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CONTENTS

ORIGINAL ARTICLES

- Posterior Endoscopic Lumbar Discectomy by Destandau's Technique-Learning Curve & Our Experience 1
Md. Akshad Al Masur, Md. Masudur Rahman, Abu Taleb, Md. Mahbub Ali, Mst. Fatema Khatun
- Evaluation of Results of Arthroscopic Partial Meniscectomy for Medial Meniscal Tear of Knee 4
Md. Delower Hossain, Abu Zaffar Chowdhury, Md. Shahidullah, Md. Naimur Rahman, Mst. Sharmin Khondoker, Md. Rashedul Haque, Akshad Al Masur, Md. Zahidul Islam, Mst. Fatema Khatun
- Incomplete Traumatic Injury of the Subaxial Cervical Spine: Evaluation of the Surgery by a Single Anterior Approach 9
Mobinul Hoque, Md. Samiul Islam, Sultana Parvin, Mohammad Mahbubur Rahman Khan, Rabin Chandra Halder, Muhammad Rafiqul Islam, Syed Khaledur Rahman, Md. Omar Faruque, Pankoj Kanti Mondol
- Comparative study of titanium elastic nailing versus hip spica cast in treating paediatrics femoral diaphyseal fracture of age group 6-10 years 16
Mohd. Sayedul Islam, Md. Samiul Islam, Sultana Parvin, Mohammad Mahbubur Rahman Khan, Md. Ehteshamul Choudhury, Maksud Ahmmad, Mohammad Aksad Al Masur, Pankoj Kanti Mondol, Md. Omar Faruque, Shyamal Chandra Debnath
- Effect of Metformin on Serum Vitamin B₁₂ and Serum Homocysteine in Patients of Type 2 Diabetes Mellitus 25
Shah Walia Nazneen, Suraiya Jahan Sonia, Khan Ashabul Haque, Forhadul Hoque Mollah, M. Iqbal Arslan, Zahra Aziz
- Comparison of the Functional Outcome between Y Reconstruction Plate and Distal Humeral Locking Plate for Treatment of the T-Y Intercondylar Distal Humeral Fracture in Adult 29
Palash Kumar Aish, Khandker Md. Nurul Arifeen, Md. Ali Faisal, Shah Newas, Md. Nur Alam, Nirmal Kanti Biswas
- Limited Adjunctive Surgery with Ilizarov Technique in Failed Cases Clubfoot in Children 39
Md. Samiul Islam, Md. Mahmudur Rahman Imrul, Sultana Parvin, Muhammad Rafiqul Islam, Rabin Chandra Halder, Shagor Kumar Sarker, Mobinul Hoque, Md. Omar Faruque, Mohammad Kamrul Islam, Mohd. Sayedul Islam
- Surgical Treatment of Posterior Wall of Acetabulum : Excellency in Pelvic Fracture Management 46
Sarwar Jahan, Md Shah Alam, Tanvir Rahman, Abdullah Al Mamun Choudhury, Md. Nur Alam

Review Article

- Inside-Out Meniscus Repair – A Review 51
Mohammad Arif Hossain¹, Gopal Verma, Khandaker Ehtesam Ahmed, Nirmal Kanti Biswas



Posterior Endoscopic Lumbar Discectomy by Destandau's Technique- Learning Curve & Our Experience

Md. Akshad Al Masur¹, Md. Masudur Rahman², Abu Taleb³, Md. Mahub Ali⁴, Mst. Fatema Khatun⁵

Abstract :

Posterior endoscopic discectomy is an established method for treatment of lumbar disc herniation. Many studies have not been reported in literature for lumbar discectomy by Destandau Endospine System. We report a series of 40 patients operated for lumbar discectomy by Destandau Endospine system. Endoscopic discectomy is carried out by conventional micro disc surgery instruments by minimal invasive route. The results were evaluated by Macnab's criteria. Based on modified Macnab's criteria, 60% patients had excellent to good, 40% had fair, and 0% had poor results. Endoscopic discectomy provides a safe and minimal access corridor for lumbar discectomy. The technique also allows early postoperative mobilization and faster return to work.

Keywords: Endoscope, endoscopic discectomy, endospine, facetectomy, laminotomy, radiculopathy

INTRODUCTION:

Posterior endoscopic discectomy is an established method for treatment of lumbar disc herniation. Many studies have not been reported in literature for lumbar discectomy by Destandau Endospine System. Endoscopic discectomy provides a safe and minimal access corridor for lumbar discectomy. The technique also allows early postoperative mobilization and faster return to work. Destandau endospine system consists of endospine tube, trocar, and working insert. The working insert comprises four ports. One port for 0 degree endoscope, second for suction cannula, third port (biggest) for working instrument, and fourth port for dural and nerve root retractor. At marked point, 15 mm skin incision is made aponeurosis is incised using Mayo's scissors; 1.5 cm wide periosteal elevator is used to elevate paravertebral muscles subperiosteally, thus exposing the interlaminar window and part of the affected side facet. Prof. Yasargil and Prof. Casper 1977 Dr. Williams, a neurosurgeon: Consultant of many casinos in Las Vegas employing female dancers who popularized the the

technique in the United States, The popularity was due to its use of smaller incisions which allowed the performance to return to dancing more quickly after the procedure. The operative technique consists of knee chest positioning after administration of anesthesia followed by level localization by localization devise. Any soft tissue bulging in the mouth of tube is removed till boundaries of interlaminar window such as superior and inferior lamina, facet joint are clearly visualized. This follows partial resection of inferior margin of the superior lamina followed by excision of ligamentum flavum leading to exposure of the dural sac and nerve root under endoscopic vision. Once the nerve root has been accurately identified, it is retracted using a nerve root retractor. The epidural veins are coagulated if necessary. Dural and nerve root retraction can be further aided by cottonoids. It also helps to keep the field dry. Depending on local findings, discectomy involving the extraction of the nucleus pulposus is then carried out. Hemostasis of the muscle layers is achieved under video-endoscopic control. Once satisfactory nerve

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root decompression is achieved, endospine tube along with working insert is withdrawn. Aponeurosis is sutured using vicryl fine suture followed by closure of the skin in a subcuticular fashion. A water-impermeable dressing is then applied over incision. Operative Procedure: The endospine tube with trocar is pushed through the incision in the direction of posterior arch over interlaminar window followed by withdrawal of trocar. The working insert is then fitted over endospine tube. The video camera is connected to 0 degree endoscope under sterile conditions. The endoscope and suction tube are introduced into their respective ports.

MATERIALS AND METHOD:

It is a Prospective Study carried out in Private Hospitals in Dhaka & Pabna, Bangladesh. Study was conducted from September 2016 to Jan'21. A total of 40 consecutive patients who under gone Posterior Endoscopic Lumbar Discectomy by Destandau's Technique for PLID included in the study.

Inclusion Criteria

1. Patients having lumbar disc prolapse with unilateral radiculopathy
2. On clinical evaluation, positive straight leg raise or femoral stretch test.
3. Identification of a single nerve root lesion on MRI.
4. All Patients had fair trial of conservative treatment in the form of rest, medication (NSAID), activity modification, and physiotherapy (minimum 6 weeks) before they were advised to undergo surgery.

Exclusion Criteria

1. Patients with bilateral symptoms.
 2. Double root involvement.
 3. Caudaequina syndrome
- Whose clinical symptoms did not match with MRI picture

Table-I
Sex distribution of patients

| Sex | Name of Case | Percentage |
|--------|--------------|------------|
| Male | 18 | 47.37% |
| Female | 20 | 52.63% |

Table-I shows distribution of sex. There were 18(47.37%)male & 20(52.63%)female.

Table-II
Age distribution of patients

| Range of Age | Number | Percentage |
|--------------|--------|------------|
| 21-30 | 8 | 21.05% |
| 31-30 | 21 | 55.27% |
| 41-50 | 9 | 23.69% |

Table-II shows distribution of Age. The highest number of cases 21(55.27%) were in the 3rd to 4th decade.

Table-III
Level of disc herniation

| Level | Number | Percentage |
|-------|--------|------------|
| L4/5 | 27 | 71.05% |
| L5/S1 | 11 | 28.94% |

Table-III shows level of disc herniation. Most common site of disc prolapse was at the level of L4/5 27 (71.05%).

Table-IV
Side of disc herniation

| Side of disc herniation | Number | Percentage |
|-------------------------|--------|------------|
| Right | 17 | 44.73% |
| Left | 21 | 55.27% |

Table-IV shows side of disc herniation. More involvement was at the left side 21 (55.27%)

Table-V
Functional outcome study

| Result | Number of patient | Percentage |
|-----------|-------------------|------------|
| Excellent | 29 | 76.31% |
| Good | 6 | 15.78% |
| Fair | 3 | 7.80% |
| Poor | 0 | 0% |

Table V shows functional outcome. Here excellent in 29 (76.31%) good in 6 (15.78%) fair in 3 (7.80%)

CONCLUSION:

It is a versatile technique. Extruded and soft disc are strongly indicated. It is a Minimal invasive procedure. Tricks and Pitfalls to Overcome Steep Learning are to exact Localization of Disc Space, endoscopic Anatomy should be maintained. Inconvenience due to

Muscle Intruding into the Outer Tube. So, advice to Overcome Steep Learning Curve is to attend Courses for Endospic training. After attending the live demonstration , one should attend cadaver or hands on plastic workshop. After learning the hand movements on cadaver or plastic model, than if it is possible you should visit nearby surgeon who is performing endoscopic procedures with Endospine. Then for the first case one can try simple left-side lateral disc prolapse with root compression without stenosis. Usually start with simple lateral disc protrusion at L5/S1 or L4/5 on left side. After each and every case, self-audit yourself and discuss your difficulties with your mentor in Endospine.

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Evaluation of Results of Arthroscopic Partial Meniscectomy for Medial Meniscal Tear of Knee

Md. Delower Hossain¹, Abu Zaffar Chowdhury², Md. Shahidullah³, Md. Naimur Rahman⁴, Mst. Sharmin Khondoker⁵, Md. Rashedul Haque⁶, Akshad Al Masur⁷, Md. Zahidul Islam⁸, Mst. Fatema Khatun⁸

Abstract

Knee is the largest and one of the weight bearing joints of the body. Knee injury can be crippling. Meniscal tears are one of the commonest intra-articular injuries involving young or middle-aged people. Proper management is an important issue regarding the future effective movements. To find out the results of arthroscopic partial meniscectomy for medial meniscal tear of the knee. This was a prospective interventional study carried out in the Department of Orthopaedics at BSMMU, Dhaka from January 2013 to December 2014. Thirty patients with meniscal tears were selected as per inclusion and exclusion criteria. After proper evaluation and clinical examination of these patients arthroscopic examination and partial meniscectomy was done under spinal anaesthesia. All patients were evaluated at follow up on 3th month using Tapper-Hoover criteria for clinical assessment. A total number of 30 patients were recruited in this study. Twenty seven (90%) patients were male and only 3 (10%) were female. Mean \pm SD of age was 26.16 ± 5.17 and range was 16 – 40 years. Out of 30 patients 21 (70.0%) had right knee affected and the rest 9 (30.0%) had left knee affected. Over 56.7% received injuries from sports activities and the rest 43.3% received them while they were working. Mean \pm SD of duration of suffering was 7.23 ± 2.93 months and range was 4–15 months. According to Tapper-Hooper classification result of arthroscopic partial meniscectomy was excellent 53.3%, good 26.7%, fair 10%, and poor 10%. This study permits to conclude that arthroscopic partial meniscectomy may be the effective method of treatment for the management of medial meniscal tear.

Key words: Arthroscopic partial meniscectomy, Medial Meniscus.

INTRODUCTION

The knee is the largest and complex joint of the body. Injuries to the knee are one of the commonest injuries, pertaining to the joints in the body, especially amongst sports professionals. The incidence of permanent and progressive residual disability following knee injury is higher than any other trauma sustained in sports (Karachalios *et al.* 2005).

Meniscal tears are the most common injury of the knee, with an incidence of meniscal injury resulting in meniscectomy of 61 per 100 000 population per year. They may occur in acute knee injuries in younger patients, or as part of a degenerative process in older individuals. Medial meniscal tears occur more frequently than tears of the lateral meniscus. (McDermott and Amis, 2006).

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The first Arthroscopic Meniscectomy was performed by Masaki Watanabe² in Japan in 1962 and was introduced in North America by O'Connor³ in 1977 including an operating arthroscopy. Dandy⁴, Jackson⁵, Gillquist⁶ and Metcalf⁷ have been among the early pioneers 'contributing to the development of arthroscopic surgical techniques, operating micro-instruments and power tools. The morbidity of arthroscopic meniscectomy of the knee is so low and return to normal function and sports activities so rapid that this technique has become very popular among the patients. Endoscopic surgery has virtually replaced open meniscus surgery wherever expertise in endoscopic surgery of the knee is available. (Umar, 1997). Since introduction of the therapeutic arthroscopy, by O'Connor, arthroscopic partial meniscectomy or meniscal repair become the treatment of choice of the meniscus tear whenever possible, which allows some preservation of normal meniscal function to avoid or reduce the risk of osteoarthritis that might develop after total meniscectomy. The major disadvantage of closed meniscus surgery is its technical difficulty while being learnt. (Alzubady, 2011).

The knee is the most frequently injured joint because of its anatomical structure, its exposure to external forces and the functional demands placed on it. Articular surface of the femur and tibia are not congruent and tibial condyles are too small and shallow to hold the large, convex femoral condyles in place. All though much emphasis has been placed on the ligaments of the knee, without the supporting action of the associated muscles and tendons, the ligaments are not enough to maintain knee stability. The structures around the knee have been classified into three broad categories: Osseous structures, extra-articular structures and intra articular structures. The intra-articular structure comprises of medial and lateral menisci; anterior and posterior cruciate ligament (Robert *et al.* 2008).The menisci of the knee have an important role in load-bearing and shock absorption within the joint. They may also function as secondary stabilizers, have a proprioceptive role, and aid the lubrication and nutrition of the articular cartilage. Complete or partial loss of a meniscus can have damaging effects on a knee, leading to serious long-term sequelae. (McDermott and Amis, 2006).Medial and lateral menisci are composed of fibro-cartilage, forms an incomplete partition and intervenes between the condyles of femur and Tibia. Medial meniscus is semilunar in shape and longer anteroposteriorly. It is convex and attached to the capsular ligament and tibial co-lateral ligament. Lateral meniscus forms four-fifth of a circle. Lateral margin is convex and attached to the fibrous capsule. In addition post horn provides, the attachment of menisco-femoral

ligaments and few fibre of popliteus. Medial meniscal tear is more easier than lateral as lateral meniscus is thicker and more-mobile. (Jason and Carne, 2007).Traumatic menisci lesions are more common in rotation or forceful twisting, deep squatting and suddenly stopping of knee. The most common location for injury of menisci are the posterior horn and longitudinal tears are most common. The other types are horizontal, oblique tears, a combination of longitudinal and horizontal tears, tears associated with cystic menisci and tears associated with discoid menisci (Robert *et al.* 2008).

The medial meniscus may be trapped between the condyles of the femur and tibia and it may torn at its periphery due to tear of the medial structures, thus producing 'The unhappy triad of O'Donoghue'. (Robert *et al.* 2008). Miller, Warner and Earner classified meniscal tears on the basis of their location in three zones of vascularity – red (Fully within vascular area), red-white (at the border of the vascular area) and white (within the avascular area). Four mechanisms have been described as capable of disrupting the menisci- (I) Abduction, flexion and Internal rotation of the femur on tibia, (II) Adduction, flexion and external rotation of femur on the tibia, (III) Hyperextension and (IV) Anterior-posterior displacement. Arthroscopy play an important role, it has both diagnostic as well therapeutic role. Nevertheless no clinical assessment or advanced investigations such as MRI diagnose medial meniscal tears in all patients. Medial meniscal tears will clinically diagnosed by joint line tenderness, positive Mc Murray test, Apley's grinding test, Duck waddle test and The Thessaly test (Mohon, 2007).Arthroscopy is now well established as a method of diagnosing meniscal lesions, and its advantages have been pointed out in several reports. Arthroscopic surgery, however, is difficult to master, so that for meniscectomy open methods remain commoner. By taking advantage of the new instruments and equipment developed for arthroscopic operations, a modified technique of open meniscectomy, designed to improve the postoperative course, has been developed (Hamberg *et al.* 1984).

Carefully performed clinical examination can give equal or better diagnosis of meniscal tear in comparison to MRI scan. When clinical diagnosis is the favour of meniscal tear, performed an MRI Scan prior to arthroscopic examination is un-likely to be significance, MRI scanning is not the primary diagnostic tool in meniscal injuries, in context of our country, most patients are from poor socio-economic conditions, MRI bears an extra financial burden to the patient (Rayan, 2009).With better knowledge of meniscal function in load transmission across the knee

and the introduction of new methods of treatment, meniscal tears are now usually managed arthroscopically with preservation of much of the meniscus. The short term results have been good, allowing early weight bearing, return of function, significantly reduced morbidity and reduction of the cost of care (Hulet *et al.* 2001.)

The vascular supply to the menisci are provided by the lateral and medial geniculate arteries which form a perimeniscal capillary plexus with radial branches directed towards the centre of joint. In the adult, the degree of vascular penetration from the periphery is 10-30% into the medial meniscus and 10-25% into the lateral meniscus. The anterior and posterior horns of the menisci are more vascularised than their bodies. The nerve supply of the meniscus is at present, debatable. Innervations arises mainly from the posterior articular nerve but branch of the medial articular nerve provide part of the innervations of the medial meniscus. No neural elements have been observed in the inner third of the meniscus (Messner, 1998). Meniscal tears usually result from a single, acute rotational force is applied to the weight-bearing knee, overloading the meniscus. Traumatic menisci lesions are more common in rotation or forceful twisting, deep squatting and suddenly stopping of knee. The meniscus consists mainly of circumferential fibers held by a few radial strands. It is, therefore, more likely to tear along its length than across its width. The most common location for injury of menisci are the posterior horn and longitudinal tears are most common. The other types are horizontal tears, oblique tears, a combination of longitudinal and horizontal tears, tears associated with cystic menisci and tears associated with discoid menisci. If in the vertical tear the separated fragment remains attached in front and back, the lesion is called bucket-handle tear. Horizontal tears are usually degenerative or due to repetitive minor trauma. Some are associated with meniscal cyst (Miller and Azar, 2008). Tapper and Hoover's1 criteria of grading each knee as excellent, good, fair or poor. Excellent, a normal knee; good, the knee was functional in all activities including vigorous sports, but with some aching or swelling afterwards; fair, a knee giving definite symptoms and some disability, preventing vigorous sports; poor, a knee giving symptoms which interfered with routine daily activities. Gentle and atraumatic technique is required because it is easy to injure and damage the delicate articular cartilage with careless and clumsy use of instruments during endoscopic surgery. (Umar, 1997). All patients had a limited medial meniscectomy with the concept of preserving the meniscus and using standard techniques. Postoperatively, patients were allowed full weight-bearing and were advised

to carry out isometric quadriceps contractions. Early return to work and sport was encouraged. So meniscal tears are now usually managed arthroscopically with preservation of much of the meniscus. The short term results have been good, allowing early weight bearing, return of function, significantly reduced morbidity and reduction of the cost of care.

