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ORIGINAL RESEARCH

Usage of Titanium Elastic Nails for Surgical Management of Both Unstable and Stable Paediatric Femoral Diaphyseal Fractures: A Comparison

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Abstract

Background: Shaft of femur fractures are one of the commonly encountered cases contributing to 1.6% of fractures seen in paediatric age group. The fracture pattern also determines the outcome of the healing process. Factors contributing to this are anatomy and location of fracture, stable or unstable patterns. Flexible titanium elastic nailing has become revolutionary with respect to stabilization of femoral shaft fractures. It has become the surgical procedure of choice due to reduced hospital stay and avoiding spica cast. In this study we have made an effort to further analyze the comparative results among the unstable and stable fracture patterns. Post-operative criteria like residual pain, duration of hospital stay, timing of mobilization, duration needed for radiological union, onset of weight bearing, time taken for full weight bearing and residual deformity were analyzed.

Materials & methods: The present retrospective study was conducted in DR B R Ambedkar Medical College from March 2020 -March 2022. Forty paediatric patients aged 5-15(25 stable and 25 unstable) who visited the hospital with history of trauma to thigh along with symptoms of pain, unable to bear weight with an X-ray showing diaphyseal femoral shaft fracture were selected for this study. Informed consent was taken as a standard.

Surgical Plan: Fifty patients (25 unstable and 25 stable) who fulfilled the inclusion criteria treated with elastic titanium nailing. The follow up was at 4th week, 8th week, 12th week and at 24 weeks.

Results: After the completion of the study, we opined that the best results was seen in stable femoral diaphyseal fractures and had 2 instances of angular deformity and 1 instance of limb length discrepancy among the unstable variety.

Conclusion: The surgical technique of elastic intramedullary titanium nails lead to early fracture healing. The chances of angular deformity and limb length discrepancy among unstable fracture types show that additional stability may be required.

Keywords: Communited femur fracture, TENS nail, pediatric fractures, femoral diaphyseal fractures.

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Introduction

Since a long time femoral diaphyseal fractures have been one of the most common traumatic injury seen among the paediatric age group. Various treatment options have been used since decades which had its own limitations and disadvantages. It has been known that this fracture has contributed to one of the highest rates of hospitalization. The gold standard for treatment of the above mentioned fracture has been casting and traction which required prolong duration of hospitalization. These conservative techniques has been known to have its own disadvantages like pressure sores due to casting, toileting and hygiene issues and reduction loss. The last couple of decades has revolutionized the treatment of femoral shaft fractures in paediatric age group. There has been wide adoption and acceptance that closed intramedullary titanium elastic nailing is the best surgical option due to its advantages as discussed. Other options used initially has fallen out of favor like compression plating, submuscular plating and also external fixators. The technique of elastic intra medullary titanium nailing has reduced not only the early morbidity associated with the fracture but also the financial burden on the family[1]. This fracture pattern is usually seen with high energy sports injuries or road traffic accidents in slightly older children while the other end of the spectrum in early age group can also sustain the fracture due to abuse as their bone is unable to tolerate the force of trauma[2]. It has been observed that the fracture pattern determines the outcome of the surgery in spite of having advantages like closed reduction causing haematoma preservation in fracture, almost non existent surgical soft tissue injury and avoidance of damage to physis[3].

Materials and methods

The present retrospective study was conducted in DR B R Ambedkar Medical College from March 2020 -March 2022. Forty paediatric patients aged 5-15(25 stable and 25 unstable) who visited the hospital with history of trauma to thigh along with symptoms of pain, unable to bear weight with an X-ray showing diaphyseal femoral shaft fracture were selected for this study. Informed consent was taken as a standard. We considered spiral and communited fractures as part of unstable group with oblique and transverse fractures considered as part of the stable group.

Inclusion criteria

1. paediatric femoral shaft fractures in age group 5-15
2. closed femoral shaft fractures
3. unilateral femoral shaft fractures

Exclusion criteria

1. femoral shaft fractures in age less than 5 years or more than 15 years
2. polytrauma
3. compound femoral shaft fractures
4. pathological fractures
5. femoral neck fractures and knee injuries

The patients was initially stabilized in casualty in case of haemodynamic derangement and limb immobilized using Thomas splint before shifting for radiological assessment. X-ray imaging was done with an Antero-posterior and Lateral view of femur to assess the fracture pattern and plan for surgical intervention. The patient was then examined in detail in the ward and thorough history and physical examination was performed. A pre-op antibiotic loading dose was used as a standard protocol along with adequate analgesic medication. The parents/guardians were counseled regarding the surgery and performed as soon as surgical fitness was taken from the paediatricain/physician.

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A pre operative evaluation was done to determine the size of nails by measuring the size of the femoral canal which was divided by two. The size of the nail was one smaller than the sized determined by division. The fracture was stabilized by introducing two titanium elastic nails into the medullary canal. The bone entry was made laterally and medially above the distal femoral physis using a bone awl of appropriate size after confirmation with a C-arm. The nails were advanced beyond the fracture site after adequate reduction under C-arm. The nails were advanced upto the proximal femoral physis and distally the nails trimmed, bent and buried under the skin after final confirmation under C-arm.

The mobilization of the knee and hip was started after post operative pain relief for the patient as tolerated. Regular follow up was done at 2 weeks for suture removal, 4th, 8th, 12th and 24th week for radiological assessment. Repeat X-rays of anteroposterior and lateral views of femur was taken at these intervals to assess fracture union. Toe touch weight bearing was initiated at 4th week with progressive weight bearing as tolerated with walker/crutch support. Full weight bearing was advised only after radiological evidence of fracture union. Follow up visits also was used to assess if there were incidences of superficial/deep infection, wound irritation due to implant, persistent deformity and any discrepancy in limb length.

