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RESEARCH ARTICLE

RESULTS OF OPERATIVE MANAGEMENT OF PAEDIATRIC FEMORAL DIAPHYSEAL FRACTURES WITH CLOSED REDUCTION AND TENS AT A TERTIARY CARE CENTRE, A PROSPECTIVE STUDY.

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Abstract

50 cases of fracture shaft of femur were managed by closed reduction with TENS at post graduate department of orthopaedics G.M.C Jammu between July 2013 to July 2015 Out of 50 cases 36 (72%) cases were male and 14(28%) female. These fractures were common in the age group between 9 to 12 years accounting for 26 cases (52%) who were involved in outdoor activities, sports and hence more prone to trauma. Right limb (60%) was more involved than left limb (40%), Road traffic accidents (80%) was the major cause of fracture shaft of femur followed by fall from height (20%), Middle third (76%) of shaft was mostly fractured followed by proximal third (20%) then lower third (4%), transverse fracture was the most common pattern of fracture (60%) followed by short oblique (24%) and short spiral type(16%). No patient develop superficial or deep infection at the surgical site.Total period of union took from 8 to 10 weeks, average time of union was 9weeks. It was also seen that 6 patients (12%) had limb length discrepancy of less than 2cm and 4 patients (8%) had angulation of less than 5 degrees and 6 patients (12%) had knee stiffness after TENS. Overall results based on Flynn et al criteria was excellent in 48 cases (96%) and good in 2 case (4%).

Introduction:-

Femoral shaft fracture is an incapacitating injury in children. The treatment has traditionally been age related, influenced by the type of injury, associated injuries and the location and type of fracture.

The aim of fracture treatment is not only anatomical realignment, but also restoration of muscle and joint function as close as possible to the normal. Psychological recovery is accelerated by early resumption of functional activity, which encourages healing of fracture, maintenance of normal circulation, preservation of tone of the muscles and restoration of the movements of the joints. The aim therefore is early mobilization by early use of the injured part without movement at the fracture site.

Because of rapid healing and spontaneous correction of angulations most of femoral shaft fractures in children younger than six years of age can be treated conservatively. Above six years of age all such fractures when treated non-operatively could have loss of reduction, malunion, intolerance and complication associated with plaster. Near the end of skeletal maturity accurate reduction is necessary as angular deformity is no longer correctable by growth.

In skeletally mature adolescents, use of an antegrade solid locked intramedullary nail has become the standard of treatment.

In patients between 6-16 years of age there has been a tendency towards operative approach. Titanium Elastic Nailing (TEN) which is variously known as elastic stable intramedullary nailing (ESIN), has become the choice of stabilization in pediatric long bone fractures, particularly the femoral shaft fracture. The present study is aimed at the evaluation of intramedullay fixation with TEN in children with femoral fractures. Previously skeletal traction and application of a cast was the preferred method of treatment of diaphyseal femoral fractures in children and young adolescent. The device would exploit a child's dense metaphyseal bone, rapid healing and ability to remodel without risking damage to the epiphysis or the blood supply to the capital femoral epiphysis. Titanium Elastic Nailing (TEN) also known as Elastic Stable Intramedullary Nailing (ESIN) is a biological, minimally invasive fracture treatment modality to achieve a level of reduction and stablization that is appropriate to the age of the child.

Aims and objectives:-

The aim of the study was to analyze the results of fixation of paediatric femoral shaft fractures with titanium elastic nails (TENS) and to study its complications.

Materials and methods:-

This prospective study was conducted in the post graduate department of Orthopaedics Government Medical College, Jammu during the period from 1st July 2013 to 31st July 2015. Both male and female patients in the age group of 5 to 15 years with length stable diapyseal femur fracture were included in this study.

Exclusion criteria:-

1. Compound fractures.
2. Unstable fractures (long oblique or spiral) and multifragmentary fractures.
3. Obese children (weight >50kg).

All the patients were initially assessed in the emergency section of GMC Jammu. They were given first aid in the form of analgesia, splint immobilization, and other resuscitation measures. After selection of the patients for surgery, patients were prepared for elective surgery to be conducted in the elective operation theatre.

Pre-operative evaluation:-

Pre-operative evaluation included detailed patient history. Every patient was evaluated for swelling, bruising & ecchymosis at the fracture site and visible deformity. A careful neurological and vascular examination of the involved limb was done. All the routine investigations like ECG, complete blood count & biochemistry were done. Radiographic evaluation by X-ray of the chest, X-ray-AP and lateral views of the femur including the hip and knee joints was done in every patient. Informed and written consent was taken from the patients

Follow up initially done every week and later on every 2 week and final assessment done at 24 weeks. The results were evaluated by Flynn et al's scoring criteria.