MATERIAL AND METHODS

Study Design:

Prospective interventional study.

Duration of Study :

From January 2013 to December 2014.

Place of Study :

Orthopaedic Surgery department, BSMMU.

Ethical Issue :

This protocol was approved by institutional review board (IRB) of Bangabandhu Sheikh Mujib Medical University, Shahabag, Dhaka.

Study Population:

The patients who were clinically positive for medial meniscus injury due to trauma visited to the Orthopaedic Outpatient Department of BSMMU and fulfill the inclusion and exclusion criteria were my study population.

Sampling technique:

Sample was collected by non randomized purposive sampling technique.

Inclusion Criteria :

- Patient with history of knee injury and clinically positive meniscal tear who underwent arthroscopy.
- Patient who failed to show clinical improvement after 3 months of conservative treatment, and those who had no additional injury to the knee between the time of clinical diagnosis and Arthroscopy.

Exclusion Criteria :

- Patients with degenerative changes or evidence of loose bodies in plain radiography.
- Any previous surgery for the index diagnosis.
- Patients treated non-operatively.
- Where clinical findings are equivocal.
- Patients with intra-articular fracture.

DISCUSSION

The present single centered, interventional study was conducted between the periods of January 2013 to December 2014 for duration of two years in the Department

of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka. The present study assesses the fruitfulness of arthroscopic partial meniscectomy of meniscal tear of knee. All patients admitted in the Department of Orthopaedic Surgery, BSMMU, Dhaka, aged 16 to 40 years with both sexes diagnosed clinically as meniscal tear were the study population. Total 30 patients with meniscal tear were included in the study. The analysis of age distribution in this study showed that age range was 16-40 years and mean age was 26.16 years. Nearly similar result was shown by Munshi *et al.*(2000). In their study the age range was 15-45 years. In another study of Jha *et al.*(2005) showed the mean age was 27.9 years. In most of the cases young people are the victim of meniscal tear due to their aggressive mobility and participation in sports activity. The majority of patients of our study were male 90% and female were 10% . Similar result was shown by Rayan *et al.* (2009). In their study 88% patients were male and 12% were female. The reason of male predominance may be due to their more involvement in manual activities, sports and random mobility for work. Out of 30 patients 70% had injury at right knee and 30% had injury at left knee. Similar result was shown by Butt *et al.*(2007). In their study they got predominant right knee injury (63.6%) but dissimilar result was shown by Jha *et al.*(2005). They got predominantly left knee injury (57.1%). This dissimilarity may be due to variation in patient selection.

Causes of injury are important and vital factors for meniscal tear. In our study it was found that sports were the major cause of injury apart from other activities. Similar result was showed by Sharma *et al.* (2011) and Jha *et al.*(2005). In their study sports was the major cause. Duration of sufferings was ranged from 4 to 15 months. In most of the cases the range was 4 – 6 months. This result was nearly similar to Butt *et al.* (2007) where the range was 5-6 months. Clinical findings showed that pain, giving way, intermittent swelling and quadriceps wasting were the predominant complaints. Karachalios *et al.*(2010) reported that pain and locking were the major complaints.

Maximum patients had McMurray test and Thessaly test positive followed by joint line tenderness, Appley's Grinding test are also positive. Varyani *et al.*(2013) showed that maximum patient had joint line tenderness. This signifies that findings of clinical examination may vary in different subjects. In our study showed that isolated MM injury was 86.6%. The study of Rahman *et al.* (2010) and Sharma *et al.*(2011) showed that MM injury was common (69.4% and 75% respectively).

We used Hoover classification to evaluate the result postoperatively because it's simple and easy to apply on our patients. When we go through the literatures to compare our results with other results that use the same Hoover classification to evaluate the results.

Briol Gulman, *et al.* (1992) reported excellent-good result in 73.8% after partial meniscectomy done in 128 patients operated by him. Camanho *et al.* (2006) reported excellent-good result in 179 patients out of 194 patients (92.2%), with traumatic meniscus injury, poor result in 14 patients (7.73%).

Martin MA *et al.* (1986) reported excellent results in 41.5%, good results in 43%, fair results in 12% and poor results in 3.5%, on short term after partial arthroscopic meniscectomy done in 116 patients. BK Tay *et al.* (2008) reported excellent-good result in 39 patients out of 51 patients operated by arthroscopic partial meniscectomy, (76.5%). Fair result in 10 patients (19.6%). Poor result in 2 patients only (3.9%).

We found that, our results is comparable with those results, we reported our excellent result in 16 patients (53.3%), good result in 8 patients (26.7%) that mean(excellent-good 80%), fair result in 3 patients (10%) and poor result in 3 patients (10%) that mean (fair and poor 20%), although our sample of patients was smaller than there study.

CONCLUSION

From this prospective interventional study satisfactory functional outcome was found by using Tapper-Hoover grading system. So it may be concluded that result of arthroscopic partial meniscectomy is a good treatment option for medial meniscal tear.

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Incomplete Traumatic Injury of the Subaxial Cervical Spine: Evaluation of the Surgery by a Single Anterior Approach

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Abstract

In the last 20 years, debate has been going on regarding the best choice of approach to stabilize the cervical spine, finally the verdict is going towards the anterior approach. But, this approach has not been tested at our facilities. The aim of this study was to decompress the cord directly by anterior approach and there by promote early functional recovery and to determine the clinical improvement at our available facilities. 33 patients of subaxial cervical spine injuries admitted to the Spine unit of, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, were observed prospectively. Through anterior approach we performed the corpectomy and stabilized spine with cervical locking plate and cage filled with bone graft. Patients were assessed radiologically using Bridwell Fusion Grade, neurologically using the American Spinal Injury Association (ASIA) scale and functionally according to Denis Pain Index and Denis Work index. Neurological status improved in 30 patients (90.9%) and 3 patients (9.10%) ASIA grade remained unaltered. Results of bony fusion was satisfactory with grade I being 81.8% and grade II being 18.2%. Denis pain scale revealed significant ($p < .05$) improvement in pain status of the patient at last follow-up. Denis work scale showed 81% of patients were able to return to work. The anterior approach used for subaxial cervical spine fracture-dislocation with incomplete neurological deficit is a safe and effective approach and enhances neurological recovery, reduces pain and improves working status. This approach can be used at our available facilities.

Keywords: Sub-axial cervical spine, anterior approach, neurological status improved 90.9%.

INTRODUCTION

Cervical spinal fractures make up 20 to 30% of all spinal fractures and 10 to 20 percent of these fractures result in cervical spinal cord injuries (SCI). Subaxial cervical spine injuries anatomically consist of C3 to C7 injuries and more than 50% of cervical spine injuries are between C5 and C7^{1,2}. Cervical cord injuries are 2-2% of all trauma patients,

representing more than half of all spinal cord injuries and accounting for 8.2% of all trauma-related deaths³. Those who survive their death, many a times face catastrophic outcomes, including tetraplegia, and serious permanent disability.

Incomplete injury defines partial preserving of sensory and motor functions below the neurological level and in

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the lower sacral segments. A complete injury means full loss of motor and sensory functions at the distal level of injury^{4, 5}. Lower early mortality rate is associated with incomplete cervical cord injuries with a better rate of patients returning home to a functional lifestyle resumption^{6, 7}. To offer a functional walking recovery in incomplete cases, a clear and evidence-based diagnosis and treatment plan is crucial.

The treatment of unstable cervical spine injuries are reduction and stabilization of the injured segment, and decompression where indicated. The approach ranges from anterior or posterior or combined approach for surgical fusion. However, there is controversy about the selection of an ideal approach^{8, 9}. The anterior approach is a less traumatic and provides the ability for decompression, reduction of dislocated facet joints, interbody grafting with reconstruction and maintenance of lordosis. Although fusion rates are high, it is associated with significant graft site morbidity⁹. Data from the only previous research on anterior cervical spine decompression in our country is sparse with a small sample size¹⁰. The study also advocated a further study with a large sample size.

Spinal Cord Lesions are a major public health problem in Bangladesh. High incidence of spinal cord lesion as a result from falls from a height, and from falling when carrying a heavy weight on the head, has been explained by the mainly agriculturally based economy of Bangladesh. Most of the patients were between 20 - 40 years old¹¹. This age group are the main work force of a nation. For the patient, family and country, the lifetime financial burden of people sustaining spinal cord injuries may be enormous.

Through anterior approach we performed the corpectomy and stabilized the subaxial cervical spine with cervical locking plate and cage filled with bone graft. The aim of our research was to decompress the cord directly and there by promote early functional recovery and to determine the clinical improvement in terms of neurological outcome, and radiographic fusion rates at our available facilities.

METHOD:

This prospective study observed 33 patients of subaxial cervical spine injuries admitted to the Spine unit of, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, from January 2017 to June 2018 and these patients were assessed radiologically using Bridwell Fusion Grade¹², neurologically using the

American Spinal Injury Association (ASIA) chart¹³, and functional outcomes according to Denis Pain Index and Denis Work Scale index¹⁴. Ethical clearance was taken from the Institutional review board of NITOR and informed written consent was taken from all the patients.

At National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Philadelphia hard cervical collar or cervical traction (Gardner-Wells tongs) is applied till the fracture is reduced. We included early and late cases of traumatic cervical spine (C3-C7) injury patients of both sexes, aged between 20-70 years having incomplete neurological deficit. Cases with pathological fracture of cervical spine, Complete cord lesion, infective condition of the spine and patients unwilling to participate in the study were excluded.

On admission of the patient history, clinical examination, routine and specific blood investigations were done which includes complete hemogram, renal function test, serum electrolytes, fasting blood sugar, electrocardiogram, viral markers for Hepatitis B, Hepatitis C. The radiological examination includes cervical spine radiograph anteroposterior view, lateral view, chest radiograph posteroanterior view and MRI of the cervical spine with whole spine screening was done in all patients [Figure:1].



Fig-1: Radiological examination after admission

Intravenous antibiotic (3rd generation cephalosporin) and injection hydrocortisone 1000 mg intravenous are given at the time of induction for general anesthesia. All patients were given intravenous antibiotics (3rd generation cephalosporin and flucloxacillin) for 5 days' after surgery. All patients were mobilized with Philadelphia collar as soon as possible by 1st-2nd day. Postoperatively, routine anteroposterior and lateral view of cervical spine was obtained [Figure 2] to assess the placement of cervical locking plate. The negative suction drain was removed 2nd postoperative day after the wound inspection. The patient was discharged on the 5th postoperative day. Sutures were removed on the 14th postoperative day in the outpatient department.



Fig.-2: Post-operative radiograph and photograph

All patients were evaluated postoperatively at 1 month, 2 months, 4 months, 6 months, and 1 year [Figure 3]. Static cervical exercises advised after the surgery. Cervical movements allowed at 6 weeks. Fusion of bone graft was assessed using Bridwell Fusion Grade, neurologically using the American Spinal Injury Association (ASIA) chart, and functional outcomes according to Denis Pain Index and Denis Work Scale index. The parameters were analyzed by the paired t-test and the chi-square test, and $P < 0.05$ was considered statistically significant.

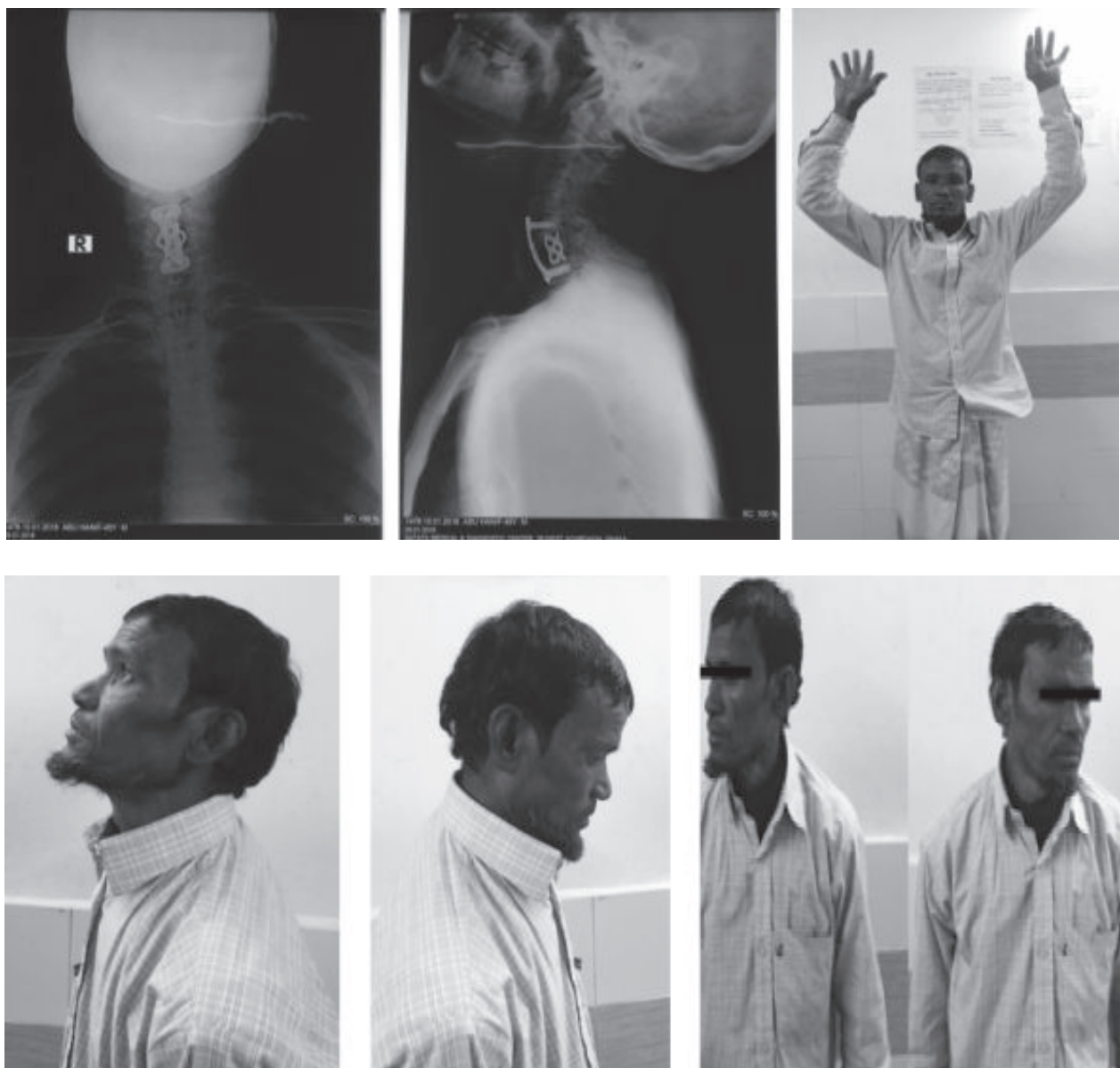


Fig.-3: Patients follow up at 1 year

Result**Table 1***Demographic and injury characteristics of the study subjects (n =33)*

| Characteristics | Value |
|------------------------|-----------------|
| Age | |
| 20 to 30 years | 9(27.3) |
| 31 to 40 years | 12(36.4) |
| 41 to 50 years | 1(3.0) |
| 51 to 60 years | 8(24.2) |
| 61 to 70 years | 3(9.1) |
| Mean (\pm SD) | 41.1 \pm 13.3 |
| Total | 33(100) |
| Sex | |
| Male | 29(87.9) |
| Female | 4(12.1) |
| Causes of injury | |
| Fall with load on head | 6(18.2) |
| RTA | 8(24.2) |
| Fall from height | 13(39.4) |
| Fall on ground | 2(6.1) |
| Fall of heavy object | 4(12.1) |
| Level of injury | |
| C3/4 | 3(9.1) |
| C4/5 | 2(6.1) |
| C5/6 | 22(66.7) |
| C6/7 | 6(18.2) |

Values are presented as frequency, mean or percentage. SD: Standard Deviation. Percentage in the parenthesis

The age of the patients ranged from 20 to 70 years, mean \pm SD being 41.1 \pm 13.3 years. The commonest age group was 31-40 years. Out of 33 patients, 12 (36.4%) were in this group. Male patients were more frequently affected than female. Out of 33 patients, 29 (87.9%) were male and 4 (12.1%) female. All the 33 patients presented with a history of trauma (100%). Out of them 13 (39.4%) had fall from height, 8(24.2%) had RTA, 6(18.2%) had fall with load on head, 4(12.1%) had fall of heavy object and 2(6.1%) had fall on ground. In this series, most common level of injury was in C5/6 level 22(66.7%), followed by C6/7 6(18.2%), C3/4 3(9.1%), and C4/5, 2(6.1%) [Table: 1].

