management, but there was also an increase in the rate of complications. Burri et al[9] reported89% acceptable results of fractures treated by experienced surgeons with accurate reconstruction of articular surface, rigid external fixation and early mobilization.

Hybrid fixation using lateral open reduction and internal fixation combined with unilateral external fixation does not address medial condylar comminution, because of the larger diameter of half pins and poor purchase in metaphyseal bone. Limited internal fixation or lateral open reduction and internal fixation alone incompletely address the meta-diaphyseal dissociation, resulting in collapse beneath the unsupported plateau. Knee spanning external fixation does not allow early range of movement, impairingarticular fracture healing. Less-invasive stabilisation systems confer a higher risk of implant-associated pain than conventional plates.

Closed reduction or limited open reduction using small tensioned wires prevents further iatrogenic soft tissue injury and minimises additional devitalisation of the bone and periosteal and endosteal blood supply. It offers superior juxta-articular, metaphyseal purchase, fixes small cancellous osteoporotic fracture fragments, and allows for early range of movement and weight bearing. This reduces hospital stays and costs. The olive wire provides superior reduction and inter-fragmentary compression of metaphyseal fracture components and facilitates fine adjustment ofrotational deformity.

In the present study, 12 cases of proximal tibial fractures are treated by Ilizarov ring fixation and evaluated for clinical and functional results.

Age of the patients ranges from 25 years to 56 years, the average age being 43. 3 years. The fractures were classified according to the Schatzker's classification. One patient had type IV fracture, two had type V and nine patients had type VI fractures of the proximal tibia.

Case 1 had associated fractures in other limbs (Fig. 1) and case 12 (Fig. 2) had fracture of ipsilateral femur and segmental fracture of the tibia. Four out of the twelve patients had open fractures, which were thoroughly washed and debrided immediately after admission. Five patients with closed fractures had gross swelling of the knee and leg initially.

Post operatively knee joint mobilization was encouraged from the first day onwards. All the patients were advised partial weight bearing in the first week post operatively, as early as the pain permits. Full weight bearing was started from 4 weeks to 12 weeks, at an average time of 10. 66 weeks.

Initially in our study full weight bearing was started after 4 weeks for case 1 and after 8 weeks for case 2. The knee radiographs of case 1 at 12 weeks showed displacement metaphyseal bone fragments without any deformity of leg clinically. Both the patients had pain and swelling on full weight bearing. Later for other cases full weight bearing was advised after 12 weeks. This produced little pain or swelling if any. So we continued it for the remaining cases.

The follow up period of the cases is 6 months to 21 months, average follow up of the study group being 13. 25 months.

The time period for radiological union of the fracture varied from 10 to 17 weeks. The average time of radiological fracture healing is 13. 6 weeks.

The knee flexion ranges from 30^0 to 140^0. 11 patients out of 12 had knee flexion of 100^0 or more. Only one patient had knee flexion of 30^0. The average knee flexion of the study group is 111. 25^0.

All the patients are evaluated using Knee Society Scoring system and Rasmussen radiological criteria. 11 patients had excellent knee score and functional score. Only one patient had poor knee

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score and functional results. This patient had segmental fracture of same tibia fixed in the same ilizarov frame and fracture of ipsilateral femur shaft fixed with interlocking nail. The mean knee score is 91.4 (range 56 - 100) and the mean functional score is 91.25(55 to 100). The mean Rasmussen radiologic score is 14. 8 (10 to 18), excellent in 3, good in 8 and fair in 1 case.

Only 3 patients had superficial pin site infection which subsided with conservative management. No other complications related to either fracture or Ilizarov ring fixator were reported.

Kumar and Anant[10] in their retrospective study of fifty-seven complex (Schatzker Type VI) fractures of the tibial plateau treated with circular wire external fixation reportedan average knee score of eighty-three and an average functional score of sixty-nine in 45 fractures with anatomic reduction and the average knee score was fifty-two, and the functional score was nineteen in 9 fractures with non-anatomic reduction. All fractures united at an average of 173 days (range, 50 to 415 days). Follow-up ranged from 16 to 90 months and averaged 42 months.