Flynn et al scoring criteria:-

	Excellent	Good	Poor
Limb length discrepancy	<1.0 cm	1-2cm	>2cm
Angulation	$<5^{O}$	$5\text{-}10^{O}$	$>10^{O}$
Pain	Absent	Present	Present
Complications	Absent	Mild	Major complication and or extended period for resolvable morbidity

Operative method:-

Pre operatively length of nail determined by measuring the minimal diameter of the diaphysis, then multiplying by 0.4 to get nail diameter. All surgeries were done under general anaesthesia. Thigh was shaved, hip and knee were cleaned with soap/savlon for 2 minutes and limb was draped in sterile sheet, prophylactic antibiotics were given half an hour prior to skin incision. The patients were positioned supine on a fracture table with C-arm on the opposite side. Incisions were made on the medial and lateral sides distal to the insertion site in the bone. The proximal end of the 2 to 3 cm incision were at or just distal to the level of the insertion site (2.5 to 3 cm proximal to the distal

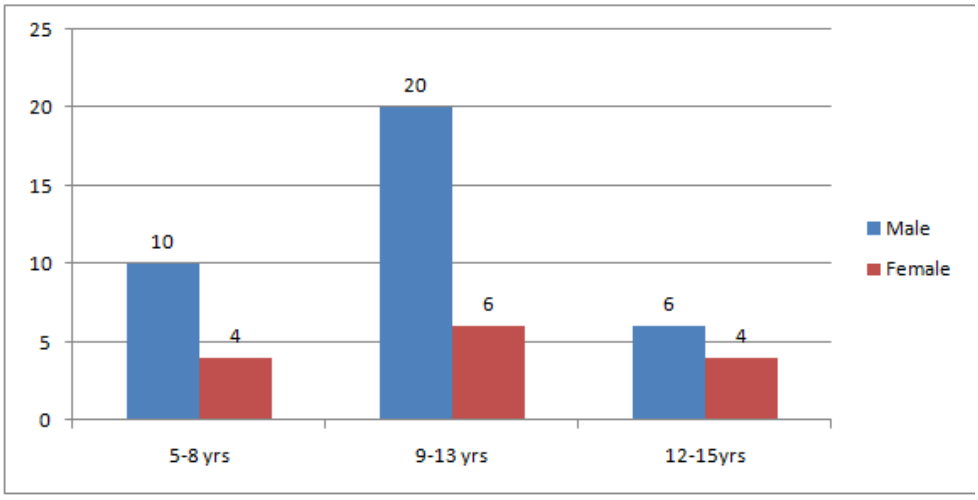
femoral physis). A 4.5-mm drill bit or awl was used to make a hole in the cortex of the bone. The distal femoral metaphysis was opened 2.5 cm proximal to the distal femoral physis using a drill or awl. The fracture was stabilized by two titanium elastic nails, each with three points of fixation.

Post operative management:-
A knee immobilizer was used to decrease knee pain and quadriceps spasm. Touchdown weight bearing was begun as soon as the patient was comfortable. Gentle knee exercises and quadriceps strengthening was begun immediately after the surgery. Full weight bearing generally was tolerated by 6 weeks.

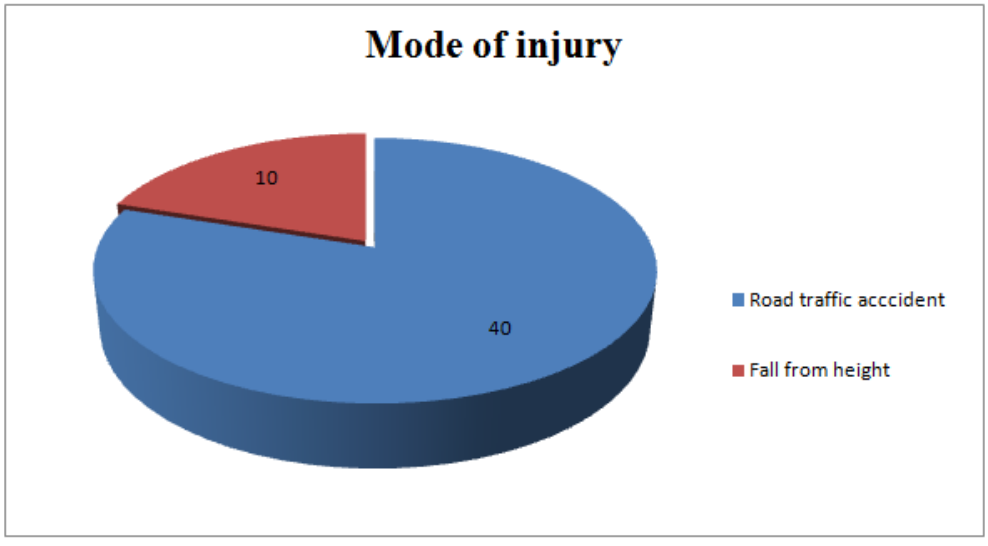
Follow up evaluation:-
The follow up in the post operative period was done at 2 weeks, 4 weeks 6 weeks, 8 weeks, 10 weeks, 12 weeks and 6 months. In each visit patient was assessed by clinical examination and radiological examination. Clinical examination included incision site (infection, dehiscence) severity of pain, swelling, tenderness, distal neurovascular status, and deep infection, range of motion, power of quadriceps muscles and fracture healing. Radiological examination included position of fragments, amount of callous, status of nail and any other complication.