Table II*Assessment of neurological status in ASIA impairment scale(n=33)*

| On Admission | Frequency | On last Follow up | Shift of grade | Frequency |
|---------------------|-----------|-------------------|----------------|-----------|
| ASIA B | 8(24.2) | ASIA B | 0 | 3 |
| | | ASIA C | 1 | 5 |
| | | ASIA D | 2 | 0 |
| | | ASIA E | 3 | 0 |
| ASIA C | 13(39.4) | ASIA B | -1 | 0 |
| | | ASIA C | 0 | 0 |
| | | ASIA D | 1 | 11 |
| | | ASIA E | 20 | 2 |
| ASIA D | 12(36.4) | ASIA B | -2 | 0 |
| | | ASIA C | -1 | 0 |
| | | ASIA D | 0 | 0 |
| | | ASIA E | 1 | 12 |
| Shift of ASIA grade | | | Frequency | |
| No grade shift | | | 3(9.1) | |
| 1 grade shift | | | 28(84.8) | |
| 2 grade shift | | | 2(6.1) | |
| Total | | | 33(100) | |

Percentage in the parenthesis

Highest number of patients 13(39.4%) were in ASIA grade C on admission. 11 cases improved by 1 grade (84-6%) and 2 cases improved by 2 grades (15.4%). 8 patients were in ASIA B on admission. Final follow up showed 5 patients improved by 1 grade (62.5%) and 3 patients did not improve and grade remained same. 12 patients were in ASIA D on admission. All 12 patients reached ASIA E. Majority of the patients had shifted by ASIA grade I 27(81.8%) and Grade II 2(6.1%) and no shift 3(9.1%). So, in total 30(90.9%) patients had improvement of ASIA grade. No downgrading is observed [Table II].

Table-III*Assessment of radiological status (n=33)*

| Radiological status | Frequency |
|--|-----------|
| Bridwell Fusion Grade | |
| Grade I:Fused with remodeling and trabeculae | 27(81.8) |
| Grade II:Graft intact, not fully remodeled and incorporated, no lucencies. | 6(18.2) |
| Grade III: Graft intact with definite lucency at the top and bottom of the graft | 00 |
| Grade IV:Graft definitely not fused with graft resorption and collapse. | 00 |
| Total | 33(100) |

Table-IV
Assessment of functional status (n=33)

| Denis work scale | | | |
|--|--------------|-------------------|-------------------|
| W1: Return to previous employment (heavy labor) or physically demanding activities | | | 7(21.2) |
| W2: Able to return to previous employment (sedentary) or return to heavy labor with restrictions | 17 | | 17(51.5) |
| W3: Unable to return to previous employment but works full time at new job | | | 3(9.1) |
| W4: Unable to return to full time work | | | 3(9.1) |
| W5: No work, completely disabled | | | 3(9.1) |
| Denis pain scale | | | |
| | On admission | On last follow-up | p-value |
| P1: no pain | 0(00) | 19(57.6) | <0.05 |
| P2: occasional mild pain, not requiring medication | 5(15.1) | 10(30.3) | (Measured |
| P3: moderate pain, occasional use of medication, not precluding the performance of professional or daily activities | 11(33.3) | 2(6.06) | by paired t test) |
| P4: Moderate to severe pain, occasional job absence, significant changes on daily activities | 10(30.3) | 2(6.06) | |
| P5: Continuous severe pain; use of chronic medications for pain | 7(21.2) | 0(00) | |
| Mean ±SD | 3.58±1.42 | 1.61±0.87 | |

Values are presented as frequency, mean or percentage.

SD: Standard Deviation.

Percentage in the parenthesis

PERCENTAGE IN THE PARENTHESIS

Assessment of radiological status according to Bridwell Fusion Grade showed majority of the patients with fused with remodeling and trabeculae (grade I) 27(81.8%) stage and Graft intact, not fully remodeled and incorporated, no lucencies (Grade II) was only in 6(18.2%) cases. However, there was no grade III or IV [Table III].

Denis work scale Showed highest number of patients were found in grade W2 17(51.5%), W1 7(21.2%), W3 was 3(9.1%), W4 scale 3(9.1%) and W5 was 3(9.1%). On admission 11 patients scored 3(33.3%) in Denis pain scale. 10 patients (30.3%) scored 4, 7 patients scored 5(21.2%) and 5 patients scored 2(15.1%) with a mean score 3.58±1.42. At last follow up, 19 patients (57.6%) scored 1, 10 patients (30.3%) scored 2, 2 patients scored 3 and another 2 scored 4 (6.06%) each. The p value is less than 0.05. So, there was significant improvement in pain status of the cases at last follow-up [Table IV].

DISCUSSION

Operative treatment of the patient with an unstable cervical spine has undergone many advances, including the use of instrumentation to impact immediate stability and

maintain alignment to promote fusion¹⁵. In this study, the cases were carefully selected for surgery and the approach was selected on the basis of available local facilities and the paying capability of the patient. The present study was conducted in NITOR from January 2017 to July 2018 to find out the effectiveness of anterior approach in the treatment of subaxial cervical spine injury with neurological deficit at our available facilities.

In this study, out of 33 patients, 9 patients (27.3%) were aged between 20-30 years, 12 patients were aged between 31-40 years (36.4%) and the rest 12 were over 40 years (36.4%). Mean± SD was 41.1 ± 13.3 (28-54 years). Gao et al. (2013) took mean age 41.5 years, range 21-72 years¹⁶. Rahman et al. (2017) showed that 25.7% patients were between 20-29 years, 24% were between 30-39 years and 35.15% were above 40 years¹⁷. Both the results correlate with the findings of this study. High incidence of young adult in the series is because they are actively working group of people. In my study, out of 33 patients, 29(87.9%) were male and 4(12%) were female. Brown et al. (1988), observed male predominance with 92.3% and female only 7.7%. Haque et al. (1999) included 88% male and 12% female¹¹. Male predominance in these studies indicate that,

as they are a major working force and continuously exposed to external environment, they are more likely to suffer injury.

In this series, the most common cause of injury was fall from height 13 (39.4%). RTA 8 (24.2%), fall with load on head 6 (18.2%), fall of heavy object on head 4 (12.1%), and fall on ground 2 (6.06%). Aebi, (2009) stated that 55% of the injuries is located at the level of C5/6². Rob et al. (2016) found that the most common injured level was C5/6 (33.3%). In this study, most common level involved is C5/6 22 (66.7%) which correlates with both the studies¹⁸.

One of the methods used for clinical assessment of spinal cord injury is the American Spinal Injury Association (ASIA) impairment scale. It is well known that the recovery from the spinal cord injury depends on the initial severity of the injury or the ASIA impairment scale (Shakya, Bista & Shrestha, 2014). Lee et al. (2016) achieved 86% improvement neurologically using the ASIA impairment scale¹⁹. Rob et al. (2016) obtained 91.7% improvement in neurological status. In our study, 13 were in ASIA grade C (39.4%), 12 were ASIA grade D (36.4%) and ASIA grade B 8 (24.2%)¹⁸. On follow-up, neurological status improved in 30 patients (90.9%) and 3 patients (9.1%) grade remained the same. The neurological outcome in my study with ASIA impairment scale is comparable with the studies mentioned.

Corticocancellous bone harvested from the iliac crest is widely used for the cervical spine. A systemic review of the literature reported was autograft to have a mean arthrodesis rate to be 77%²⁰. Koller et al. (2009) assessed fusion grade using Bridwell et al. and 26 patients were followed up, and according to interobserver rating and assessment of fusion, fusion grade was 88.5%²¹. In this study grade I was 27 patients (81.8%) and grade II was 6 (18.2%) patients.

Koller et al. (2009) used Denis work scale to assess working capabilities of the patients. Out of 19 patients, 16 had W1 (84.2%), 1 had W3 (5.26%) and 2 patients had W4 (21.5%). 84% patients were able to go back to work²¹. In this study, 17 patients were in grade W2 (51.5%), W1 7 (21.2%), W4 3 (9.1%), W3 3 (9.1%) and W5 were 3 (9.1%) patients. 81 patients were able to go back to work. So, both the studies correlate in terms of Denis work scale. On admission 11 patients scored 3 (33.3%) in Denis pain scale. 10 patients (30.3%) scored 4, 7 patients scored 5 (21.2%) and 5 patients scored 2 (15.1%) with a mean score 3.58±1.42. At last follow up, 19 patients (57.6%) scored 1, 10 patients (30.3%) scored 2, 2 patients scored 3 and another 2 scored 4 (6.06%) each. The p value is less than 0.05. So, there was significant

improvement in pain status of the cases at last follow-up. Similar study conducted by Denis et al. (1984) showed significant improvement on Denis pain scale¹⁴.

The study shows that the surgery of subaxial cervical spine fracture-dislocation with incomplete neurological deficit through a single anterior approach is relatively safe and effective procedure with good neurological and radiological outcome. It reduces pain and improves working status of the patient. This approach can be used at our available facilities.

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Conflict of interest

The authors disclose and confirm no conflict of interest.

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Comparative study of titanium elastic nailing versus hip spica cast in treating paediatrics femoral diaphyseal fracture of age group 6-10 years

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Abstract

Treatment option of the femoral shaft fracture is controversial in children of age 6-10 years. The results of previous studies comparing Titanium Elastic Nail (TEN) with traction and a spica cast were mostly in favor of TEN but in particular, the recent shift to operative management needed to be validated, especially for center, where facilities are lacking. The present study is aimed to evaluate and compare the results of treatment by surface traction followed by hip spica cast with those of elastic nailing fixation in school-aged children (6–10 years) diagnosed with closed femoral fracture. Total 40 patients aging between 6 to 10 years were included in the study and compared between groups. All cases were evaluated by clinical features, radiological and functional outcome. Six months follow up was done. The mean age was 8.525 ± 1.28 year with a male predominance (65%). In TENS group, LLD (0.53 ± 0.45) is significantly lower than HS group (1.175 ± 0.406). Mean coronal malalignment in TENS group was 0.850 ± 2.1090 whereas, it was significantly higher in HS group (5.70 ± 3.1970). In TENS group, 14 (70%) cases were found excellent, 5 (25%) were good and 1 (5%) case was found to be poor. However, in hip spica group, 4 (20%) cases were found excellent, 14 (70%) were good and 2 (10%) found poor at last follow up. Both of the procedure is safe in regards of complication, time required for radiological union. Patient treated with titanium elastic nails, coronal alignment is better; patients can start walking earlier and can return to school earlier in compare to hip spica group. But still hip spica can be a valid alternative in low resource situation.

Key words: Fracture shaft of femur, Titanium elastic nailing, Hip Spica

INTRODUCTION

Femoral-shaft fractures are among the most common fractures of the lower extremity in children, with an annual incidence of up to 1 per 5,000 and the commonest requiring hospital admission.¹⁻³ They account for 1.6% of all

fractures in paediatric population and requires prolonged immobilization or surgery that can result in significant morbidity.^{4, 5} Because almost all femoral shaft fractures require hospital admission, they are one of the most expensive injuries to treat in childhood.⁶

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Treatment option of the femoral shaft fracture is controversial in children of age 6-10 years.⁷ There are a wide range of conservative and surgical options available. The options include skeletal or skin traction (with or without the delayed application of either a hip spica or a cast brace), early (or immediate) application of a hip spica cast, external fixation and internal fixation, including plating and the insertion of intramedullary nails (both traditional intramedullary nails or multiple flexible intramedullary nails).^{8,9}

In children older than six years, flexible intramedullary nailing is currently favored. It requires shorter hospital stays and less care during implant removal.¹⁰ Surgery, however, comes at the risk of surgical complications, including infection, neurovascular injury and damage to the growth plate. Often a second operation is required for implant removal. The main disadvantage is that these nails are less suitable for unstable fracture patterns and in heavier children.¹¹ The spica cast has been used as a definitive treatment since the mid-20th century and remains an indispensable skill for an orthopaedist. This safe form of treatment has some drawbacks: limb length discrepancy, angulations, loss of reduction, prolonged bed rest, maternal duties overload, difficulty in transporting child and high cost of bed for hospital for long period which might be able to serve other patients.^{7, 12}

The results of previous prospective and retrospective studies comparing TEN with traction and a spica cast were mostly in favor of TEN, considering recovery time, complication rate, and in some cases hospital charges.^{3, 13, 14} But in particular, the recent shift to operative management in 6-10 years age groups needs to be validated, as there are other trusted alternative and especially for a resource-compromised setting like our country. As there is a lack of data in Bangladesh in this regard, the present study is aimed to evaluate and compare the results of treatment by early reduction and spica cast with those of elastic nailing fixation in school-aged children (6–10 years) diagnosed with closed femoral fracture.

METHOD:

This prospective study observed 40 paediatric patients of femoral shaft fracture aged between 6 to 10 years presented at National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, from July 2017 to June 2019. Minimally comminuted, transverse or oblique closed fractures of the shaft of femur of less than two weeks duration and patient's guardian willing to give informed written consent for the study were included in the study. Undisplaced, Spiral, comminuted (Winquist type III & IV)

or pathological fracture and patient with weight more than 49 kg or with neuromuscular disorder, cerebral Palsy, metabolic bone disorder, osteomyelitis were excluded. Using purposive sampling method the patients were allocated in equal half of 20 in each group, one TENS (Titanium Elastic Nails) group and another is hip spica group for comparison. This study was approved by the Institutional Review Board (IRB), National Institute of Traumatology and Orthopedic Rehabilitation (NITOR).

All cases were admitted in the ward. X-ray of the affected thigh including hip and knee was done in antero-posterior and lateral views, X-ray pelvis including both hip antero-posterior and lateral views. Surface traction was applied in all patients just after admission. In case of TENS group, operation was done within 1 to 2 weeks after admission. In hip spica group, once callus has appeared as seen in skiagrams, hip spica cast was applied. This usually took 2 to 3 weeks. Isometric quadriceps exercise was started day after intervention of both groups.

In TENS group, stitches were removed on 12th to 14th post-operative day and the patients were allowed to walk as long as pain was tolerable by using crutches without weight bearing on affected limb. Adequate antibiotics were given for two weeks in all the cases of TENS group. In hip spica group, spica cast was kept for 6 to 8 weeks depending upon radiological union of the fracture. Once radiological union was seen in skiagrams, spica was removed. After removal of spica cast, non-weight bearing hip, knee and ankle mobilizing exercises were advised for 3 to 4 weeks. After 1-week, protected weight bearing was allowed.

All patients were advised to attend at follow up sessions at 2nd, 4th, 6th, 8th and 10th weeks then every month to a minimum of 6 months up to 8 months. The pain was evaluated using Visual Analogue Scale (VAS). The functional outcome was evaluated at last follow up according Flynn criteria which assessed leg-length discrepancy, malalignment, Pain and complication. Data was processed using computer software program Microsoft Excel 2010 and analyzed using SPSS version 25.0. The data present on categorical scale was expressed as frequency and corresponding percentage, while the quantitative data was presented as mean and standard deviation (SD). P value was measured by either student t test or Fishers' exact test. P value less than 0.05 is taken as significant.

RESULTS

The overall mean age was 8.525 ± 1.28 year, ranging from 6 to 10 years. Maximum age incidence was found in 9-10 years of age in both groups. The mean age was 8.5 ± 1.357 in TENS group and 8.55 ± 1.234 in hip spica group. There was no significant difference as the P-value was 0.903 which is >0.05 . [Table1]

Table 1
Age of the patients in different groups

| Age group (In years) | TENS group (n=20) Frequency | Hip Spica group (n=20) Frequency | Total (n=40) Frequency | p-value |
|-------------------------|--------------------------------|-------------------------------------|---------------------------|---------|
| 5-6 | 2(10) | 1(5) | 3(7.50) | 0.903 |
| 7-8 | 7(35) | 9(45) | 16(40.00) | |
| 9-10 | 11(55) | 10(50) | 21(52.50) | |
| Mean±SD | 8.5±1.357 | 8.55±1.234 | 8.525±1.28 | |

Values are presented as frequency, mean or percentage. SD: Standard Deviation. Percentage in the parenthesis. Student t test was employed to see the difference.

Out of 40 patients 26 (65%) were male and 14 (35%) were female. In TENS group, 12 (60%) were male and 8 (40%) were female. And in hip spica group out of 20 patients, 14 (70%) were male and 6 (30%) were female. So, male patients were predominant in this study. [Figure 1]

In all fractures in both groups, bridging callus appeared in between 5 to 9 weeks with a mean bridging callus formation time 6.15 ± 0.892 weeks. In TENS group, the mean time of was 5.7 ± 0.733 weeks and 6.6 ± 0.821 weeks in hip spica group with significant difference between groups (p value < 0.05). [Table II]

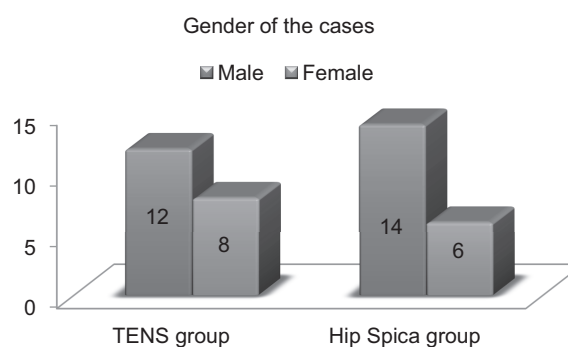


Fig-1: Showing Gender of the cases

Table-II
Comparison of time to appear bridging callus (in weeks)

| Time to appear bridging callus (In weeks) | TENS group (n=20) Frequency | Hip Spica group (n=20) Frequency | Total (n=40) Frequency | P value |
|---|-----------------------------------|--|------------------------------|---------|
| 5 | 8(40) | 1(5) | 9(22.50) | 0.002 |
| 6 | 11(55) | 8(40) | 19(47.50) | |
| 7 | 0(0) | 10(50) | 10(25) | |
| 8 | 1(5) | 0(0) | 1(2.50) | |
| 9 | 0(0) | 1(5) | 1(2.50) | |
| Mean±SD | 5.7±0.733 | 6.6±0.821 | 6.15±0.892 | |

Percentage in the parenthesis. Student t test was employed to see the difference.

In both groups, radiological union has occurred in between 9 to 14 weeks with a mean union time 10.35 ± 1.099 weeks. In TENS group, the mean time of was 10.1 ± 1.294 weeks and 10.6 ± 0.821 weeks in hip spica group with no significant difference between groups. [Table 3]

Table III
Comparison of time to radiological union (in weeks)

| Radiological Union (In weeks) | TENS group (n=20) Frequency | Hip Spica group (n=20) Frequency | Total (n=40) Frequency | p-value |
|-------------------------------|--------------------------------|-------------------------------------|---------------------------|---------|
| 9-10 | 16(80) | 9(45) | 25(62.50) | 0.143 |
| 11-12 | 3(15) | 10(50) | 13(32.50) | |
| 13-14 | 1(5) | 1(5) | 2(5) | |
| Mean±SD | 10.1±1.294 | 10.6±0.821 | 10.35±1.099 | |

Percentage in the parenthesis. Student t test was employed to see the difference.