H. Kataria and N. sharma[11] in their study of 38 cases of high energy tibial plateau fractures treated with small wire external fixation reported excellent functional results in 19 patients, good in 17 and fair in 2. The mean Rasmussen radiological score is 14(range 10-18), excellent in 6, good in 26 and fair in 6. The mean range of knee movement was 132^0. Average age of the study group is 32 years (range 21-60). 22 patients had type VI and 16 had type V schatzker's tibial plateau fractures. 34 fractures were closed and 4 were open. Complications reported were2 superficial infections, 3 pin site infections and 4 peroneal nerve palsies.

Our study of 12 patients with average age 43 years including 1 schatzker's type IV, 2 type V and 9 type VI fractures showed a mean knee range of motion 111^0. Functional results are excellent in 11 patients and mean Rasmussen radiological score is 14.8. The results of our study appear to be better than other studies. But the number of patients in our study is small and a large number of patients is necessary to make a better comparison of results with other studies.

CONCLUSION: Ilizarov external fixation gives excellent clinical and functional results in the management of complex proximal tibial fractures. With the use of Olive wires it is possible to achieve satisfactory reduction and inter fragmentary compression of intra articular fractures of proximal tibia without soft tissue dissection.

The incidence of complications including deep postoperative infection after Ilizarov ring fixation is less when compared with internal fixation.

It allows early rehabilitation of the knee joint and thereby results in a knee with good range of movement.

Ilizarov external fixation is a promising alternative in the management of complex proximal tibial fractures with results comparable to internal fixation with a low rate of complications, resulting in early bone union, early restoration of joint function.

REFERENCES:

1. S. Robert Rozbruch, Svetlana Ilizarov. Limb lengthening And Reconstruction, 2007, Informa Health care, pg 9.
2. Ilizarov G A: The tension stress effect on the genesis and growth of tissues: I: The influence of stability of fixation and soft tissue preservation. Clin Orthop 238:249-280,1989
3. S. Terry Canale, James H. Beaty. Campbell's Operative Orthopaedics, 11th edition, 2008. pg 258-259.

4. Insall JN, Dorr LD, Scott RD, et al. Rationale of the Knee Society clinical rating system. Clin Orthop 1989(Nov); 248:13-14.
5. Poul s. Rasmussen. Tibial condylar fractures: impairment of knee joint stability as an indication for surgical treatment. Jbone joint surg am. 1973; 55: 1331-1350.
6. De Coster TA, Nepola JV, El Khoury GY. Cast Brace treatment of proximal tibia fracture: A ten-year follow-up. ClinOrthop 1988; 231: 196-204.
7. Duparac, Ficat. Volume 2; Fracture of the tibial plateau in Insall: Surgery of the knee: Second edition, New York, Churchill Livingstone, 1993; 1047. 9.
8. Apley AG. Fracture of the tibial plateau. OCNA 1979; 10: 61.
9. Burri C, Bartzle G, Coldway J. Fractures of the tibial plateau. Clin Orthop 1979; 138:84-93.
10. Kumar, Anant; Whittle, A. Paige, Treatment of Complex (Schatzker Type VI) Fractures of the Tibial Plateau with Circular Wire External Fixation: Retrospective Case Review, Journal of Orthopaedic Trauma: June/July 2000 - Volume 14 - Issue 5 - pp 339-344.
11. H Kataria, N Sharma, RK Kanojia. Small wire external fixation for high-energy tibial plateau fractures. Journal of Orthopaedic Surgery2007; 15 (2):137-43.

Sl. No.	Knee score	No. of cases	% of cases
1	Excellent	11	92%
2	Good	0	0%
3	Fair	0	0%
4	Poor	1	8%

Table 1

Sl. No.	Functional score	No. of cases	% of cases
1	Excellent	11	92%
2	Good	0	0%
3	Fair	0	0%
4	Poor	1	8%

Table 2

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Sl. No.	Radiological score	No. of cases	% of cases
1	Excellent	3	25%
2	Good	8	67%
3	Fair	1	8%
4	poor	0	0%

Table 3

Sl. No.	Complication	No. of cases	% of cases
1	Infection	3	25%
2	Neurovascular injury	0	0%
3	Contractures	0	0%
4	Device failure	0	0%
5	Malunion/nonunion	0	0%