Observation and Results:-

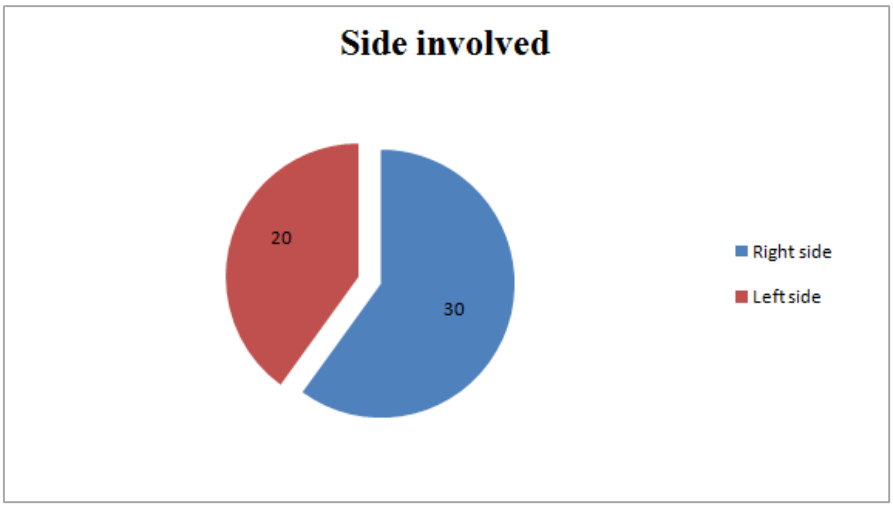
Distribution as per age and sex**:**



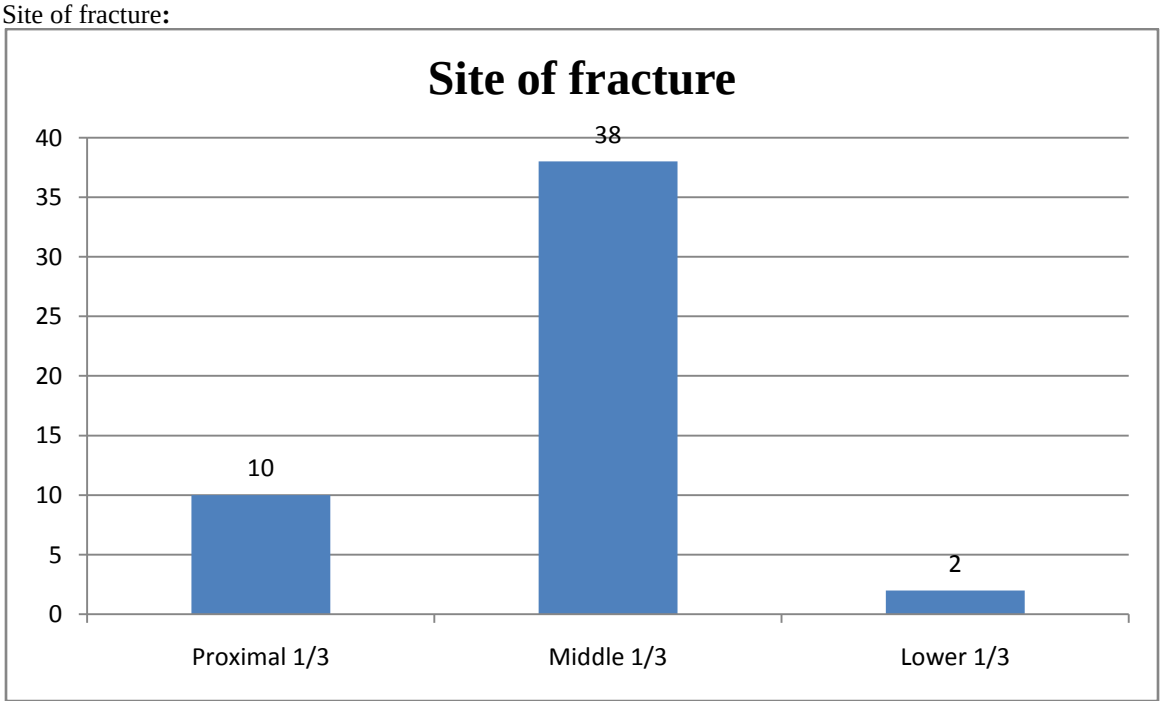