At last follow up, only 3 (7.5%) cases have complained of mild pain and 37 (92.5%) cases have had no pain. In TENS group, 1 (5%) and in hip spica group, 2 (10%) cases have complained of pain. There was no difference in pain status at last follow up in between groups (p value > 0.05). [Table IV]

The mean coronal malalignment was found in this study was 3.275±3.63 degree. In TENS group, in 17 (85%) cases there were no coronal malalignment found at last follow up. 3 to 5-degree malalignment found in 2 (10%) cases and 6 to 8 degree in 1 (5%) case. The mean was 0.85±2.109 degree. However, in hip spica group, there were no coronal malalignment in only 3 (15%) case. Six (30%) cases had 3 to 5 degree, 8 (40%) had 6 to 8 degree and 3 (15%) had 9 to

11-degree coronal malalignment. The mean coronal malalignment in this group was 5.7±3.197 degree. The incidence of coronal malalignment was significantly higher in hip spica group than TENS group (p value< 0.05) [Table 5]. The mean sagittal malalignment was found in this study was 0.9±2.205 degree. In TENS group, in 17 (85%) cases there were no sagittal malalignment found at last follow up. 5-degree malalignment found in 2 (10%) cases and 7 degree in 1 (5%) case. The mean was 0.85±2.109 degree. However, in hip spica group, there were no sagittal malalignment in 17 (85%) cases. One (5%) case had 5 degree and 2 (10%) had 7-degree sagittal malalignment. The mean sagittal malalignment in this group was 0.95±2.35 degree. The incidence of sagittal malalignment was indifferent in both groups (p value> 0.05) [Table V].

Table-IV
Comparison of pain status (according to VAS) at last follow up

| Pain at last follow up | TENS group (n=20) Frequency | Hip Spica group (n=20) Frequency | Total (n=40) Frequency | p-value |
|------------------------|--------------------------------|-------------------------------------|---------------------------|---------|
| No pain (VAS 0) | 19(95) | 18(90) | 37(92) | 0.99 |
| Mild Pain (VAS 1-3) | 1(5) | 2(10) | 3(7.50) | |
| Total | 20(100) | 20(100) | 40(100) | |

Percentage in the parenthesis. Fisher's exact test was employed to see the difference.

Table V
Comparison of Mean malalignment in between groups

| Mean misalignment | TENS group (n=20) | Hip Spica group (n=20) | Total (n=40) | p-value |
|-----------------------|-------------------|------------------------|--------------|---------|
| Coronal misalignment | | | | |
| Mean±SD | 0.85±2.109 | 5.7±3.197 | 3.275±3.63 | 0.0146s |
| Sagittal misalignment | | | | |
| Mean±SD | 0.85±2.109 | 0.95±2.35 | 0.9±2.205 | 0.887 |

Percentage in the parenthesis. Student t test was employed to see the difference.

Total incidence of complication was 7 (17.5%). Muscle wasting was present in 4 (10%) cases (2 in each group). There was 1 (5%) incidence of skin irritation in TENS group and 2 (10%) incidence of plaster sore in hip spica group. [Table VI].

Regarding limb length discrepancy, the mean LLD was 0.85 ± 0.535 cm ranging from 0 cm to 1.5 cm. In TENS group, 7 (35%) had no LLD, 9 (45%) cases have 0.5-0.9 cm LLD, 3 (15%) had 1.0-1.4 cm LLD and 1 (5%) case has 1.5 cm LLD from normal lower limb. The mean LLD was 0.53 ± 0.45 . In hip spica group, 4 (20%) cases had LLD 0.5-0.9 cm, 5 (25%) had 1-1.4 cm LLD and 11 (55%) had 1.5 cm LLD. The mean

LLD in this group was 1.175 ± 0.406 . The TENS group had a significant lower LLD than hip spica group (p value < 0.05). [Table VII]

Among the 40 cases, 18 (45%) were scored excellent as per Flynn criteria at last follow up. Nineteen (47.5%) were found good and 3 (7.5%) were found poor. In TENS group, 14 (70%) cases were found excellent, 5 (25%) were good and 1 (5%) case was found to be poor at last follow up. However, in hip spica group, 4 (20%) cases were found excellent, 14 (70%) were good and 2 (10%) found poor at last follow up. In TENS group, outcomes were significantly excellent than hip spica group (p value was 0.0036). [Table VIII]

Table VI
Complications of the cases

| Complications | TENS group (n=20) | Hip Spica group (n=20) | Total (n=40) |
|-----------------|-------------------|------------------------|----------------|
| | Frequency | Frequency | Frequency |
| No Complication | 17(85) | 16(80) | 33(82.50) |
| Muscle wasting | 2(10) | 2(10) | 4(10) |
| Skin irritation | 1(5) | 0(0) | 1(2.50) |
| Plaster sore | 0(0) | 2(10) | 2(5) |
| Total | 20(100) | 20(100) | 40(100) |

Percentage in the parenthesis

Table VII
Comparison of limb length discrepancy (LLD) at last follow up

| LLD at last follow up (In cm) | TENS group (n=20) | Hip Spica group (n=20) | Total (n=40) | p-value |
|-------------------------------|-------------------|------------------------|------------------|---------|
| | Frequency | Frequency | Frequency | |
| 0-0.4 | 7(35) | 0(0) | 7(17.5) | |
| 0.5-0.9 | 9(45) | 4(20) | 13(32.5) | |
| 1.0-1.4 | 3(15) | 5(25) | 8(20) | |
| ≥ 1.5 | 1(5) | 11(55) | 12(30) | |
| Mean \pm SD | 0.53 ± 0.45 | 1.175 ± 0.406 | 0.85 ± 0.535 | 0.000 |

Percentage in the parenthesis. Student t test was employed to see the difference.

Table VIII
Comparison of functional outcome according to Flynn criteria

| Outcome criteria | TENS group (n=20) | Hip Spica group (n=20) | Total (n=40) | P value |
|------------------|-------------------|------------------------|----------------|---------------|
| | Frequency | Frequency | Frequency | |
| Excellent | 14(70) | 4(20) | 18(45) | |
| Satisfactory | 5(25) | 14(70) | 19(47) | |
| Poor | 1(5) | 2(10) | 3(7.50) | |
| Total | 20(100) | 20(100) | 40(100) | 0.0036 |

Percentage in the parenthesis. Fisher's exact test was employed to see the difference.

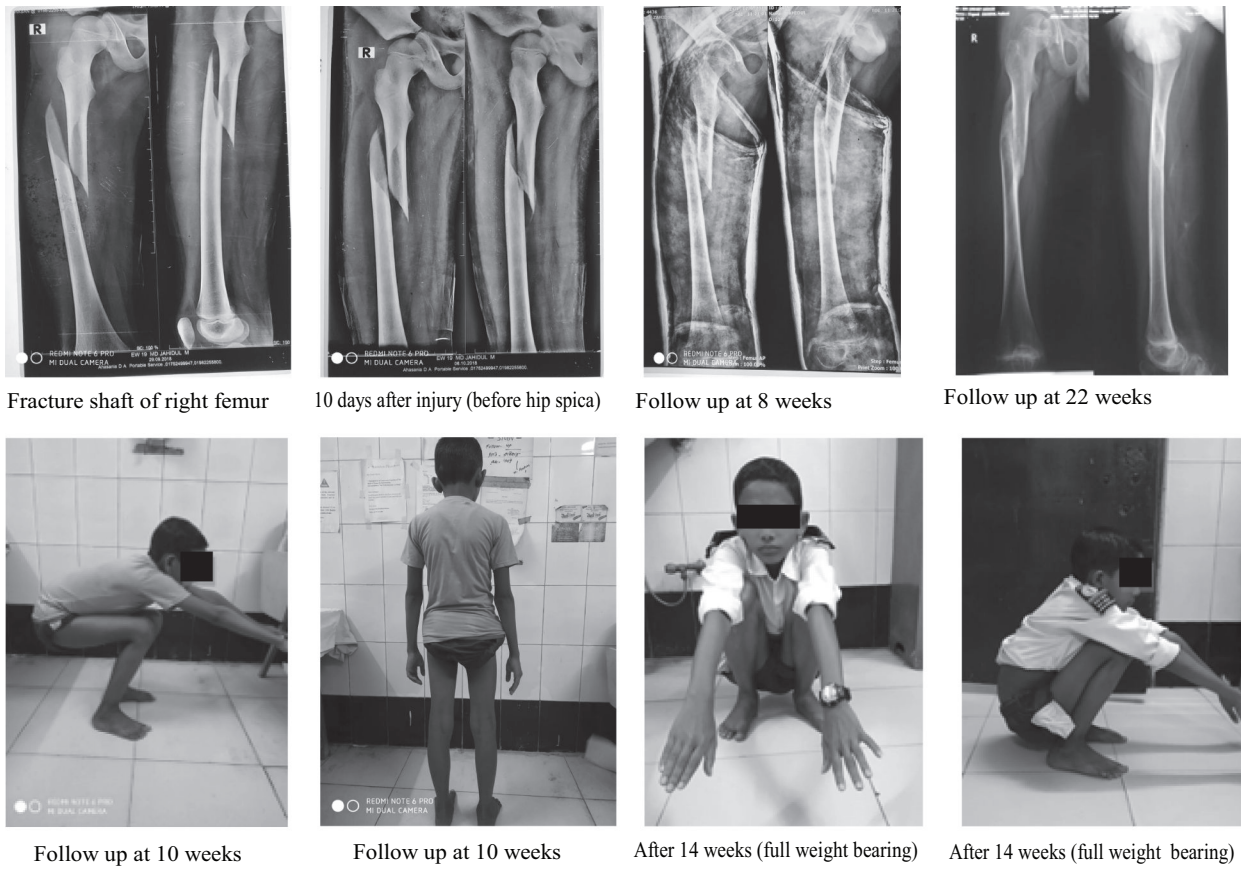


Figure 2 a representative image from a 10-year old boy with femoral shaft fracture from hip spica group

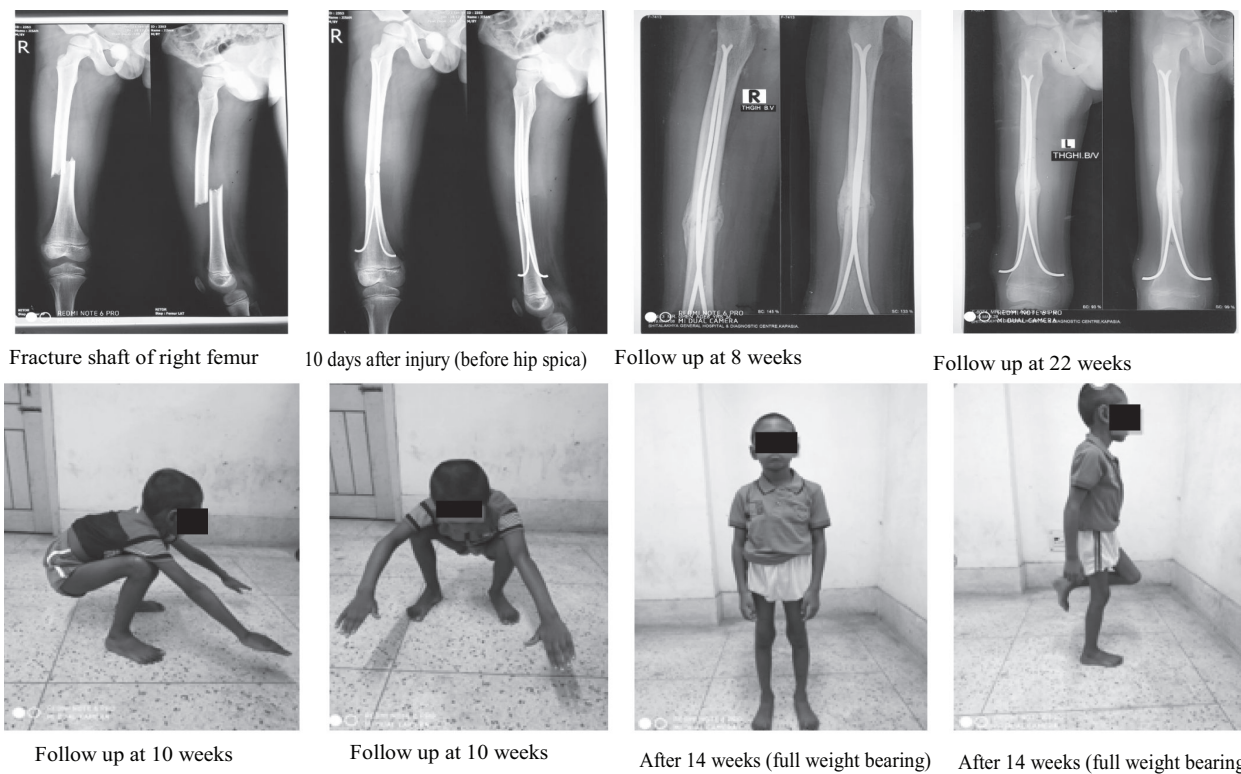


Figure 3 a representative image from a 08-year old boy with femoral shaft fracture from TENS group

DISCUSSION

The present study has been undertaken in NITOR from July 2017 to June 2019 to evaluate the outcome of TENS and Hip spica in treating Paediatric closed shaft of femur fracture and compare the results. Twenty cases from each group satisfying the inclusion and exclusion criteria were selected for this study.

In this study, the mean age was 8.525 ± 1.28 year, ranging from 6 to 10 years. Maximum age incidence was found in 9-10 years of age in both groups. The mean age was 8.5 ± 1.357 in TENS group and 8.55 ± 1.234 in hip spica group. There was no significant difference as the P-value was 0.501 which is > 0.05 . Various other related studies have also reported similarity in age between this two groups.¹⁵⁻¹⁷ The aggregated mean age of these study cases were 8.53 years which is similar to the present study. In present study, out of 40 patients 26 (65%) were male and 14 (35%) were female. In TENS group, 12 (60%) were male and 8 (40%) were female. And in hip spica group out of 20 patients, 14 (70%) were male and 6 (30%) were female. So, male patients were predominant in this study. Most of the related study review, found males are predominantly affected form closed shaft of femur fracture¹⁵⁻¹⁸.

In all fractures in both groups, bridging callus appeared in between 5 to 9 weeks with a mean bridging callus formation time 6.15 ± 0.892 weeks. In TENS group, the mean time of was 5.7 ± 0.733 weeks and 6.6 ± 0.821 weeks in hip spica group with significant difference between groups. In case of paediatric shaft of femur fracture, bridging callus usually forms within 4 to 6 weeks¹⁹. In TENS group, as there was early weight bearing given, bridging callus appear early which supports the Wolff's law²⁰.

In all fractures in both groups, radiological union has occurred in between 9 to 14 weeks with a mean union time 10.35 ± 1.099 weeks. In TENS group, the mean time of was 10.1 ± 1.294 weeks and 10.6 ± 0.821 weeks in hip spica group with no significant difference between groups. There was no instance of delayed or non-union. In the series of Lohiya, et al., the mean radiological union time was 11 weeks (range 6-18 weeks).¹⁸

Pain was measured with VAS scale²¹. At last follow up, only 3 (7.5%) cases have complained of mild pain and 37 (92.5%) cases have had no pain. In TENS group, 1 (5%) and in hip spica group, 2 (10%) cases have complained of pain. There was no difference in pain status at last follow up in between groups (p value > 0.05).

Regarding limb length discrepancy, the mean LLD was 0.85 ± 0.535 cm ranging from 0 cm to 1.5 cm. In TENS group,

7 (35%) had no LLD, 9 (45%) cases have 0.5-0.9 cm LLD, 3 (15%) had 1.0-1.4 cm LLD and 1 (5%) case has 1.5 cm LLD from normal lower limb. All were within acceptable limit. The mean LLD was 0.53 ± 0.45 cm. In the series of Lohiya, et al., (2011) found LLD in 58% cases and in our series it is 55%¹⁸. In hip spica group, 4 (20%) cases had LLD 0.5 cm, 5 (25%) had 1 cm LLD and 11 (55%) had 1.5 cm LLD. All were within acceptable limit¹⁹. In the present study, the TENS group had a significant lower LLD than hip spica group (p value < 0.05) which has been also reported by others¹⁷.

In TENS group, in 17 (85%) cases there were no coronal malalignment at last follow up. 3 to 5-degree malalignment found in 2 (10%) cases and 6 to 8 degree in 1 (5%) case. The mean was 0.85 ± 2.109 degree. However, in hip spica group, there were no coronal malalignment in only 3 (15%) case. Six (30%) cases had 3 to 5 degree, 8 (40%) had 6 to 8 degree and 3 (15%) had 9 to 11-degree coronal malalignment. The mean coronal malalignment in this group was 5.7 ± 3.197 degree. The incidence of coronal malalignment was significantly higher in hip spica group than TENS group (p value < 0.05). Saseendar, et al., (2010) found in their study that, mean coronal angulation in TENS group and Hip spica group were 3.19 ± 3.35 degree and 9.57 ± 5.61 degree respectively¹⁷. In hip spica group, chance coronal malalignment happened to be more as showed in other series¹⁹. But in 6-10 years age group, coronal angulation up to 10^0 is acceptable¹⁹. In this study, coronal angulation has ranged from 0^0 to 10^0 .

In TENS group, in 17 (85%) cases there were no sagittal malalignment at last follow up. 5-degree malalignment found in 2 (10%) cases and 7 degree in 1 (5%) case. The mean was 0.85 ± 2.109 degree. However, in hip spica group, there were no sagittal malalignment in 17 (85%) cases. One (5%) case had 5 degree and 2 (10%) had 7 degree sagittal malalignment which was acceptable¹⁹. The mean sagittal malalignment in this group was 0.95 ± 2.35 degree. The incidence of sagittal malalignment was indifferent in both groups (p value > 0.05). Saseendar, et al., (2010) found in their study that, mean sagittal angulation in TENS group and Hip spica group were 5.75 ± 6.13 degree and 7.79 ± 5.46 degree respectively with no significant differences between groups¹⁷.