Table 4

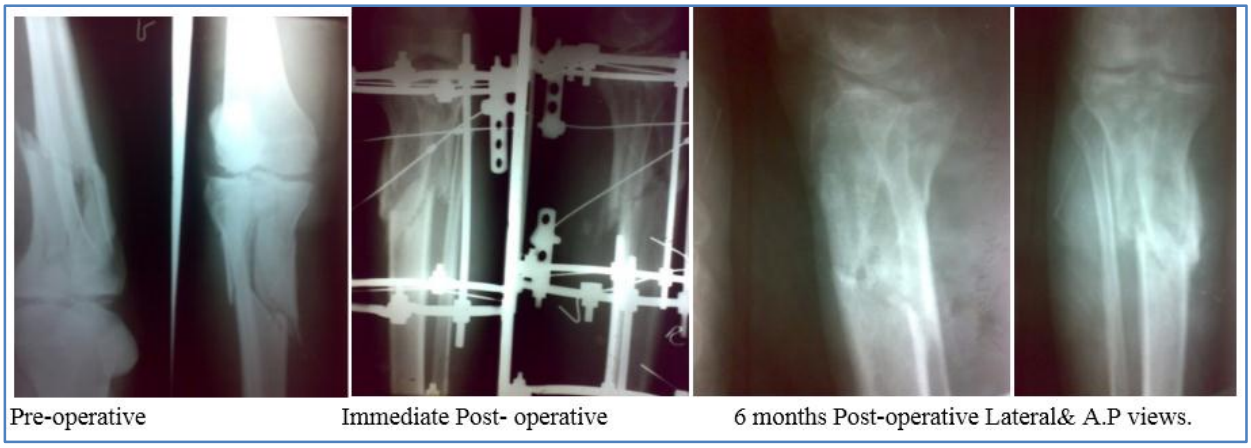

Figure 1

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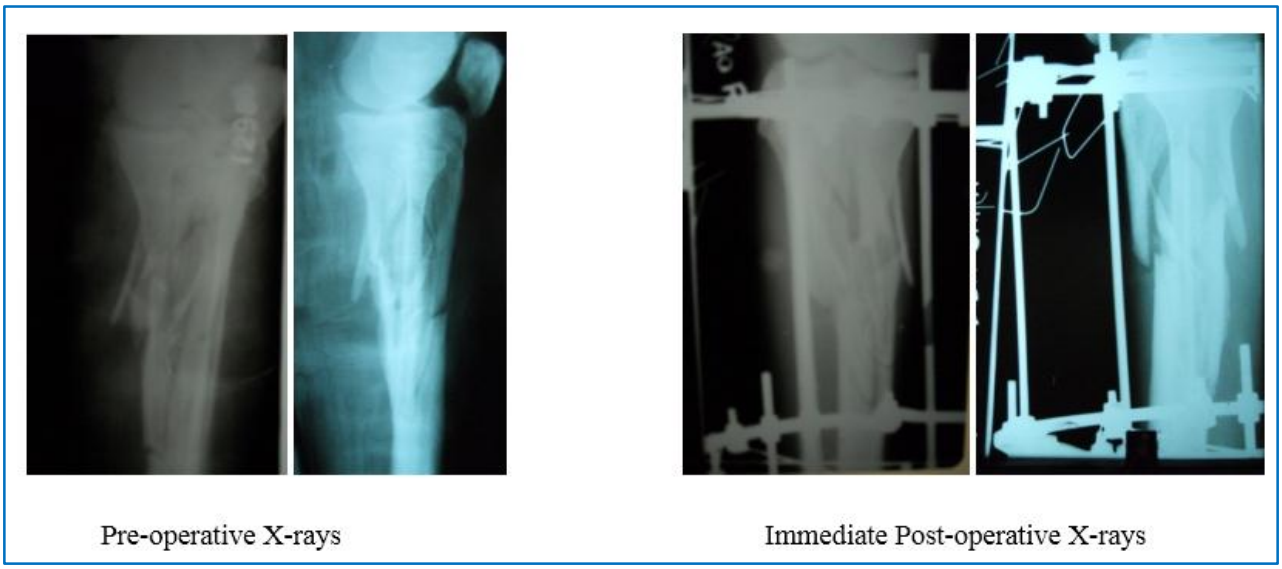
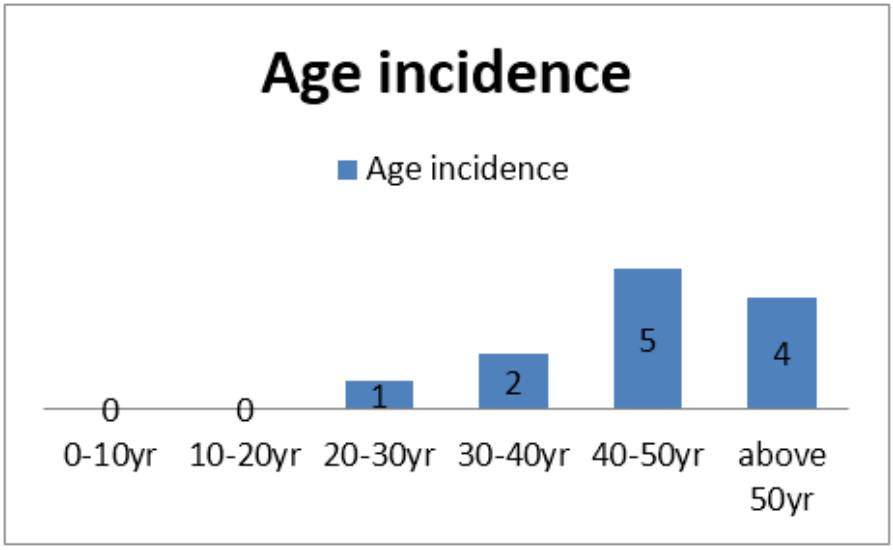