Mode of injury**:**



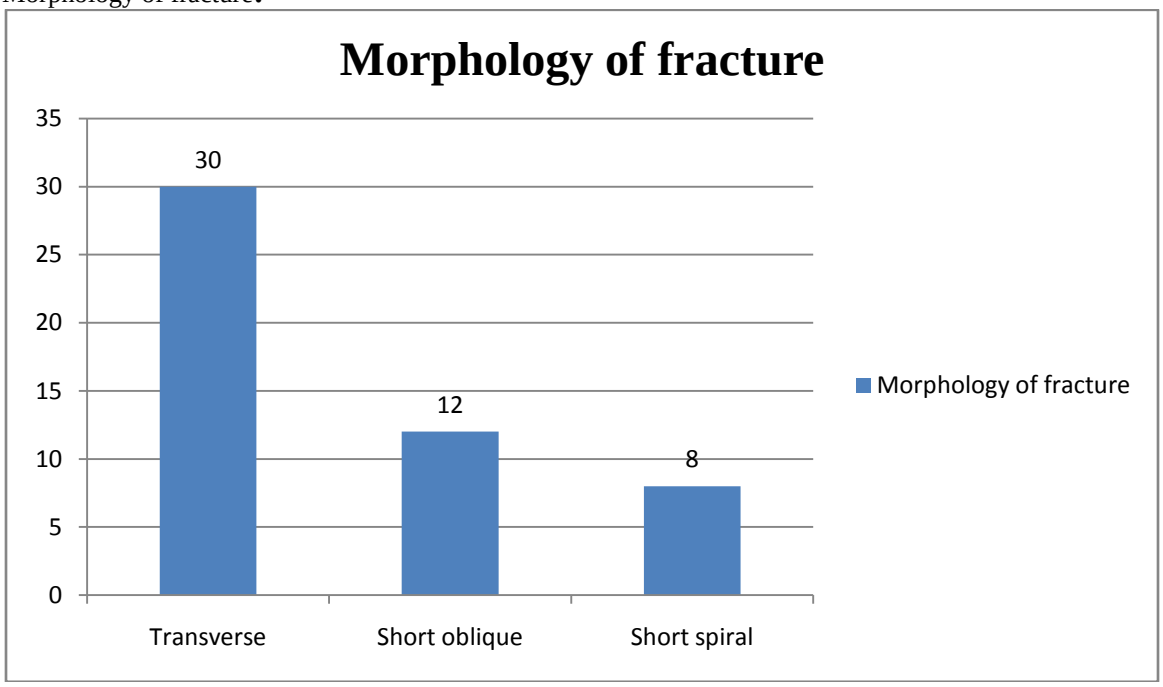
Side involved:



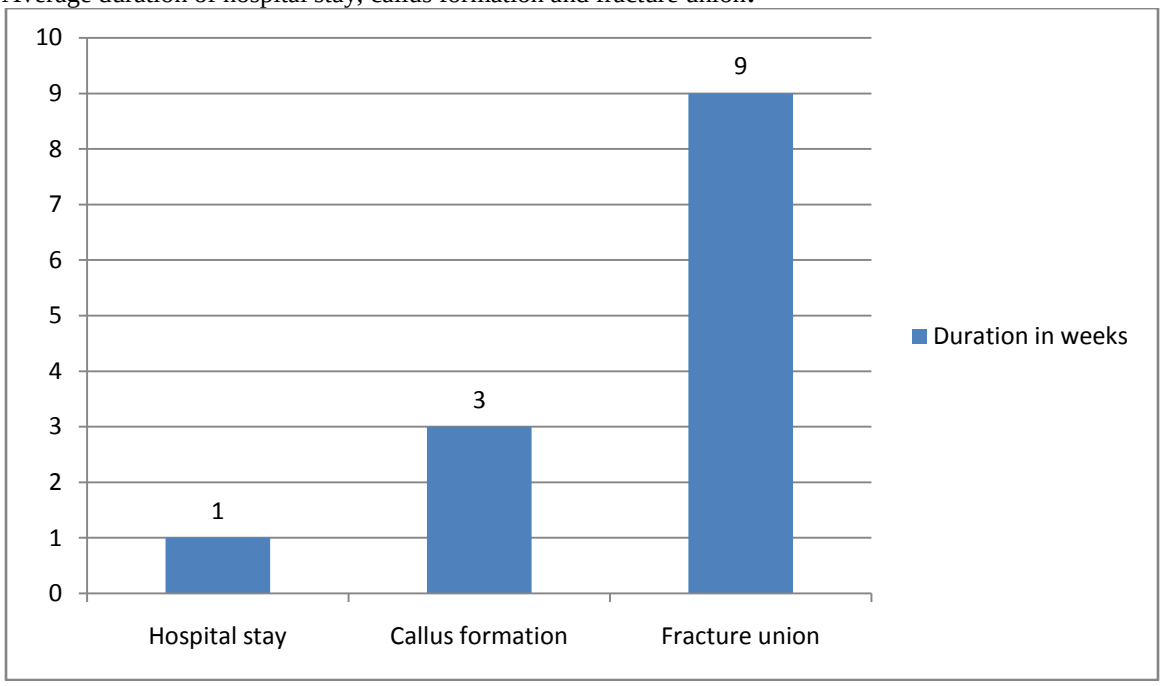
Site of fracture:



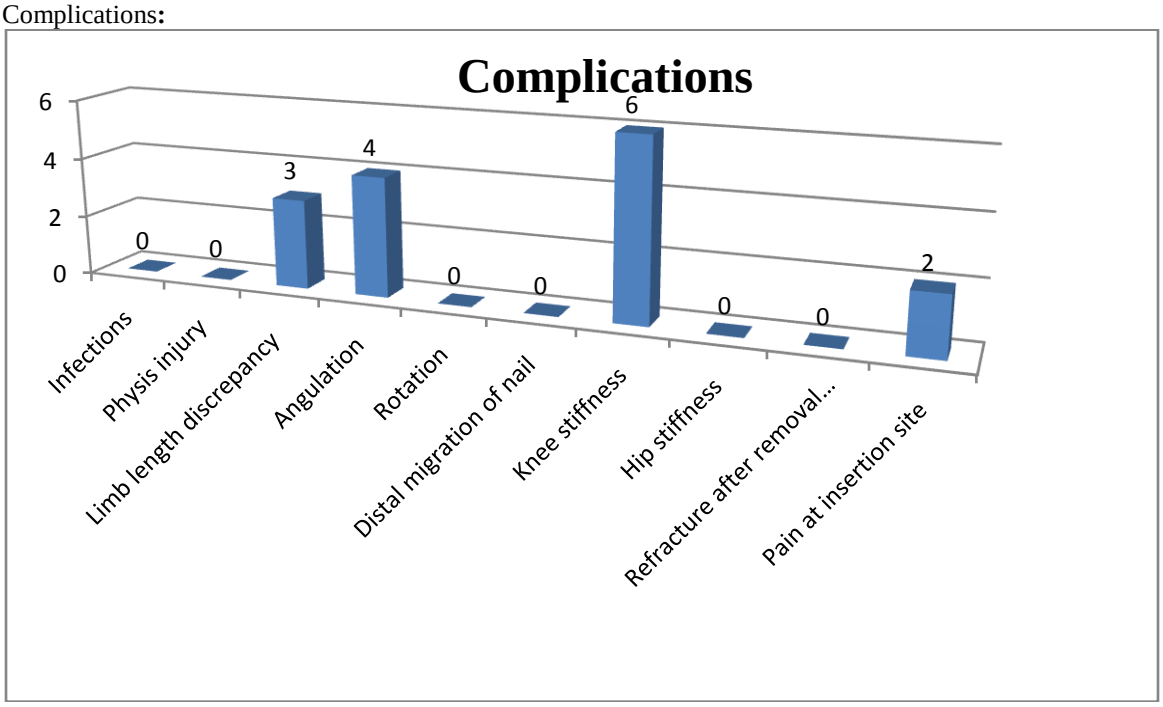
Morphology of fracture**:**



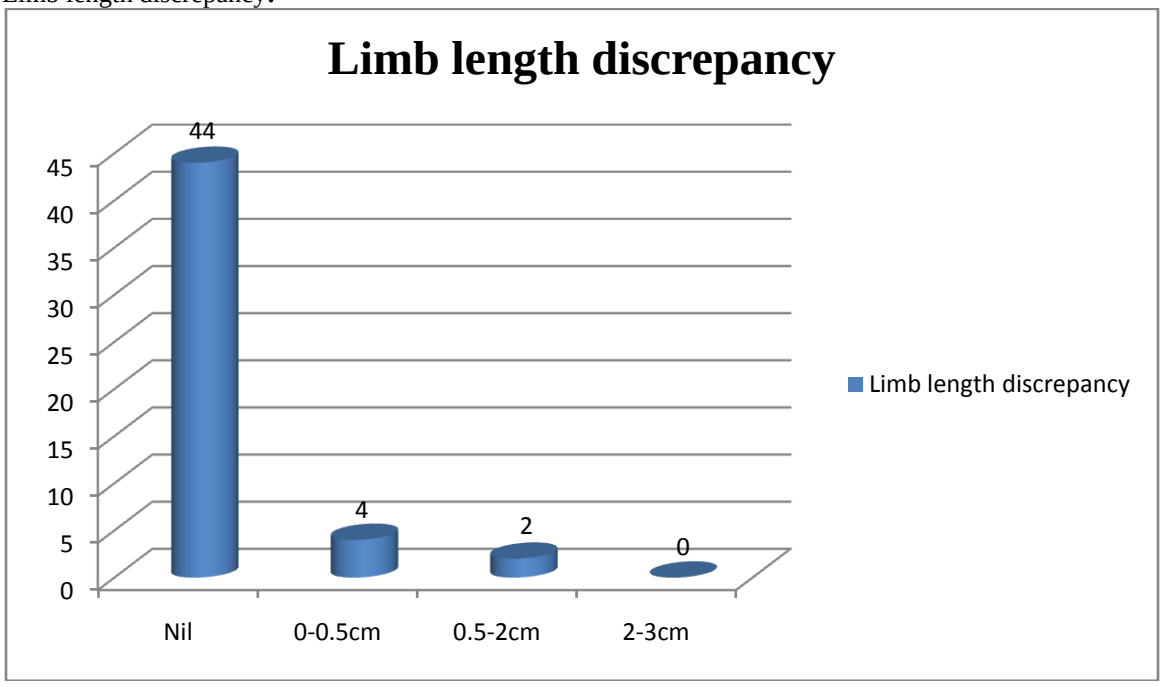
Average duration of hospital stay, callus formation and fracture union**:**