Total incidence of complication was 7 (17.5%). Muscle wasting was present in 4 (10%) cases (2 in each group). There was 1 (5%) incidence of skin irritation in TENS group and 2 (10%) incidence of plaster sore in hip spica group. There was no instance of nerve palsy, nail breakage, fracture displacement, non-union or delayed union in both

groups. There was no significant difference in groups regarding occurrence of complication. Fracture treated with TENS; skin irritation is common problem. Ligier, et al. reported nail irritation was most common complication²². Narayanan, et al. encountered this problem in 51% of their patients²³. But in the present series, there was only one instance of skin irritation because nail was not bended.

Among the 40 cases, 18 (45%) were scored excellent as per Flynn criteria at last follow up. Nineteen (47.5%) were found good and 3 (7.5%) were found poor. In TENS group, 14 (70%) cases were found excellent, 5 (25%) were good and 1 (5%) case was found to be poor at last follow up. However, in hip spica group, 4 (20%) cases were found excellent, 14 (70%) were good and 2 (10%) found poor at last follow up. According to Flynn, et al., (2004) both the excellent and satisfactory results were acceptable¹⁵. In the series of Saseendar, et al., (2010), in the surgical group, the Flynn score was 'excellent' in 12 (75%), 'satisfactory' in 1 (6.2%), and 'poor' in 3 (18.8%), while the scores for the spica group were 'excellent' in 1 (6.2%), 'satisfactory' in 2 (12.5%), and 'poor' in 13 (81.3%)¹⁷. The Flynn scores were better in the TENS group than in the spica group. The most common cause of poor score in the spica group was excessive coronal malalignment and LLD.

From the study, it can be concluded that, both of the procedure is safe in regards of complication and indifferent in regards of time required for radiological union. Only, coronal alignment is better in TENS group than hip spica group. Finally, the functional outcome according to Flynn criteria showed better result in TENS group. But concern raised regarding the costing of titanium nails which is still out of reach to our general population. Moreover, as this technique required more surgical skill along with image intensifier and standard OT facility, it will be difficult to avail this operation all over our country. If the minor difference could be accepted, hip spica still could be a good option in low resource situation.

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Conflict of interest

The authors disclose and confirm no conflict of interest.

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Effect of Metformin on Serum Vitamin B₁₂ and Serum Homocysteine in Patients of Type2 Diabetes Mellitus

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Abstract

Now a day's diabetes mellitus is the most common non communicable disease through the world and metformin is the most common prescribed oral antihypoglycaemic drug for the patients with type2 DM. This was a case control study conducted at department of Biochemistry of BSMMU from January 2016 to January 2018. Total 126 patients were enrolled in this study. Study population were divided into two groups of which non-metformin group was considered as control (group-I) and metformin group was as case (group-II). Plasma homocysteine and plasma vitamin B₁₂ of both group were measured. Hypocobalaminemia was found in 6.5% patients of group II (in metformin group). And a serum homocysteine level was moderately increased among 43.5% patients in metformin group. Treatment of type2 DM patients with metformin causes hypocobalaminemia and hyperhomocysteinemia.

Kew words: Type2 DM, Metformin, Hypocobalaminemia, Hyperhomocysteinemia.

INTRODUCTION:

Diabetes mellitus is a leading cause of death and disability worldwide. Its global prevalence was about 8% in 2011 and its predicted to rise to 10% by 2030. A recent meta-analysis conducted in Bangladesh showed that the prevalence of diabetes among adults had increased substantially from 4% to 9% from 1995 to 2010.¹ According to the International Diabetes Federation, the prevalence will be 13% by 2030.

Metformin is one of the most common prescribed oral antihypoglycaemic drug for patients with type2 DM which is an effective hypoglycaemic agent with less weight gain and decreased hypoglycaemia, myocardial infarction, stroke and death.² But metformin cause vitamin B₁₂

malabsorption. So, it may increase the risk of developing vitB12 deficiency. So diabetic patients who are treated by metformin may develop peripheral neuropathy.³

Metformin might result in an increase in homocysteine concentration. This homocysteine is an independent risk factor for cardio vascular disease in type 2 DM.³ And hyperhomocysteinemia is associated with macroangiopathy, nephropathy, microalbuminuria.^{4,5}

Hence the present study was carried out to identify the effect of metformin therapy on serum vitamin B₁₂ and serum homocysteine in type2 DM patients which will be beneficial for medical practitioners to manage type2 DM patients more efficiently so that they may enjoy a good quality of life.

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METHODS:

Study design and ethical obligations This case control study was conducted at department of Biochemistry of Bangabandhu Sheikh Mujib Medical University (BSMMU) from January 2016 to January 2018. Ethical clearance for the study was taken from IRB, BSMMU. Written informed consent was taken from the patients those who agreed to participate in the study. Patients who were taking vitamin B₁₂ supplements were not included in the study.

A total 126 patients from outdoor of endocrinology department were enrolled in this study. Study populations were divided into two groups. In group-1: type 2 diabetic patients taking various anti-diabetic agents other than metformin (non-metformin group) as control and group-2: type 2 diabetic patients on metformin (metformin group) as case.

Sample collection: All the participants were thoroughly described about the benefits and risk of the study. Blood sample was used for the study and proper safety method was followed for blood collection. For safeguarding confidentiality and protecting anonymity each of the study subjects were given a special identity number which were followed in sample collection, transport to lab and reporting in each and every step of the procedure.

Laboratory method: Estimation of plasma homosysteine Chemiluminescent Micro particle Immunoassay (CMIA) method by Architect Abbott Diagnostics Inc 2012 was used for estimation of plasma homosysteine.⁶ And 5-15 μ mol/L reference range of serum homosysteine was taken as standard.⁷

Estimation of plasma vitamin B₁₂

Chemiluminescent Micro particle Immunoassay (CMIA) by Architect Abbott Diagnostics Inc 2012 was used for estimation of plasma vitamin B₁₂.⁸ 200-1100 pg/ml was taken as normal serum vitamin B₁₂ level and < 200 pg/ml was taken as hypcobalaminemia.⁷

Statistical analysis

The numerical data of the study were compiled and analysed and the results were evaluated by statistical analyses by using standard statistical method SPSS (version 23). Results were expressed by using Chi-square test, one way ANOVA, Mann-Whitney U test.

RESULTS:

Serum vitamin B₁₂ levels of group I is shown at table I and of group II is shown at table II. Among group II population 6.5% were found as vitamin B12 deficient. Serum

homocysteine levels of group I is shown at table III and of group II is shown at table IV. In group II in 43.5% study population serum homocysteine levels of 42.19% study population were moderately increased.

Table I*Serum Vitamin B12 levels in group -I*

| Serum Vitamin B12 levels (pg/ml) | n | Percentage |
|----------------------------------|----|------------|
| Hypcobalaminemia (<200) | 0 | 0 |
| Normal (200-1100) | 60 | 93.8 |
| Hypercobalaminemia (>1100) | 4 | 6.2 |
| Total | 64 | 100.00 |

Table II*Serum Vitamin B12 levels in group -II*

| Serum Vitamin B12 levels (pg/ml) | n | Percentage |
|----------------------------------|----|------------|
| Hypcobalaminemia (<200) | 4 | 6.5 |
| Normal (200-1100) | 58 | 93.5 |
| Hypercobalaminemia (>1100) | 0 | 0 |
| Total | 62 | 100.00 |

Table III*Serum Homocysteine levels in group -I*

| Serum Homocysteine level (μ mol/L) | n | Percentage |
|---|----|------------|
| Subnormal (<5) | 5 | 7.8 |
| Normal (5-15) | 56 | 87.5 |
| Moderate (>15-30) Intermediate (30-100) | 30 | 4.70 |
| Total | 64 | 100.00 |

Table IV*Serum Homocysteine levels in group -II*

| Serum Homocysteine level (μ mol/L) | n | Percentage |
|---|-----|------------|
| Subnormal (<5) | 0 | 0 |
| Normal (5-15) | 36 | 56.25 |
| Moderate (>15-30) Intermediate (30-100) | 271 | 42.191.56 |
| Total | 64 | 100.00 |

DISCUSSION:

This case-control study aimed to find out the effect of metformin therapy on serum level of vitamin B₁₂ and homocysteine among the study population. All the data of socio-demographic status (the mean age, male-female distribution, smoking), clinical (history of hypertension,

duration of DM, blood pressure both systole and diastole) and anthropometric measurements of the participants and mean values showed there was no significant statistical difference among the groups, which reflects the homogeneity of the groups. In the present study, we found mean values of serum homocysteine levels were considerably higher in metformin group, showing statistical significant difference.

Higher levels of homocysteine in diabetic patients were also observed by sheikh et al.⁹ Another study by Dr.Zewoskiet al¹⁰ mentioned that metabolic control of diabetes may influence homocysteine level. Hoogeveen et al¹¹ at his study showed that minimum difference of total serum homocysteine level between metformin and non-metformin group that was not statistically significant but proper reason of such difference was not established.

Hyperhomocysteinemia is associated with macroangiopathy, nephropathy and microalbuminuria and is a risk factor for atherosclerosis.^{4,5,12} Hyperhomocysteinemia was found as an independent risk factor of CVD in diabetic patients. And increased mortality due to CVD was also reported in the population of diabetic patients with hyperhomocysteinemia.¹³⁻¹⁵ Though the significance of small rise of serum Hcy level in diabetic patients is unknown, but Buysschaert et al⁴ estimated that 1mmol/L increase of serum tHcy elevates the risk of coronary artery disease by a factor of approx. 1.1

In this study vitamin B₁₂ deficiency was present in 6.5% of patients using metformin. Another studies reported prevalence of vitamin B₁₂ deficiency from 9.5% to 31% among patients taking metformin.^{16,17} The cause of variation of prevalence of hypcobalaminemia among metformin users may be due to variation of study population. Besides a study in America did not find any significant correlation between metformin use and vitamin B12 deficiency. But the exact reason behind the was not explored.¹⁸

Vitamin B₁₂ deficiency is a reversible cause of demyelinating nerve disease, bone marrow failure, megaloblastic anaemia.¹⁹ As vitamin B₁₂ associated neuropathy is a treatable and reversible condition, early detection and treatment of vitamin B₁₂ deficiency is clinically important for patients with diabetes using metformin.

CONCLUSION:

Treatment of diabetic patients with metformin reduces the level of serum vitamin B₁₂.

Reduction in the level of vitamin B₁₂ thought to be increased the level of plasma homocysteine in patients treated with metformin.

Conflict of interest:

There is no conflict of interest.

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Comparison of the Functional Outcome between Y Reconstruction Plate and Distal Humeral Locking Plate for Treatment of the T-Y Intercondylar Distal Humeral Fracture in Adult

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Abstract

T-Y intercondylar fracture of distal humerus in adults are some of the most complicated and difficult fractures to treat. Successful management of T-Y intercondylar fracture of distal humerus in adult depends on correct reduction of the fracture, reconstruction of the articular surface if needed, stability and rigidity of the fixation and appropriate rehabilitation. To compare the functional outcome between Y reconstruction plate and distal humeral locking plate for treatment of the T-Y intercondylar distal humeral fracture in adult. This Prospective observational study was conducted in the Department of Orthopaedic surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh from March 2017 to September 2019. A total of 40 patients with T-Y intercondylar fracture of distal humerus that underwent surgery were selected and randomly allocated into two groups. Group A consisted of 20 patients who underwent distal humerus locking (DHL) plate and Group B consisted of 20 patients who underwent Y-reconstruction plate. Mayo Elbow Performance Score (MEPS) was used to assess the outcomes. Data were analyzed and compared by statistical tests. The results of present study demonstrate that the postoperative means (\pm SD) pain, motions, stability and function of elbow scores were 30.75 ± 11.10 , 15.25 ± 4.87 , 8.25 ± 2.38 and 5.00 ± 0.00 respectively in group A and 27.00 ± 10.17 , 15.25 ± 4.88 , 7.50 ± 2.50 and 4.65 ± 0.57 respectively in group B. This indicates that MEP score was comparatively better in group A than group B. A total number of 18 (90%) & 17 (85%) patients were in the satisfactory group and only 2 (10%) & 3 (15%) patients were in the unsatisfactory group respectively. This study concluded that DHL plate showed better functional outcome and stability than Y reconstruction plate for the treatment of T-Y intercondylar fractures of distal humerus in adult.

Key words: Distal Humerus Locking (DHL) plate, Mayo Elbow Performance Score (MEPS), T-Y intercondylar fracture of distal humerus, Y reconstruction plate

INTRODUCTION

The humerus is the largest bone in the upper limb. Many powerful muscles that manipulate the upper arm at the shoulder and the forearm at the elbow are anchored to the humerus. Movement of the humerus is essential to all of the varied activities of the arm, such as throwing, lifting, and writing.¹

Intercondylar fractures are the most common fracture pattern in distal humeral fractures. Medial and lateral condyles are usually separate fragments displaced in T or Y configuration and both unconnected from the humeral shaft and rotated in axial plane. The forearm musculature originating on the condyles tends to produce rotational redisplacement even when closed reduction is achieved.

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These fractures are most often caused by falling directly on the elbow, receiving a direct blow to the elbow and falling on an outstretched arm with the elbow. Intercondylar fractures are also sometimes caused by weak or insufficient bone. This is most common in older patients whose bones have become weakened by osteoporosis.²

T-Y intercondylar fractures of the humerus account for approximately 2–6% of all fractures but up to 30% of fractures involving the elbow, with an incidence of 5.7/100000 per year found in United Kingdom.³ The fracture patterns being mainly distributed bimodally, differentiating between young male due to high energy trauma and elderly female patients due to osteoporotic fractures.⁴ In addition, the incidence of distal humerus fractures among the elderly seems to be increased. Palvanen et al. identified more than a 2-fold increase in the age-adjusted incidence of distal humerus fractures in Finnish women older than 60 between 1970 and 1995 and predicted a 3-fold increase by the year 2030.⁵ This is reinforced by Court-Brown and Caesar who also identified an increasing trend in osteoporotic distal humerus fractures as people are living longer and the prevalence of osteoporosis grows.⁶

Several studies have been done on reconstruction of T-Y intercondylar fracture of distal humerus by using different plates. In India, Krishnamurthy et al.⁷, Singh et al.⁸ and Kumar et al.⁹ suggested that open reduction and internal fixation of intercondylar fractures of distal humerus with locking plates is very effective in restoring articular congruity and alignment and early rehabilitation decreasing morbidity, resulting good results. Krishnamurthy et al.⁷ and Dayanand et al.¹⁰ concluded that Y reconstruction plate gave excellent medium-term results in terms of both fixation stability and recovery of elbow function after fracture of intercondyle of distal humerus, even in elderly osteoporotic patients. There is scarce evidence to compare the functional outcome between Y reconstruction plate and distal humeral locking plate for treatment of the T-Y intercondylar distal humeral fracture in adults. So, this study was aimed to compare the functional outcome between Y reconstruction plate and distal humeral locking plate for treatment of the T-Y intercondylar distal humeral fracture in adults.

METHODOLOGY

This was a prospective observational study conducted during March 2017 to September 2019 at the Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Ethical clearance was obtained from the Institutional Review Board (IRB) of BSMMU. Purposive non-randomized

sampling technique was used. A total of 40 patients with T-Y intercondylar fracture of distal humerus that underwent surgery were selected as cases by statistical calculation and randomly allocated into two groups. Group A consisted of 20 patients who underwent distal humerus locking (DHL) plate and Group B consisted of 20 patients who underwent Y-reconstruction plate. All the odd-numbered cases were allocated for group A and the even-numbered cases were allocated for group B. The study subjects were enrolled according to the selection criteria. Adult patients (aged over 18 years) of both sexes with T-Y inter-condylar fracture of the distal humerus without any neurological deficit planned for surgical management were included in this study. Patients aged below 18 years, pathological fracture except osteoporosis, previously operated or non-functional elbow, and patients having chronic elbow pain were excluded from the study. Each study subject was evaluated by history, clinical examinations and investigations. After taking informed written consent, a detailed history of the selected patients was taken regarding socio-demographic, mode of injury, time of injury and relevant other history. A complete clinical (general, local and neurological) examination and radiological evaluation of each study subject were done for proper assessment. Data were collected from history, clinical examination, investigations and follow up findings. Outcome of distal humeral locking (DHL) plate and Y reconstruction plate were measured by using Mayo Elbow Performance Score (MEPS).¹¹

Measurement of variables

The following variables were measured-

Demographic variable

- Age
- Sex
- Occupation

Clinical variable

- Sidedness of involvement (Right/ Left)
- Pain
- Mechanism of injury
- Time interval between the injury and surgery
- Duration of union of fracture

Outcome variables: According to Mayo Elbow Performance Score¹¹ (MEPS) in term of-

- Pain
- Motion
- Stability
- Function

Final outcome was categorized by-

- Excellent
- Good
- Fair
- Poor

Investigations required in the Study

- For diagnosis purpose
Plain X-ray right/ left elbow antero-posterior and lateral view.
- Plain X-Ray right/ left arm with shoulder joint antero-posterior and lateral view.
- For pre-operative evaluation
Relevant investigations were also done for evaluation of general condition and pre-operative fitness such as

- Complete blood count (CBC), Serum creatinine, Serum electrolytes, Random blood sugar (RBS), Blood for grouping and Rh typing, HBsAg, Anti-HCV, Electrocardiography, Echocardiogram, X-ray chest etc.
- For follow up
Plain X-ray right/ left elbow antero-posterior and lateral view.
- Plain X-Ray right/ left arm with shoulder joint antero-posterior and lateral view.

Assessment of the patient according to Mayo Elbow Performance Score¹¹ (MEPS) criteria

| | Pre-operative | | Post-operative | | | |
|---------------------|---|---|---|--|--|--|
| | Base line follow-up (at 1 st POD) | 1 st follow-up (at 3 weeks) | 2 nd follow-up (at 6 weeks) | 3 rd follow-up (at 18 weeks) | 4 th follow-up (at 6 months) | |
| Pain | | | | | | |
| Motions | | | | | | |
| Stability | | | | | | |
| Function of elbow | | | | | | |
| X-ray findings | | | | | | |
| Complication | | | | | | |
| Infection | | | | | | |
| Nerve injury | | | | | | |
| Myositis ossificans | | | | | | |
| Stiffness | | | | | | |

| | |
|--|----|
| Section 1 - Pain Intensity | |
| None | 45 |
| Mild | 30 |
| Moderate | 15 |
| Severe | 0 |
| Section 2 – Motion | |
| Arc of motion greater than 100 degrees | 20 |
| Arc of motion between 50 and 100 degrees | 15 |
| Arc of motion less than 50 degrees | 5 |
| Section 3 – Stability | |
| Stable | 10 |
| Moderate stability | 5 |
| Grossly Unstable | 0 |
| Section 4 - Function (Tick as many as able) | |
| Can comb hair | 5 |
| Performing personal hygiene | 5 |
| Can eat | 5 |
| Can wear shirt | 5 |
| Can wear shoe | 5 |

The Mayo Elbow Performance Score (MEPS).....