Figure 2



Graph 1

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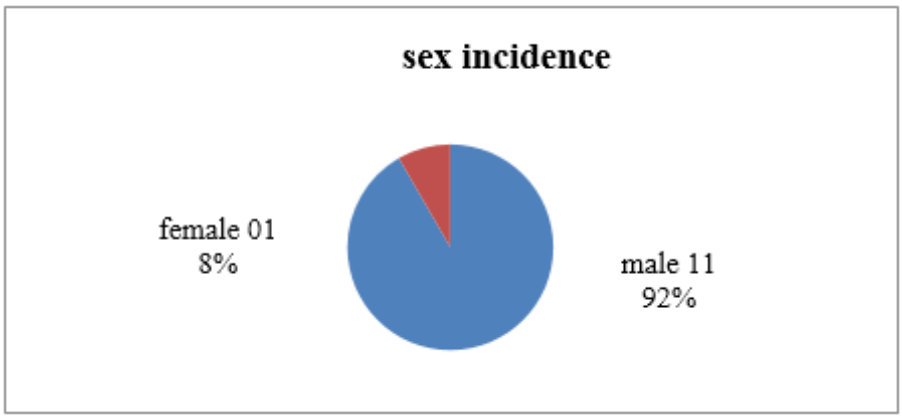

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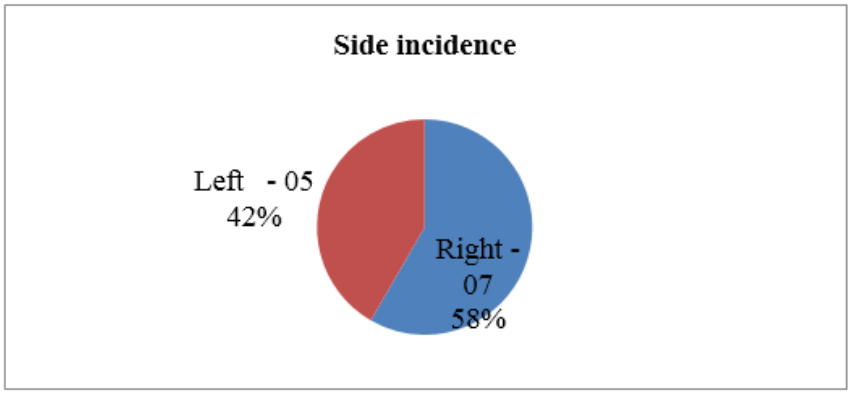
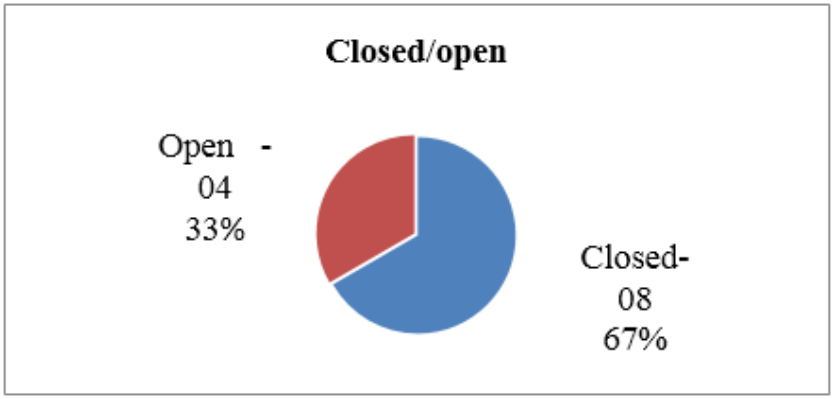