Results

Forty paediatric femoral diaphyseal fractures were considered for this study. Twenty of them were unstable variety (spiral and communited pattern) and the other twenty were stable variety (transverse and oblique) who visited the hospital between march 2020 and march 2022.

Age group

Twenty eight patients were between ages 5-10 and twelve patients were between the ages 10-15.

Mechanism of injury

The predominant cause of fracture was road traffic accident in 26 cases (65%), 10 cases of self fall (25%) and 4 cases of fall from height (10%).

Fractures were seen commonly in males (29 out of 40) contributing to 72.5% and the rest were females (27.5%)

Right side saw the most cases of fracture with 27 (67.5%) and the rest were on the left (32.5%).

Unstable fractures had predominantly spiral variety with thirteen out of twenty (65%), communited being seven (35%). Among the stable fracture pattern we encountered oblique as the most common variety being twelve out of the twenty(60%) and the rest being transverse(40%).

Fracture location was commonly in the mid shaft in 24 cases (60%), lower third in 10(25%) and proximal third in 6 cases (15%)

Among the forty cases, thirty four of them were operated within the first forty eight hours while the other six were operated after due to fitness issues and pre-existing respiratory/urinary infection. In these six cases it was operated within the first five days after injury.

All patients were discharged within forty eight hours after surgery.

Post-operative complications seen were superficial infection in 2 cases(5%) in which one each was from both the groups, persistent operative site pain in 5 cases(12.5%) in which four cases were from unstable pattern and one from stable pattern, angular deformity in 2 cases of unstable variety(10%) and one case of limb length discrepancy among the unstable variety(5%).

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Flynn's criteria was used to assess the post operative result which used certain parameters like residual pain, persistent deformity, discrepancy in limb length.

The result of the study showed that excellent result was seen among 33 cases (82.5%) and good outcome was among seven (17.5%). We did not find a poor outcome among our patients.

Average time for fracture healing radiologically was 11.2 weeks with unstable variety averaging at 11.6 weeks and stable pattern averaging at 10.9 weeks.

X-ray 1 of patient 1: Pre-Operative Communitted Femur Fracture.

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X-ray2 of patient 1: Immediate post-operativexray with tens nailing.

X-ray3 of patient 1.:6 months post-operative xray with tens nailing showing fracture healing.

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X-Ray 1. of patient 2: Pre-Operative Communitted Femur Fracture.

X-ray2 of patient 2:Immediate post-operative xray with tens nailing.

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X-ray3 of patient 2.-3 months post-operative xray with tens nailing showing fracture healing.

Discussion

There was decades of following conservative management for one of the most commonly encountered paediatric fracture patterns like spica casting, traction application, Thomas splint. These techniques were associated with disadvantages like pressure sores due to casting, inadequate hygiene, persistent deformity due to loss of alignment of limb in the cast. With the advent of C-arm and titanium elastic nails, surgical intervention has become the gold standard for the management due to its numerous advantages[4].

Elastic nailing system of titanium uses the concept of three point fixation. It provides rotational, axial and translational stability by symmetrically shoring up the fracture and stabilizing the bone at three points by the two nails inserted into the metaphysis. This sort of stable construct help in achieving the best possible result[5].The elastic nails are stabilized at both ends of the bone providing support at entry site and at the metaphysis. Due to the bending and elastic capability of the bone, it prevents altering its shape after introduction into the medullary canal thereby creating some tension in the medullary canal. This also provides resistance against further bending helping in reducing the risk of deformity. Any additional nail introduction resulted in an unstable construct[6]. Due to the ability of titanium because of its elasticity and strength, it provides resistance to the deforming rotational, compressive and angular forces thereby preventing loss of reduction. It provides a stable construct thereby allowing early mobilization.

Excellent results were seen in stable fracture patterns and near excellent results were seen in unstable patterns with an occasional satisfactory result due to angulation and loss of reduction[7]. Our results with regards to fracture union, superficial infection, limb length discrepancies and surgical ease correlated in another study done recently[8]. There was a study conducted to ascertain the functional outcome of titanium elastic nailing of fracture shaft

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femur in patients less than six years of age. They concluded that this surgical technique was safe and effective for this age group also[9]. Khanna et al performed a similar study and came to an opinion of safe effective and first choice of surgical management[10]. A similar prospective study conducted for age group five to fifteen concluded that titanium elastic nailing provides a safe and reliable surgical technique for management of fracture shaft femur[11]. Titanium elastic nailing system provides for faster fracture healing, faster weight bearing and rehabilitation giving excellent results. They even reported that there were no complications apart from superficial infections[12].

Conclusion

After completing the study, we were able to conclude that elastic titanium nailing system is the best available surgical technique for both unstable and stable fracture patterns in spite of the occasional complication like angulation and limb length discrepancy although highly communited fractures may need a more stable construct for preventing any persistent deformity or length variation. It has proved to be the gold standard of treating paediatric femoral diaphyseal fractures due to high rates of fracture union, early weight bearing, early range of hip and knee motion with rare instances of complications. It also has the added advantages of minimal blood loss, minimal soft tissue injury, shorter admission times in the hospital and early radiological union. We encountered complications in three out of the twenty cases in the unstable group in spite of best intra operative reduction. We also feel that these unstable fracture patterns may need additional stability to avoid long term morbidity. However, there was no incidence of non union which is also an added advantage in this technqiue.

Consent

Was taken from the institutional ethical committee.

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