Interpreting the Mayo Elbow Performance Score

| | |
|----------------|-----------|
| Score 91-100 | Excellent |
| Score 81-90 | Good |
| Score 71-80 | Fair |
| Score below 70 | Poor |

Surgical procedure

A total of 40 patients with T-Y intercondylar fracture of distal humerus were managed surgically. Among them 20 patients underwent distal humerus locking plate and 20 patients underwent Y-reconstruction plate from March 2017 to September 2019. Informed written consent was taken for surgery from each patient prior to the surgical procedure.

Pre-operative preparation

Counseling regarding the treatment procedure with emphasis on the available treatment options with their merits and demerits of each was done along with information about the possible post-operative sequel.

Surgical technique

Position of the patient

The patient was anaesthetized in supine position. Then a pneumatic tourniquet was applied. After that patient was in either lateral or prone position with shoulder 90 degree abducted and elbow 90 degree flexed on a short arm-board with forearm hanging over the sideboard. So, forearm and hand was free for draping.

Approach

In this series, either Muller and McAusland's olecranon osteotomy or Campbell triceps splitting (tongue shaped) approach was used. In the Muller approach, the incision starts approximately 6-8 cm distal and 8-10 cm proximal to the tip of the olecranon through midline. The ulnar nerve was protected and lateral margin of triceps was identified and reflected ideally to expose the distal humerus. After the proximal ulna was drilled, an oblique extra-articular or transverse transarticular osteotomy including the triceps attachment was made across the proximal ulna and the triceps attachment was reflected proximally. The elbow was flexed and the joint was exposed. Reduction of distal humeral fragments was done in two steps: (a) reduction and fixation of the condyles, and (b) reduction and fixation of reassembled condyle was fixed with the shaft of the humerus through the lateral and medial columns.

Reduction and fixation of the condyles

The condyles was reduced and held together firmly by towel clip or reduction clamp. Kirschner wire was used for reduction and temporary fixation. Parallel to this wire, a 2.7 mm hole was drilled from radial to ulnar fragment or ulnar to radial side (depending on the fracture fragments) and a 4mm cancellous screw was introduced.

Reduction and fixation of reassembled condyles to the shaft of the humerus

Once the articular fragments was anatomically reduced to form an articular block, then proper reassembly of the medial and lateral columns are resumed and these was fixed with the shaft of the humerus by lateral support locking plate or cross-tension band-wires with or without medial support locking plate or cancellous screws. Sometimes more than one Kirschner wire was used on each side of the condylar column for rigid fixation.

Olecranon was fixed either with cancellous screw or tension band-wire. After reduction and fixation, the wound was closed in layers by keeping a drain. Long-arm back-slab was applied with the elbow at right angle in case of tricep splitting approach or at 60 degree elbow flexion in

case of olecranon ostiotomy. Drain was removed after 48 hours postoperatively. Stitches were removed after 10 to 14 days.

Post-operative care

Triangular sling was applied to each and every patient after removal of back-slab at 3 weeks. Patient was advised to continue this sling for further 2 weeks and to allow active limited exercise of the elbow within the sling. After removal of the sling, all the patients was advised for active movement of elbow and forearm freely.

Follow up

All patients were evaluated both clinically and radiologically according to Mayo Elbow Performance Score¹¹ (MEPS) during each follow up.

Baselines follow up: At 1st POD

1st follow up: After 3 weeks

2nd follow up: After 6 weeks

3rd follow up: After 18 weeks

4th follow up (Final follow up): After 6 months

Statistical analysis

All the data were compiled and sorted properly and were analyzed statistically by using Statistical Package for Social Science (SPSS) version- 25 software. Categorical data were presented as frequency/percentage and continuous variable was expressed as mean±SD (standard deviation). Level of significance was calculated at 95% confident interval (CI) and $p < 0.05$. Comparison between both groups were made with Unaired Student's 't' test and Chi Square test.

RESULTS

A total 40 cases of T-Y intercondylar fracture of distal humerus that meet the inclusion criteria were selected. Outcome of the distal humeral locking (DHL) plate and Y reconstruction plate were assessed by using Mayo Elbow Performance Score¹¹ (MEPS). The cases were allocated into two groups – group A and group B. In group A; out of 20 patients 8 (40%) were 18-30 years of age, 3 (15%) were 31-40 years of age, 6 (30%) were 41-50 years of age and 3 (15%) were 51-60 years old. In group B; out of 20 patients 6 (30%) were 18-30 years of age, 3 (15%) were 31-40 years of age, 8 (40%) were 41-50 years of age and 3 (15%) were 51-60 years old. The youngest and the oldest patients were 18 and 58 years respectively in both groups. Majority (60% & 70%) of the study subjects were male and only 8

(40%) & 6 (30%) were female in both groups. Among 40 patients service holders were 6 (30%) & 4 (20%), business men 4 (20%) & 4 (20%), house wife 4 (20%) & 2 (10%), student 4 (20%) & 4 (20%) and others 2 (10%) & 6 (30%) in occupation respectively in both groups. Among 40 subjects, 11 (55%) & 10 (50%) patients had history of road traffic accident, 4 (20%) & 6 (30%) patients had history of fall from height, 2 (10%) & 2 (10%) patients had history of domestic injury, 1 (5%) & 1 (5%) patients had history of assault and 2 (10%) & 1 (5%) patients had history of sports injury in both groups. Among 40 subjects, 12 (60%) & 14 (70%) subjects had right sided distal humeral fracture and 8 (40%) & 6 (30%) subjects had left sided fracture in both groups (Table-1).

Table-I

Baseline characteristics of the study population (N=40)

| Variables | Group A (n=20) | Group B (n=20) | p value |
|-----------------------|-------------------|-------------------|---------------------|
| Age (years) | | | |
| 18-30 | 8 (40%) | 6 (30%) | 0.414 ^{ns} |
| 31-40 | 3 (15%) | 3 (15%) | |
| 41-50 | 6 (30%) | 8 (40%) | |
| 51-60 | 3 (15%) | 3 (15%) | |
| Sex | | | |
| Male | 12 (60%) | 14 (70%) | 0.138 ^{ns} |
| Female | 8 (40%) | 6 (30%) | |
| Occupation | | | |
| Service holder | 6 (30%) | 4 (20%) | 0.004 ^s |
| Business men | 4 (20%) | 4 (20%) | |
| House wife | 4 (20%) | 2 (10%) | |
| Student | 4 (20%) | 4 (20%) | |
| Others | 2 (10%) | 6 (30%) | |
| Mechanism of injury | | | |
| Road traffic accident | 11 (55%) | 10 (50%) | 0.941 ^{ns} |
| Fall from height | 4 (20%) | 6 (30%) | |
| Domestic injury | 2 (10%) | 2 (10%) | |
| Assault | 1 (5%) | 1 (5%) | |
| Sports injury | 2 (10%) | 1 (5%) | |
| Side | | | |
| Right | 12 (60%) | 14 (70%) | 0.507 ^{ns} |
| Left | 8 (40%) | 6 (30%) | |

Results were expressed in frequency and percentage. Chi Square test was performed to compare the groups. The test of significance was calculated and *p* value < 0.05 was accepted as level of significance.

Group A: Reconstructions with distal humeral locking plate
Group B: Reconstruction with Y reconstruction plate
s= significant, ns= not significant

It was observed that, in 6 (30%) & 8 (40%) cases of DHL plate and Y reconstruction plate was fixed within 3 weeks of occurrence of fracture respectively. While in the 14 (70%) & 12 (60%) cases, fixation was done after 3 weeks but within 6 weeks of the fracture. In 4 (20%) & 2 (10%) cases duration of union of fracture were 8 - 10 weeks, in 12 (60%) & 6 (30%) cases duration of union of fracture were 10- 12 weeks, while in the 4 (20%) & 12 (60%) cases duration of union was 13-16 weeks according to radiological evidence (Table-II).

Table-II

Distribution of study population time interval between injury and operation and duration of union of fracture (N=40)

| | Group A (n=20) | Group B (n=20) | p value |
|---------------|-------------------|-------------------|---------------------|
| Time Interval | | | |
| ≤3 weeks | 6 (30%) | 8 (40%) | 0.507 ^{ns} |
| >3 weeks | 14 (70%) | 12 (60%) | |
| Union | | | |
| 8-10 weeks | 4 (20%) | 2 (10%) | 0.036 ^s |
| 11-12 weeks | 12 (60%) | 6 (30%) | |
| 13-16weeks | 4 (20%) | 12 (60%) | |

Results were expressed in frequency and percentage. Chi Square test was performed to compare the groups. The test of significance was calculated and *p* value < 0.05 was accepted as level of significance.

Group A: Reconstructions with distal humeral locking plate
Group B: Reconstruction with Y reconstruction plate
N= Total number of subjects, n= Total number of subjects in each group, s= significant, ns= not significant

The preoperative means (±SD) pain, motions, stability and function of elbow scores were 3.00 ± 6.00, 6.50 ± 3.57, 0.75 ± 1.83 and 1.95 ± 1.02 respectively in group A and 2.25 ± 5.36, 6.00 ± 3.00, 1.00 ± 2.00 and 2.00 ± 1.00 respectively in group B. No significant differences were observed preoperatively between the groups (Table-III).

The postoperative means (±SD) pain, motions, stability and function of elbow scores were 30.75 ± 11.10, 15.25 ± 4.87, 8.25 ± 2.38 and 5.00 ± 0.00 respectively in group A and 27.00 ± 10.17, 15.25 ± 4.88, 7.50 ± 2.50 and 4.65 ± 0.57 respectively in group B. This indicates that MEP score was significantly improved more in group A than group B. But this difference was not statistically significant in case of pain, motions and stability score and significant for functional score (Table-IV).

Table-III*Assessment of the study population by preoperative Mayo Elbow Performance Score (MEPS) (Jillett al 1996)(N=40)*

| MEPS | Group A (n=20) | Group B (n=20) | Mean difference | 95%CI | p value |
|----------------|----------------|----------------|-----------------|-----------------|---------------------|
| Pain intensity | 3.00±6.00 | 2.25±5.36 | 0.75 | -4.392 to 2.892 | 0.679 ^{ns} |
| Motion | 6.50±3.57 | 6.00±3.00 | 0.5 | -2.611 to 1.611 | 0.634 ^{ns} |
| Stability | 0.75±1.83 | 1.00±2.00 | 0.25 | -0.977 to 1.477 | 0.682 ^{ns} |
| Function | 1.95±1.02 | 2.00±1.00 | 0.05 | -0.597 to 0.697 | 0.876 ^{ns} |

Results are expressed as mean ± SD. Student's 't' test was performed. Level of significance was calculated at confidence interval of 95% and p value <0.05, ns= not significant.

Table-IV*Assessment of the study population by postoperative Mayo Elbow Performance Score (MEPS) (Jillett al 1996) (N=40)*

| MEPS | Group A(n=20) | Group B(n=20) | Mean difference | 95%CI | p value |
|----------------|---------------|---------------|-----------------|------------------|---------------------|
| Pain intensity | 30.75±11.10 | 27.0±10.17 | 3.75 | -10.565 to 3.065 | 0.272 ^{ns} |
| Motion | 15.25±4.87 | 15.25±4.88 | 1.25 | -4.377 to 1.877 | 0.423 ^{ns} |
| Stability | 8.25±2.38 | 7.50±2.50 | 0.75 | -0.812 to 2.312 | 0.337 ^{ns} |
| Function | 5.00±0.00 | 4.65±0.57 | 0.35 | -0.608 to -0.092 | 0.009 ^s |

Results are expressed as mean ± SD. Student's 't' test was performed. Level of significance was calculated at confidence interval of 95% and p value <0.05, s= significant, ns= not significant.

The outcome of the subjects was graded according to Mayo Elbow Performance Score as excellent in 4 (20%) & 2 (10%), good in 10 (50%) & 7 (35%), fair in 4 (20%) & 8 (40%) and poor in 2 (10%) & 3 (15%) patients in both groups (Table-5).

Table-V*Distribution of study population according to Mayo Elbow Performance Score (N=40)*

| MEPS | Grading | Group A (n=20) | Group B (n=20) | p value |
|-----------|---------|----------------|----------------|---------------------|
| Excellent | 91-100 | 4 (20%) | 2 (10%) | 0.435 ^{ns} |
| Good | 81-90 | 10 (50%) | 7 (35%) | |
| Fair | 71-80 | 4 (20%) | 8 (40%) | |
| Poor | <70 | 2 (10%) | 3 (15%) | |

Results were expressed in frequency and percentage. Chi Square test was performed to compare the groups. The test of significance was calculated and p value < 0.05 was accepted as level of significance. ns= not significant

Regarding the complications, 2 (10%) & 2 (10%) patients developed infection, 1 (5%) & 1 (5%) patients developed myositis and 2 (10%) & 4 (20%) patients developed stiffness and 15 (75%) & 13 (65%) had no complication in both groups respectively (Table-6).

Table-VI*Distribution of study population according to complications (N=40)*

| Parameters | Group A (n=20) | Group B (n=20) | p value |
|-----------------|----------------|----------------|---------------------|
| No complication | 15 (75%) | 13 (65%) | 0.847 ^{ns} |
| Complications | | | |
| Infection | 2 (10%) | 2 (10%) | |
| Myositis | 1 (5%) | 1 (5%) | |
| Stiff | 2 (10%) | 4 (20%) | |

Results were expressed in frequency and percentage. Chi Square test was performed to compare the groups. The test of significance was calculated and p value < 0.05 was accepted as level of significance.

ns= not significant

To determine the final outcome of the study, excellent, good and fair grades was treated as satisfactory and poor grade was treated as unsatisfactory according to Mayo Elbow Performance Score. So, a total number of 18 (90%) & 17 (85%) patients were in the satisfactory group and only 2 (10%) & 3 (15%) patients were in the unsatisfactory group respectively (Table-VII).

Table-VII
Distribution of study population according to functional outcome (N=40)

| Outcome | Group A (n=20) | Group B (n=20) | p value |
|----------------|----------------|----------------|---------------------|
| Satisfactory | 18 (90%) | 17 (85%) | 0.632 ^{ns} |
| Unsatisfactory | 2 (10%) | 3 (15%) | |

Results were expressed in frequency and percentage. Chi Square test was performed to compare the groups. The test of significance was calculated and *p* value < 0.05 was accepted as level of significance, ns= not significant

Photograph of patient (Group B: Reconstruction with Y reconstruction plate), 22 years old female



Figure-1: Pre- operative photograph of the patient.



Figure-4: Immediate Post- operative x-ray of elbow.



Figure-2: Pre- operative X-ray of left elbow in anterior-posterior and lateral view:



Figure-5: Post- operative x-ray of elbow at final follow up (at 6 months)

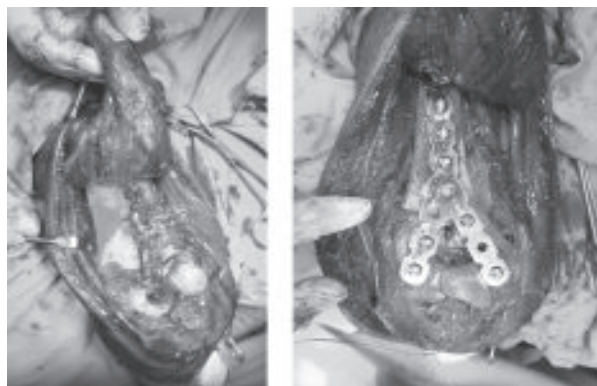


Figure-3: Per- operative photograph.



Figure-6: Post- operative functional outcome of elbow (Flexion / Extension) at final follow up Photograph of patient (Group A: Reconstructions with distal humeral locking plate), 22 years old male



Figure-7: Pre- operative photograph of the patient.



Figure-8: Pre-operative X-ray of right elbow in anterior-posterior and lateral view:

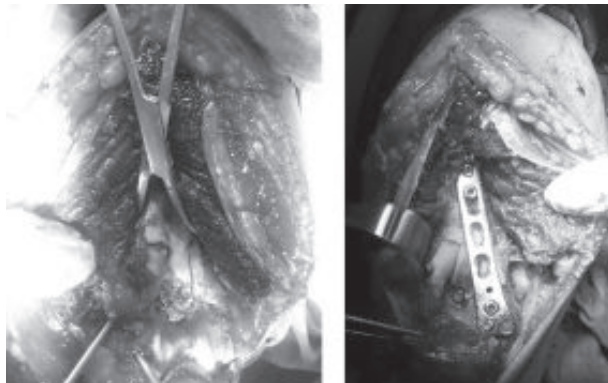


Figure-9: Per- operative photograph.

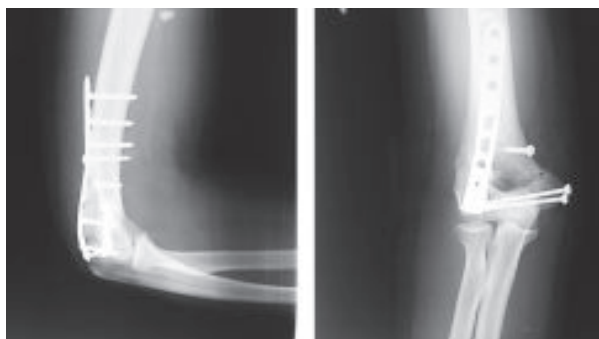


Figure-10: Post- operative x-ray of elbow (at 2 weeks)

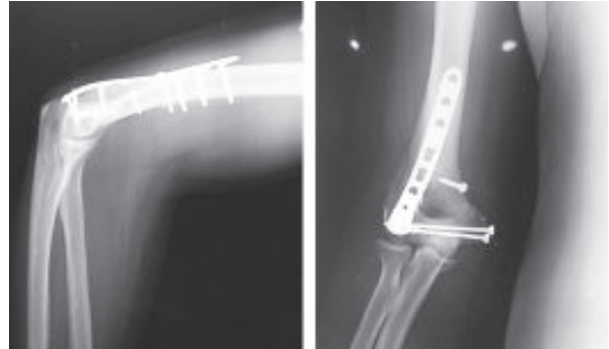


Figure-11: Post- operative x-ray of elbow joint at final follow up (at 6 months)



Figure-12: Post- operative functional outcome of elbow joint (Flexion / Extension) at final follow up

DISCUSSION

The present study was undertaken to compare the functional outcome between Y reconstruction plate and distal humeral locking plate for treatment of the T-Y intercondylar distal humeral fracture in adults. A total number of 40 cases of T-Y intercondylar fracture of distal humerus that meet the inclusion criteria were selected. Outcome of the surgery were assessed by using Mayo Elbow Performance Score¹¹ (MEPS).