Graph 3



Graph 4

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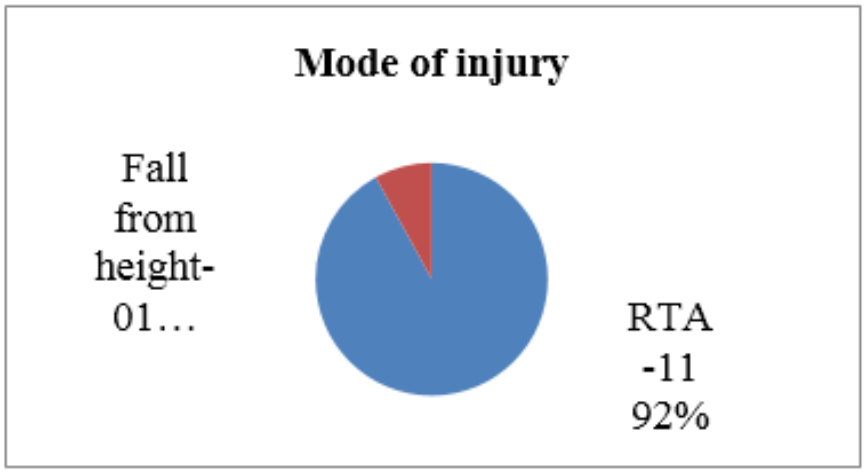
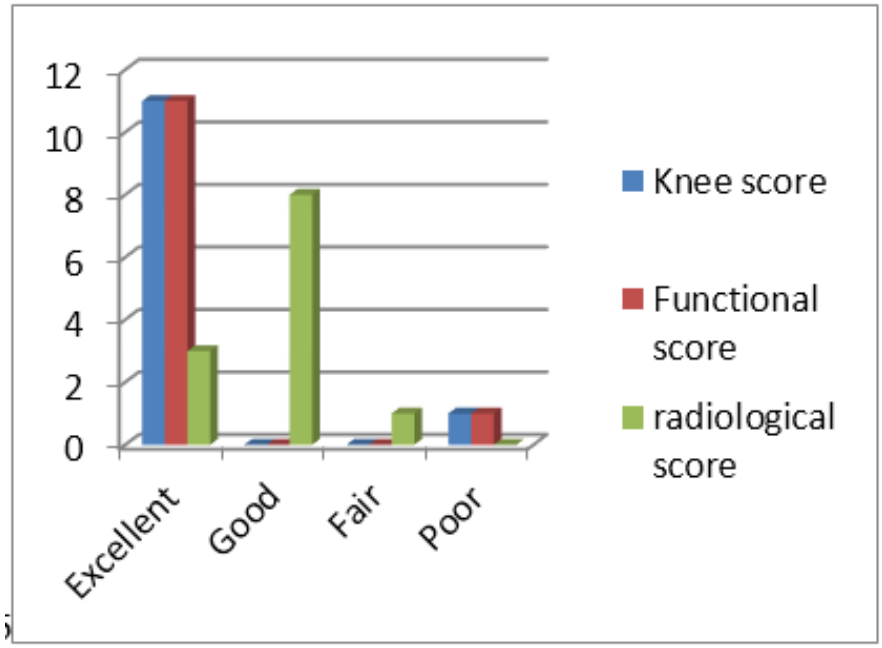


Graph 5



Graph 6

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