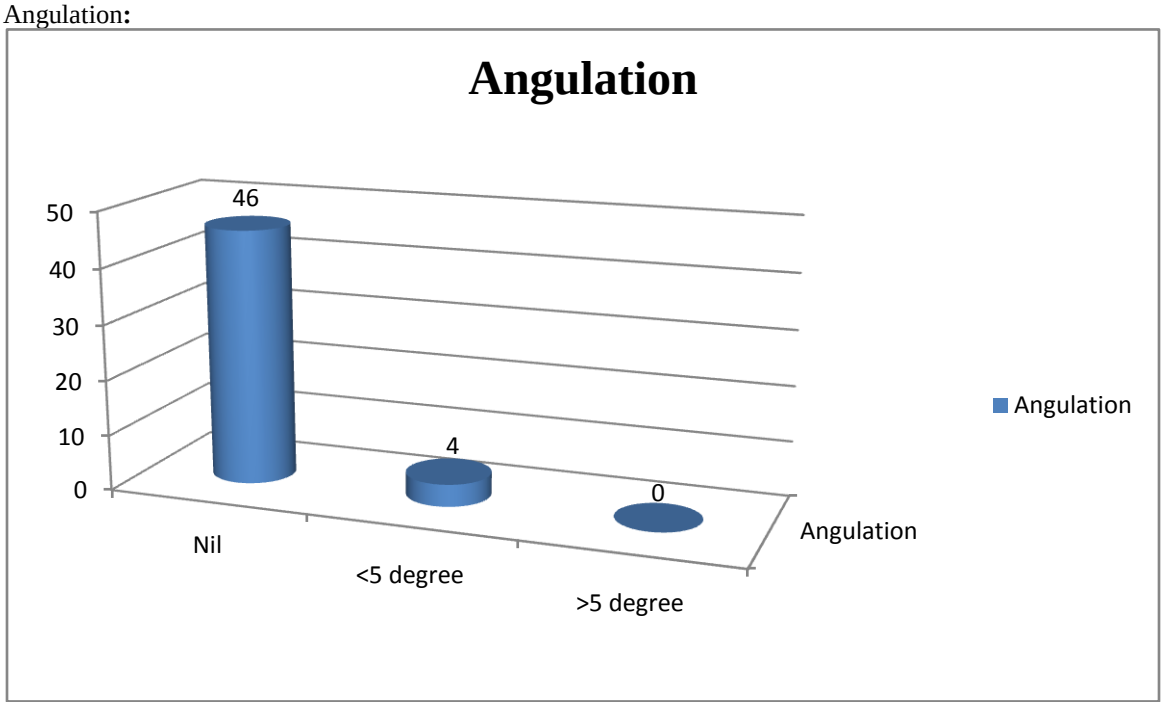
Complications:



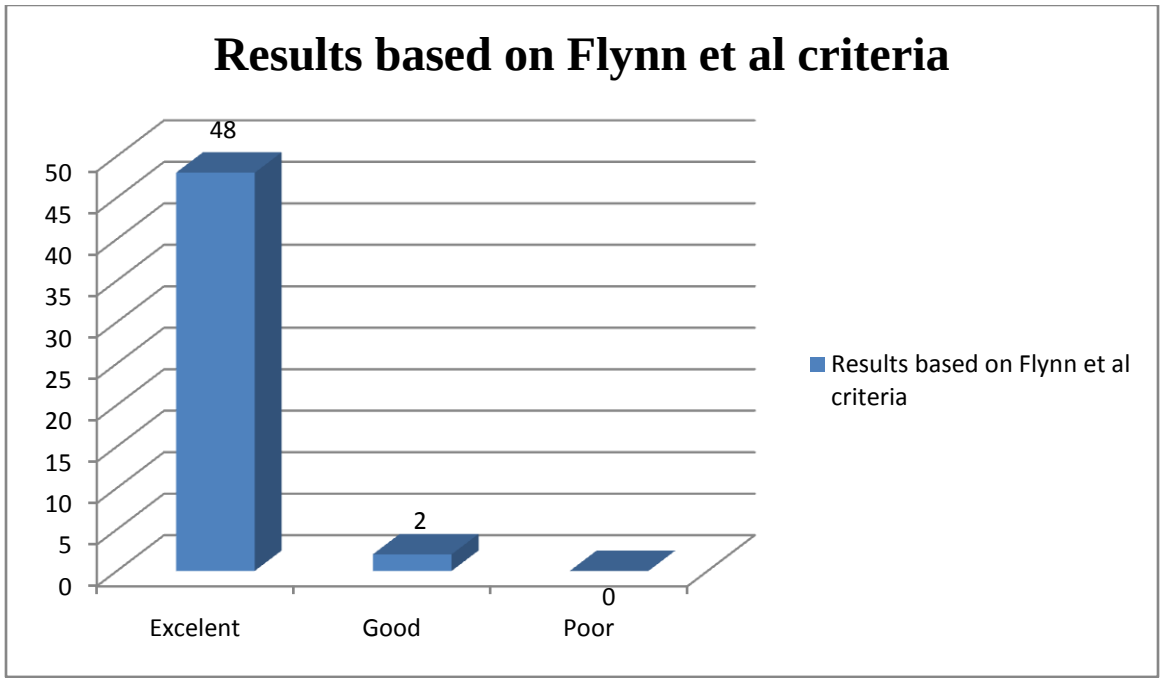
Limb length discrepancy:



Angulation:



Results:



Summary of results:-

50 cases of fracture shaft of femur were managed by closed reduction with TENS at post graduate department of orthopaedics G.M.C Jammu between July 2013 to July 2015 Out of 50 cases 36 (72%) cases were male and 14(28%) female. These fractures were common in the age group between 9 to 12 years accounting for 26 cases (52%) who were involved in outdoor activities, sports and hence more prone to trauma. Right limb 30 cases (60%) was more involved than left limb 20 cases (40%), Road traffic accidents 40 cases (80%) was the major cause of

fracture shaft of femur followed by fall from height 10 cases (20%), Middle third 38 cases (76%) of shaft was mostly fractured followed by proximal third 10 cases (20%) then lower third 2 cases (4%), transverse fracture was the most common pattern of fracture 30 cases (60%) followed by short oblique 12 cases (24%) and short spiral type 8 cases (16%). No patient develop superficial or deep infection at the surgical site. Total period of union took from 8 to 10 weeks, average time of union was 9weeks. It was also seen that 6 patients (12%) had limb length discrepancy of less than 2cm and 4 patients (8%) had angulation of less than 5 degrees and 6 patients (12%) had knee stiffness after TENS. Overall results based on Flynn et al criteria was excellent in 48 cases (96%) and good in 2 case (4%).