The results of current study demonstrate that T-Y intercondylar fractures of distal humerus occurs more in middle aged male population and the youngest and the oldest patients were 18 and 58 years respectively. Almost

similar findings were observed in previous studies by the various investigators.^{12, 13, 14} But the study conducted by Clavert et al.¹⁵ showed that relatively older population was affected by fractures of distal humerus.

The younger population is characterized by trauma group as the trauma group who sustained the fracture usually due to some high energy mechanism of injury. The older peoples often have osteoporotic bone and sustained comminuted fractures even after trivial trauma. High energy trauma following road traffic accident occurs most commonly in young active population who are usually earning members of the family.¹⁶ In present study; occupational categorization was done according to service holder, business men, house wife, student, others and their mode of injuries were road traffic accident, fall from height, domestic injuries, assaults and sports injury. Almost similar findings were observed in couple of related studies by the various researchers.^{15, 16, 17, 18}

Among the total study subjects, majority had right sided distal humeral fracture then left sided distal humeral fracture. All the cases were T-Y intercondylar fracture and all were operated by open reduction and internal fixation with Y reconstruction plate and distal humeral locking (DHL) plate. Fixation was done after 3 weeks but within 6 weeks of the fracture in majority of the cases. These findings were consistent with similar previous studies.^{15, 17, 18, 19} On the contrary, Shivakumar J¹⁶ found right and left humerus was equally affected.

In present study, majority of the cases had duration of union of fracture at 10- 12 weeks in DHL plate group and 13-16 weeks in Y reconstruction plate group. This union was assessed according to the radiological evidences. Before 40 years of age duration of union of fracture occurs more at 8- 10 weeks in DHL plate group but after 40 years duration of union of fracture occurs more at 13-16 weeks in Y reconstruction plate groups. In their studies; Clavert et al.¹⁵, Saragaglia et al.¹⁸ and Muzaffar et al.²⁰ found similar findings in patients operated with DHL plate only. This dissimilarity was due to difference in methodology.

No significant differences were observed in pre-operative pain intensity, motions, stability and function of elbow scores between the groups. This finding was supported by the similar previous studies.^{7, 8, 18, 21}

At follow-up, each patient was assessed for pain intensity, motions, stability and function by Mayo Elbow Performance Score.¹¹ The mean (\pm SD) pain score was significantly ($p < 0.001$) higher at the end of the final follow-up period of 6 months in comparison to pre-operative

periods. This finding was an agreement with the related previous studies.^{14, 17, 19}

At follow-up; the post-operative pain intensity, motions, stability and function of elbow scores were comparatively improved in patients operated with DHL plate than Y reconstruction plate. But these differences were not statistically significant in case of pain, motion and stability scores while significant only for functional score. This finding was also an agreement with the findings of similar previous studies.^{7, 8, 22}

During operation strict asepsis was followed in every step and broad spectrum intravenous antibiotic was given for three days. Initial recovery was uneventful in all the cases. But during the post-operative follow up periods few patients developed stiffness, infection and myositis in both groups. Among them post-operative stiffness was found more in Y reconstruction plate group. This finding was consistent with the studies conducted by Saragaglia et al.¹⁸ and Korner et al.²¹ and but different from the findings of Kumar et al.⁹ and Muzaffar et al.²⁰ studies. This disagreement was possibly due to environmental and nutritional variations.

In present study, final outcome was determined by excellent, good and fair grades according to Mayo Elbow Performance Score¹¹ and leveled as satisfactory and poor grade was leveled as unsatisfactory outcome. In this series; 90% subjects were found as satisfactory in DHL plate group and 85% subjects were found as satisfactory outcome in Y reconstruction plate at the end of the final follow-up. These findings were partially supported by previous studies.^{8, 18, 22}

Various researchers of different countries suggested that DHL offer potential advantage over Y reconstruction plate for the treatment of T-Y intercondylar fractures of distal humerus. These are site specific, low profile plate. The plate is pre contoured for the distal humerus and the insertion of locking screws obviates the need for a plate to bone compression, preserving the blood supply to the bones. The insertion of distal humeral locking (DHL) plate into the humeral fragment provides a fixed angle support in multiple planes, which should maintain the reduction, while allowing the early mobilization.^{21, 22, 23}

CONCLUSIONS

This study concluded that distal humeral locking (DHL) plate showed better functional outcome and stability than Y reconstruction plate for the treatment of T-Y intercondylar fractures of distal humerus and all the functions of elbows were improved in compared with their pre-operative status.

Limitations

It was a single center study with a relatively small sample size. Moreover, surgeon's heterogeneity was also the mentionable limitation of this study.

Recommendations

Further multicentre comparative studies with large sample size should be done to compare functional outcome of Y reconstruction plate and distal humeral locking (DHL) plate for the treatment of T-Y intercondylar fracture of distal humerus in adults.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Limited Adjunctive Surgery with Ilizarov Technique in Failed Cases Clubfoot in Children

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Abstract

Dr. Ignacio Ponseti's 'conservative' (non-surgical) method has revolutionized the clubfoot management, but failure in terms of relapsed and residual cases still occurs. Correction of these cases is still challenging. Aim of this study was to evaluate the result of the Ilizarov technique combined with limited surgical operations in the treatment of failed cases of clubfoot in children. This prospective study evaluated failed cases of clubfoot by Ilizarov method with limited adjunctive surgery at the National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, from January 2017 and December 2018. The study included 13 feet of 11 children 8 to 16 years of age. They were assessed both clinically and radiologically before and after surgery. The clinical outcomes were evaluated according to the criteria of Laaveg-Ponseti score. A plantigrade foot was achieved in all studied cases and significant ($P < 0.05$ for all comparisons) improvement in the basic deformity of clubfoot namely equinus, cavus, heel varus and forefoot adductus were achieved. The postoperative result was excellent in two feet (15.3%), good in eight feet (61.5), and moderate to poor in three feet (23.1%); giving a rate of the satisfactory result of 76.9% cases. These current findings suggest that the Ilizarov technique combined with limited surgery effectively corrects relapsed and residual clubfoot cases in children.

Keywords: Limited surgery, Failed clubfoot, Ilizarov technique, children

INTRODUCTION

Clubfoot or Congenital talipes equinovarus (CTEV) occurring at 1 in 1000 live births is one of the most common pediatric foot deformity worldwide. It comprises four components: ankle equinus, hindfoot varus, adductus of the forefoot, and cavus of the midfoot^{1, 2}. Dr. Ignacio Ponseti's 'conservative' (non-surgical) method of clubfoot treatment based on the fundamentals of kinematics and pathoanatomy of the deformity has been adopted

throughout the World^{2, 3}. But this method is not exclusively conservative as it often requires some minimally invasive procedures. Even Ponseti himself routinely used surgery for certain patients: at least 90% of feet needed percutaneous tenotomy, and about 15% to 40% required tibialis anterior tendon transfer³. Although, this conservative or non-surgical treatment is well accepted but to correct the clubfoot is still challenging, especially in failed cases which are termed as residual and relapse.

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The Ponseti method has been a true revolution over the past more than 20 years. Nonetheless, failed cases still happen, which are mainly related to incorrect treatment protocol or noncompliance with the foot abduction brace. Residual deformities may be defined as persistent deformities in incompletely corrected feet, and relapse may be defined as recurrent deformities in previously well-corrected feet³. These cases require surgical intervention beyond a tenotomy or tibialis anterior tendon transfer. Revision surgeries frequently require osteotomy in addition. Although the foot looks better after surgery, it is stiff, weak, and often painful. After adolescence, the pain increases and often becomes crippling². Because of the complicated treatment technique and the weak curative effect, despite a good expense, there is no clear agreement on the best treatment strategy. The Ilizarov technique can be an effective treatment for clubfoot, especially in failed cases, but complications can still arise when the Ilizarov technique is used alone. In addition, poor correction rates and high relapse rates also arise from the traditional surgical procedure, with just 20-50% of patients not needing further operations⁴.

The purpose of the present study was to evaluate the result of failed cases of clubfoot in children by using the Ilizarov technique with limited adjunctive surgeries.

METHOD:

This prospective study observed the outcomes of 12 pediatric patients age with failed cases clubfoot who presented to the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) Sher-e-Banglanagar, Dhaka-1207, Bangladesh and was treated with the Ilizarov technique with moderate open limited soft tissue or bony operations between January 2017 and December 2018. Cases with other congenital anomalies, arthrogryposis and neurological clubfoot were excluded. The study was approved by the local ethical committee of NITOR. Informed consent was provided by the parents/legal guardians of all patients included in this study.

All children received routine general anesthesia. Systemic antibiotics were given 1 hour before surgery, and a tourniquet was also used. The Ilizarov technique can be combined with limited soft tissue procedure or osteotomies. The choice of adjunctive surgical procedures was determined by the type of foot deformity:^{4,5} (i) subtalar arthrodesis was selected for the patient with hindfoot varus; (ii) midtarsal osteotomy for forefoot over adduction;

(iii) three joint arthrodesis for combined forefoot and hindfoot deformities; (iv) percutaneous Achilles tendon lengthening for Achilles tendon contracture and forefoot deformities; and (v) adjunctive soft tissue operations were selected in the situation of a percutaneous plantar fasciotomy and tenotomy of the long toe flexors. A standard Ilizarov frame was used for patients in this study that consisted of: (i) a preassembled tibial base construct formed from two rings; (ii) a forefoot construct formed from a half-ring was attached by wires inserted transversely through the metatarsal shafts according to the foot size; (iii) the heel construct made of a half-ring was attached to the calcaneus by two wires⁴. After application of the frame, anteroposterior and lateral radiograms were taken for all the studied patients. Antibiotics were given for one day after surgery.

The correction was started on the second day after surgery at a rate of 1 mm per day if only soft tissue release was used or after 1 week if selective osteotomies were undertaken. The frame was kept in a stable situation for 6 weeks once a prospective correction was achieved. During this stable time, until the removal of the frame under general anesthesia, the children were encouraged and allowed to bear full weight. Thereafter, an ankle-foot orthosis was routinely used in all the children for the following 6 months to 1 year. The Laaveg-Ponseti score system was used to evaluate patients' outcomes which included satisfaction, function, the position of the heel, passive motion and gait^{6,7}. The score is a 100-point evaluation system with scores between 90 and 100 considered as excellent, 80 and 89 as good, 70 and 79 as moderate, and below 70 as poor⁸.

All statistical analyses were performed using the SPSS statistical package, version 20.0 for Windows. Data are expressed as mean \pm SD. Differences between two groups were tested using sample t-test. A P-value < 0.05 was considered statistically significant.

RESULT

This study analyzed data for 13 feet from 11 patients (eight boys, three girls) with failed cases of clubfoot talipes equinovarus who were treated with the Ilizarov technique in combination with limited open, moderate soft tissue or bony operations. The mean \pm SD age at the time of the surgery was 11.0 \pm 2.4 years (range 8.0–16.0 years). Six patients had the deformity on the right side, three on the left while two patients had the bilateral clubfoot. Out of 11 failed cases, seven had the residual deformity and, six had the relapse. (Table 1)

Table 1
Basic characteristics of the study subjects (n =11; 13 feet)

| Characteristics | Value |
|---|----------|
| Age | |
| 08 to 10 years | 5(45.5) |
| 11 to 13 years | 4(36.4) |
| 14 to 16 years | 2(18.2) |
| Mean (±SD) | 11.0±2.4 |
| Total | 11(100) |
| Sex | |
| Male | 8(72.7) |
| Female | 3(27.3) |
| Side of the involvement | |
| Right | 6(54.5) |
| Left | 3(27.3) |
| Bilateral | 2(18.2) |
| Type of the failed cases (11 cases; 13 feet) | |
| Residual | 7(53.8) |
| Relapse | 6(46.2) |

Values are presented as frequency, mean or percentage. SD: Standard Deviation. Percentage in the parenthesis

While comparing preprocedural and postprocedural parameters (Table2), the preoperative mean equinus angle was 72.30±18.44 degree and, after gradual correction, the equinus angle was 1.92±3.83degree. The mean cavus angle was 53.85±6.17 degree and 25.78±4.93 degree before and after the procedure, respectively. The mean heel varus angle was 11.46±2.14 degree and 2.46±2.88-degree postoperatively. The mean forefoot adduction angle was 41.92±8.04 degree and 7.30±3.89 degree before and after the procedure, respectively. At the final follow-up, allradiological parameters showed highly significant improvement. The mean (±SD) talocalcaneal angle A/P view increased to 44.61° from a pretreatment value of 24.61°(P<0.001). Similarly, at final follow-up talus first metatarsal angle decreased to 8.4514° from pretreatment value 36.15 (p<0.001) (Table II)

Five feet experienced no complications during the study (Figure 1). Seven feet experienced complications during the study: (i) pin tract infection took place in three feet; (ii) mild pain was experienced in two feet;(iii) Clawing deformity took place in one foot and subluxation of talus in two feet after removal of the frame. However, At the last follow-up, the mean ankle dorsiflexion and plantarflexion improved significantly (P< 0.05) and ranges were 8.3° (range 6–13°) and 34.6° (range 30–46°), respectively (Figure 1).

Table II
Comparison of preprocedural and postprocedural parameters

| | Before procedure | Final follow-up | P-value |
|--|------------------|-----------------|---------|
| | Mean±SD | Mean±SD | |
| | (degree) | (degree) | |
| Deformities | | | |
| Equinus | 72.30±18.44 | 1.92±3.83 | <0.001 |
| Cavus | 53.85±6.17 | 25.78±4.93 | <0.001 |
| Heel varus | 11.46±2.14 | 2.46±2.88 | <0.001 |
| Forefoot adduction | 41.92±8.04 | 7.30±3.89 | <0.001 |
| Radiological angle | | | |
| Talocalcaneal angle (Antero-posterior view) | 24.61±6.60 | 44.61±13.14 | <0.001 |
| Talus-1 st metatarsalangle (Lateral view) | 36.15±10.23 | 8.46±5.91 | <0.001 |

Paired ‘t’ test were employed to see statical significance. SD= Standard deviation

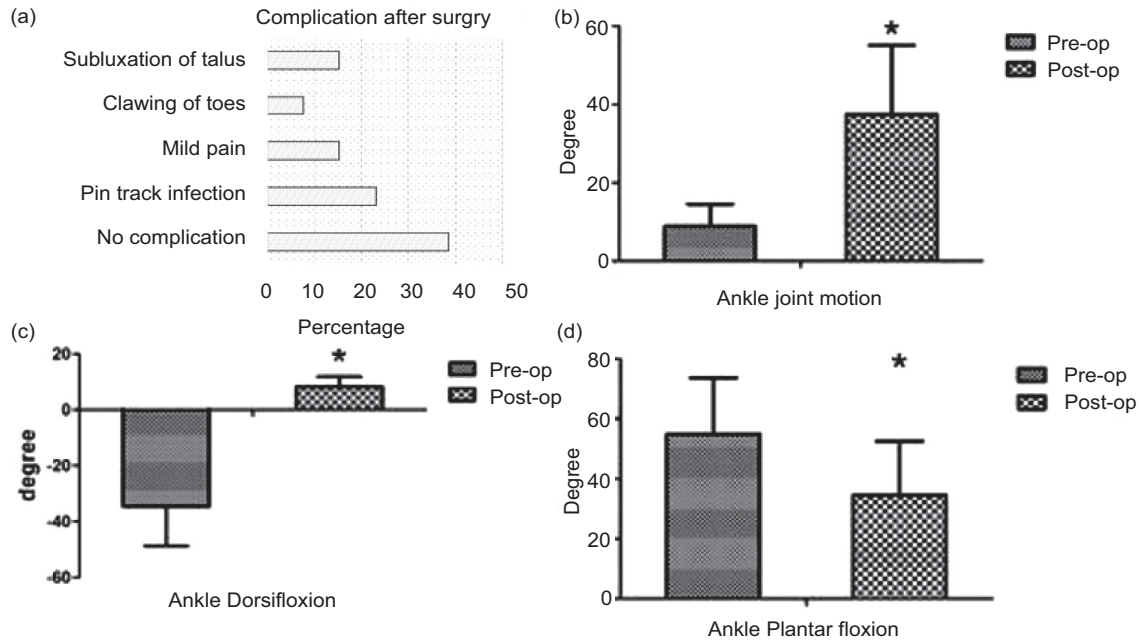


Figure 1 Postoperative complication (a) and the improvement of ankle joint motion (b, c, d). A Paired 't' test found significant difference ($P < 0.05$ for all comparisons) between pre and postoperative ankle motion.

A representative image from an 8-year-old girl with a deformed left foot after previous treatments has been shown (Figure 2). This girl had percutaneous Achilles tendon lengthening and percutaneous plantar fasciotomy and deformity correction using an Ilizarov frame.