Fig 1A
Pre op X ray of shaft femur fracture

Fig 1B
Post Op X ray after closed reduction and TENS

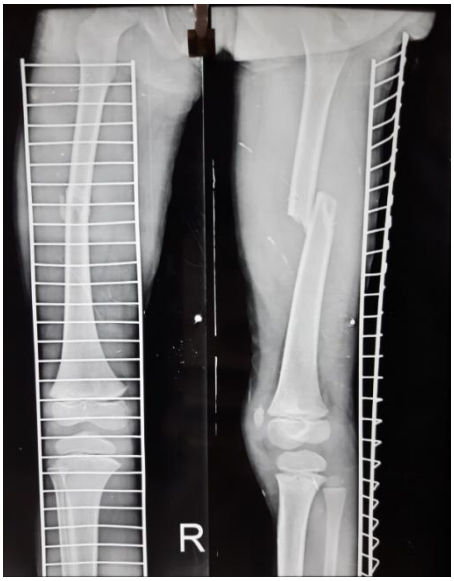


Fig 2A
Pre op X ray of shaft femur fracture

Fig 2B
Immediate Post Op X ray after closed reduction and TENS

Fig. 2 C
8th week post operative X ray

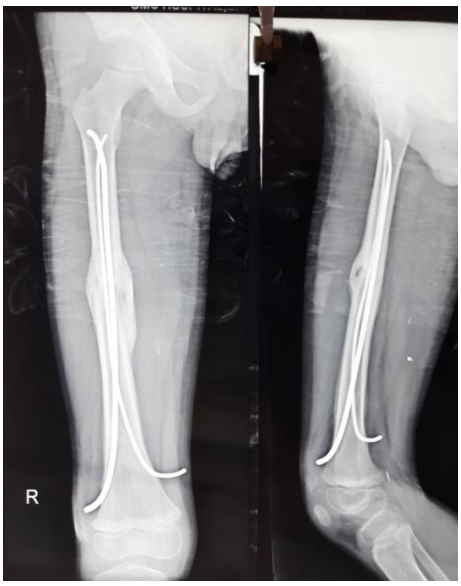


Fig. 2 D
12th week Post operative X ray

Discussion:-

Titanium elastic nailing (TEN) is a biological, minimally invasive fracture treatment modality to achieve a level of reduction and stablization that is appropriate to the age of the child. Barry and Paterson and Flynn et al recommended titanium elastic nails to be the ideal implant to stabilize many paediatric femur fractures, avoiding prolonged immobilization and complications of traction and spica casting. They postulated that nonunion or delayed union is uncommon and when it occurs, it may be related to the use of nails of inadequate diameter. Growth disturbance appears to be minimal due to avoidance of proximal and distal physes with a mean femoral overgrowth of only 1.2 mm. They concluded that flexible intramedullary nailing is a safe and effective method for the treatment of femoral shaft fractures in the child between 6 and 12 years of age. Aktekin et al reported a study on flexible intramedullary nailing in 21 patients in the age group 6-12 years with diaphyseal fractures of femur, treated with titanium elastic nailing. There was no angular or rotational deformity at one year follow up. They recommended flexible titanium nailing as the first treatment choice in this age group. Accourding to our study 4 patients (8%) had angulation of less than 5 degrees.

Singh et al conducted a study on titanium elastic nailing in paediatric femoral diaphyseal fractures on 35 patients (age group 6-14 years). The results were excellent in twenty five, satisfactory in eight and poor in two patients. All the fractures healed with an average time to union of 9.6 weeks. Return to school was early with an average of 7.8 weeks. The most common problem encountered was pain and discomfort near the knee produced by the nail ends. Three cases had shortening and restriction of knee flexion was observed in five patients. There was no delayed union, infection or re-fractures. Total period of union took from 8 to 10 weeks, average time of union was 9weeks.

According to our study total period of union took from 8 to 10 weeks, average time of union was 9weeks. It was also seen that 6 patients (12%) had limb length discrepancy of less than 2cm . Overall results based on Flynn et al criteria was excellent in 48 cases (96%) and good in 2 cases (4%).

Li ea al provided biomechanical evidence that patients weighing more than 40 to 45 kg who undergo stabilization of a transverse midshaft femur fracture with titanium elastic nails are at risk for loss of reduction in the sagittal and coronal planes. Luhmann et al found no correlation between weight and coronal and sagittal angulation. There was no significant relation between weight nail ratio and coronal angulation (p =0.4237) while sagittal angulation increased with increased weight nail ratio (p=0.0007). Salem et al concluded elastic stable intramedullary nailing with six month (4-7 month) follow up can provide satisfactory results in terms of limb length and axial alignment, but has a high rate of early torsional malalignment (47%). In a study, 36 children with 37 closed fractures were treated by flexible intramedullary nailing. Follow-up radiographs revealed that 44% of the children had malalignment at the fracture site in one or both planes. However none of the children presented with clinical

malalignment of the fractured limb. Fifty percent of the children had a leg-length inequality but none of them complained of a functional problem. Houshian et al reported a series of 31 children (4-11 years) with femoral shaft fractures treated with ESIN. All fractures radiographically united at a median of seven weeks. Limb length discrepancy of up to one cm was found in six children and ten degrees of rotational deformity in one child and no case of angular deformity. In a multicentric study of TENS, Flynn et al reported excellent or satisfactory results in 57 of 58 patients with six patients having limb length discrepancy, four cases of nail impingement and one refracture after implant removal. Luhmann et al retrospectively reviewed 43 shaft femur fractures and found 49% complication rate but only two major complications (one non-union and one deep infection). The most common minor complication was pain at the nail insertion site. Narayanan et al reported a study on complications of ESIN in 79 paediatric femoral fractures. Complications included pain and irritation at the nail insertion site in 41 cases, radiographic mal-union in eight cases, refractures in two cases, transient neurologic deficit in two cases and superficial wound infection in two cases. Ten patients required re operation prior to union. Three patients had nail migration and skin perforation , three patients had loss of reduction, two patients had re fracture and one patient had neural deficit. Mal-union and loss of reduction requiring re operation were strongly associated with the use of nails of mismatched diameter and comminution of more than 25%. Sink et al conducted a study to analyze the complications in 39 children with femur fractures stabilized with titanium elastic nails and concluded that in patients with length unstable femur fractures, consideration should be given to methods of treatment other than titanium flexible intramedullary nails.

Conclusion:-

The following conclusion can be drawn from the present study:
Retrograde intramedullary nailing is a rapid, safe and an effective method for treating fractures of the paediatric femoral shaft in the age group of 5 to 15 years.

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