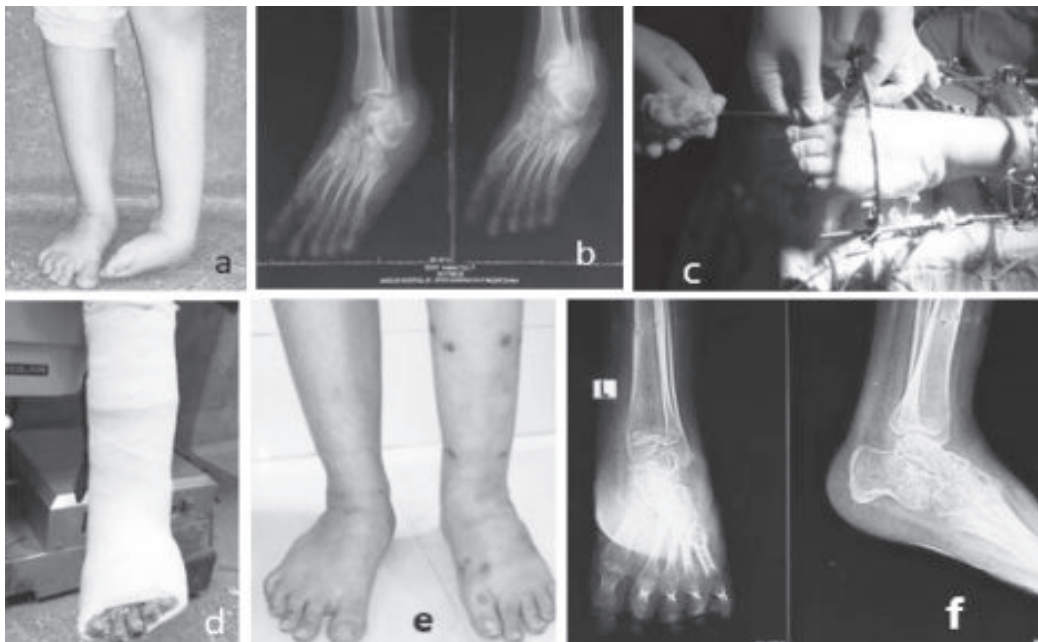


Figure 2 Representative images of an 8-year-old girl with a deformed left foot who has been treated previously for clubfoot. A preoperative photograph of the child standing showed severe talipes equinovarus remained on the left side after previous treatment (a). A preoperative radiograph showing the deformity of left foot (b). An external fixator was used to correct the deformity (c). Short leg full plaster after the procedure (d). The photograph shows that a plantigrade foot was achieved and the appearance and function of the left foot had been improved significantly after removing the frame (e). The postoperative radiograph showed that the deformity had been corrected and the foot bones had returned to a normal arrangement (f).

Table-III
Clinical outcome according to Laaveg-Ponseti scale (n =11; 13 feet)

| Scale | Frequency | Outcome |
|---------------------------|-----------|-------------------------|
| Excellent (90-100 points) | 02(15.3) | Satisfactory 10(76.9) |
| Good (80 -89 points) | 08(61.5) | |
| Moderate (70-79 points) | 02(15.3) | Unsatisfactory 03(23.1) |
| Poor (bellow70 points) | 01(7.6) | |
| Total | 13 feet | 13 feet |

Percentage in the parenthesis

The plantigrade foot was achieved in all patients as the frame was removed and their gait was improved. As per clinical outcome according to Laaveg-Ponseti scale. Out of 13 feet treated, in order of frequency, the outcome shows excellent result in 02(15.3%) feet, good in 8(61.5%) feet but moderate and poor outcome also occurred in 2(15.3%) and 1(7.6%). While considering the final outcome, the study found 10(76.9%) showed satisfactory results (Table III).

DISCUSSION

The principal aim of clubfoot care is to provide a functional mobile plantigrade foot without pain. The Ponseti method of serial casting can be used to achieve this objective. The failure rate of the Ponseti process, however, has been reported to be about 3% to 5%⁹ and in 20% to 41% of cases, recurrence after correction occurred¹⁰. Many children with clubfoot may experience residual deformity or recurrence of foot deformity that needs more corrective treatment despite advanced surgical treatment. It is unfortunate that certain surgical operations can result in a rigid, small and painful foot, and the foot can also be shortened in those patients treated with osteotomy⁴. To improve the result, an alternative form of treatment is required. In the past decade, the Ilizarov technique has made the most outstanding contribution to correcting the most complex foot deformities in children^{3, 11, 12}. The aim of this study to treat failed cases of clubfoot to achieve a fully corrected, mobile, painless, plantigrade, normal-looking foot using a combination of soft tissue release and gradual correction with the Ilizarov technique.

In this study, the management of clubfoot by Ilizarov method included 11 children, of which the maximum number of patients 5 (45.5%) were observed between 08-10 years age group, followed by 11-13 years age group 4(36.4%) and 14-16 years age group 2(18.2%) showed a gradual decrease in the number of distributions. Mean age of the

patients was 11.00±2.40 within the range of 8-16 years. Makhdoom et al. (2012) included 27 clubfeet in the study, ranging from 8 to 20 years (mean 12 years) of age which was similar to our study¹².

Out of 13 failed feet, 6(46.2)feet received proper treatment, but relapse occurred, and 7(53.8%) were treated inadequately; hence the deformity became residual. Other study studies have also reported similar treatment of residual or relapse cases of clubfoot by external fixator^{4, 13}. The present study found the male in 72.7% of cases. Male predominance was also reported by other authors, including Ponseti himself^{6, 12, 14}. The unilateral involvement was in more than 80% of cases in our study. Different studies have also documented related unilateral cases^{4, 15}.

In our study, 6 patients, with unilateral deformity and another patient with bilateral deformity lengthening of Tendo-Achilles done by Z-plasty with the addition of subcutaneous plantar fasciotomy, followed by application of the Ilizarov external fixator. So, out of 13 feet, application of Ilizarov fixator without any soft tissue procedure was done in 5 feet. A good or excellent result was achieved in tenotomy patient reported by Hussain et al. (2004), was consistent with the present study. A plantigrade foot was achieved in all studied cases and significant ($P < 0.05$ for all comparisons) improvement in the basic deformity of clubfoot namely equinus, cavus, heel varus and forefoot adductus were achieved. The movement of the ankle joint specially planter and dorsiflexion also improved. At final follow-up, the mean (\pm SD) talocalcaneal angle A/P view increased to 44.61° from pretreatment 24.61($P < 0.001$). Similarly, at the last follow-up, talus first metatarsal angle decreased to 8.4514° from pretreatment value 36.15 ($p < 0.001$). All these findings are unanimous with other studies^{4, 16}.

Patients in this current study experienced several complications during treatment. Pin tract infection was

treated by proper attentive pin care. Mild pain was experienced in two feet that improved with mild analgesics. Three patients had a recurrence of the deformity: subluxation of talus and clawing of the foot. The potential causes for the deformity recurrence include recoiling of elastic soft tissue, joint incongruity, and growth interference. Manipulation and casting under general anesthesia were sufficient to achieved good foot appearance of two feet. However, only one foot required further surgery. Other research has also found this type of complications⁴.

Follow-up was done during the course of the study for 6 months to 1 year and the final results evaluated according to the Laaveg-Ponseti scale. This scale is the most widely used functional score in patients with soft tissue release or Ponseti method since 1980 to the present⁷. According to Laaveg-Ponseti scale, the postoperative result was excellent in two feet, good in eight feet, and moderate to poor in three feet; giving a rate of the satisfactory outcome of 76.9% cases. This result was statistically significant, as it was in others^{4, 7}.

There were some limitations of this study. Firstly, only a small number of patients was included. Secondly, the time for follow-up was reasonably short.

In summary, Limited adjunctive surgery with Ilizarov technique can be used to treat foot deformities in children with relapsed and residual clubfoot as it eliminates the need for a prolonged open surgical wound, certain foot complications are minimized, radiological anomalies are corrected, and the function of the foot is improved.

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Conflict of interest

The authors disclose and confirm no conflict of interest.

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Surgical Treatment of Posterior Wall of Acetabulum : Excellency in Pelvic Fracture Management

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ABSTRACT

Acetabular fractures are one of the most serious injuries treated by orthopedic surgeons. Among various types, posterior wall fracture is the most common. Open reduction and internal fixation is considered the best surgical treatment method for acetabular fractures and several studies shows satisfactory outcome following surgery. The objective of the study was to evaluate the functional and radiological outcome of surgically treated acetabular fractures. 32 patients of posterior wall acetabular fracture were enrolled in this study, from July 2016 to December 2017 through non randomized purposive sampling. All the patients were between 18 to 60 years of age and operated within 21 days of fracture. All the patients were operated by posterior Kocher Langenbeck approach. Titanium made implants (3.5 mm reconstruction plate & 3.5 mm cortico cancellous screws) was used in all the cases. Postoperative functional outcome was assessed both clinically by modified Merle D' Aubigne and Postel criteria and radiologically by Matta criteria. Postoperative follow up was conducted at 2nd, 6th, 12th and 24th weeks. Excellent results were obtained in 19(59.4%) patients, good in 8 (25%), fair in 2 (6.3%) and poor results in 3 (9.3%) patients after functional evaluation. Postoperative complications included avascular necrosis of femoral head in 3 (9.3%) & iatrogenic sciatic nerve injury in 3 (9.3%) patients. The study showed surgery in posterior wall acetabular fractures leads good to excellent outcome in majority of the patients.

Key words: Post wall fracture, Acetabulum, Management.

INTRODUCTION:

Acetabular fractures are one of the most serious injuries treated by orthopedic surgeons. The incidence of acetabular and pelvic fractures is approximately 2% to 7% of all fractures (Mucha and Farnell, 1984) Posterior wall fractures are the most common acetabular fractures about 21% (Matta, 1994). The most common injury mechanisms are motor vehicle accidents (primarily dashboard injury) and fall from height. The patient of acetabulum fracture usually present with pain in affected hip region & inability to use affected limb with or without shock. Careful neurological examination is important, specially testing the function of the sciatic nerve. (Solomon, 2010).

From a historical perspective, Knight and Smith (1958) observed conflicting recommendations regarding both non-operative and operative treatment regimens.

Posterior dislocation of the hip & sciatic nerve injury are common with a posterior wall fracture. Avascular necrosis of the femoral head can be seen as an early as well as a late complication (Alonso, Kellam and Tile, 2015).

Open anatomic reduction and internal fixation is the choice of treatment of displaced fractures of the acetabulum.

Kocher-Langenbeck is the recommended surgical approach for posterior wall fracture of acetabulum. (Olson and Zlowodzki, 2015).

Fracture reduction is easier and the results are superior when operative fixation is performed within 3 weeks of injury (Judet, Judet and Letournel, 1964;

METHODS

A prospective longitudinal study was undertaken in NITOR during the period of July 2016 to December 2017. A total number of 32 patients were included in the study. All age group and both the gender were included in the study. Patients with the history of fall or RTA and pain in the pelvic region were examined clinically and radiologically by doing an X-ray of plain AP view & special Judet view (obturator oblique & iliac oblique view) of the pelvis Showing characteristics "GULL SIGN". CT-scan with 3D reconstruction view, 2D axial view & femoral head

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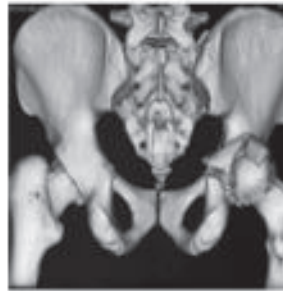
subtraction view (Berton, Moed and Reilly, 2015) are essential for a more detailed pre-operative planning (choice of approach, extent of displacement, evaluation of marginal impaction & comminution).

Based on the radiological finding the acetabular fractures were classified according to the Judet – Letournel classification.

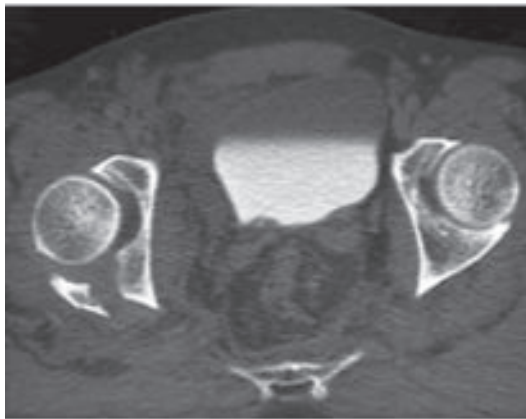


X-ray pelvis (A/P)

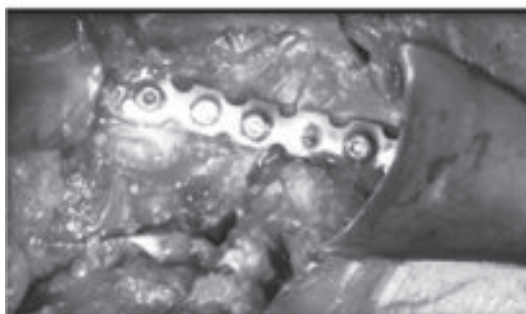
X-ray pelvis (obturator oblique view)



X-ray showing characteristics “GULL SIGN”



CT scan of pelvis with 3D reconstruction



Pic: Per operative photograph of fracture fixation

Pre-operative skin traction was applied on all patients. Intervention in the form of open reduction & internal fixation was done by reconstruction plate & screws & spring plate.



X-ray pelvis after plate fixation

Physiotherapy exercises were started for all surgically treated patients from day one post-operative period and the patients were mobilized to high sitting position with quadriceps training. Following the surgical drain removal, patients were mobilized with non-weight bearing using walking frame for 1.5 month, partial weight bearing for the following 6 weeks and started full weight bearing from 3 months onwards.

The follow-up schedule was 1.5, 3 & 6 months postoperatively. The outcome measure in the patients were measured clinically by using Merle d’Aubigné and Postel Method of scoring system which included pain, gait and mobility on a scale. Radiological evaluation was done by Matta radiological scoring system, the results were expressed in the form of poor, fair, good and excellent.

DATA ANALYSIS WAS DONE BY SPSS

Matta reduction criteria (Matta, 1994)

| | |
|-----------------------|--|
| Anatomical | Zero to one millimetre of displacement |
| Satisfactory | Two to three millimetres |
| Unsatisfactory | More than three millimetres |

Merle d' Aubigne and Postel criteria (Matta,1994)

| | |
|---|-------|
| Pain | |
| None | 6 |
| Slight or intermittent | 5 |
| After walking but resolves | 4 |
| Moderately severe but patient is able to walk | 3 |
| Severe, prevents walking | 2 |
| Gait | |
| Normal | 6 |
| No cane but slight limp | 5 |
| Long distance with cane or crutch | 4 |
| Limited even with support | 3 |
| Very limited | 2 |
| Unable to walk | 1 |
| Range of motion | |
| 95–100% | 6 |
| 80–94% | 5 |
| 70–79% | 4 |
| 60–69% | 3 |
| 50–59% | 2 |
| <50% | 1 |
| Clinical grade | |
| Excellent | 18 |
| Good | 15-17 |
| Fair | 14-15 |
| Poor | <13 |

Matta radiographic criteria (Matta,1994)

| | |
|------------------|--|
| Excellent | Normal appearance of the hip; |
| Good | Mild changes, small osteophytes, moderate (1mm) narrowing of joint & minimum sclerosis; |
| Fair | mm) narrowing of joint & minimum sclerosis; Intermediate changes, moderate osteophytes, moderate (<50%) narrowing of joint & moderate sclerosis; |
| Poor | Advanced changes, large osteophytes, severe (>50%) narrowing of the joint, collapse or wear of the femoral head, and acetabular wear. |

RESULT:

Table I

Percentage distribution of the study population by associated femoral head dislocation (n=32).

| Associated injury | Frequency | Percentage |
|--------------------------|-----------|------------|
| None | 24 | 75.0 |
| Femoral head dislocation | 8 | 25.0 |

Table II

Percentage distribution of the study population by post-operative complications (n=32)

| Complication | Frequency | Percentage |
|----------------------|-----------|------------|
| None | 24 | 75.0 |
| Sciatic nerve injury | 3 | 9.3 |
| Wound infection | 2 | 6.3 |
| AVN | 3 | 9.3 |

Table III

Percentage distribution of the study population by Matta reduction criteria(n=32).(Matta, 1994)

| Reduction | Frequency | Percentage(%) |
|----------------|-----------|---------------|
| Anatomic | 30 | 93.7 |
| Satisfactory | 2 | 6.3 |
| Unsatisfactory | 0 | 0 |

Table IV

Percentage distribution of the study population by radiological score (n=32).

| Radiographic score | No of patients | Percentage (%) |
|--------------------|----------------|----------------|
| Excellent | 22 | 68.7 |
| Good | 5 | 15.6 |
| Fair | 2 | 6.3 |
| Poor | 3 | 9.3 |

Table V

Percentage distribution of the study population by functional score (n=32).

| Reduction | Frequency | Percentage (%) |
|-----------|-----------|----------------|
| Excellent | 19 | 59.4 |
| Good | 8 | 25 |
| Fair | 2 | 6.3 |
| Poor | 3 | 9.3 |

Table VI

Correlation between posterior dislocation of femoral head with AVN among the study population(n=32).

| | Present | Absent |
|-----------------------|---------|--------|
| Posterior dislocation | 8 | 24 |
| AVN | 3 | 29 |

Relative Risk (RR) = 2.67

DISCUSSION

In this study, the main mechanism of injury was road traffic accident (84.4%) & mostly involved young males. This was higher than other studies (about 56%) done by Matta (1996) and Giannoudis, et al. (2005).

Delay in fixation may be detrimental to the viability of the femoral head in cases of persistent subluxation. There is an increase in the incidence of both chondrolysis and osteonecrosis of the head with delayed reconstruction (Letournel and Judet, 1993).

The incidence of iatrogenic sciatic nerve palsy was found in 3 of our patients, which was 9.4% of total patient.

In the present study, 25(78.1%) had excellent radiographic outcome at final follow-up. Matta, et al (1986) reported 77% excellent or good radiographic outcome in a series of case study. We feel that the length of follow-up is critical for identifying some other complications like osteoarthritis.

In this study, 3 (9.4 %) patients developed early features of AVN. All of these cases are associated with posterior dislocation of the femoral head. The rate of AVN has been reported to be between 3-10% (Matta 1996). Moed, WillsonCarr and Watson (2002) also showed nearly similar results in their study. Magu, et al. (2014) observed a series of patients for post-operative complication and found AVN in 11.53% patients.

Heterotopic ossification was not seen in any of our cases. The rates of heterotopic ossification reported by various authors in acetabular fractures surpass 50% in some series (Bosse, et al., 1988; Routt and Swiontkowski, 1990).

Mears, Velyvis and Chang (2003) described in their study that simple fractures could be reduced anatomically in 87% patients, while associated fractures had satisfactory reduction in only 59% of patients.

Matta (1996) also observed similar results with satisfactory reduction in 96% of simple fractures and 64% in associated fractures.

In our study, 2 (6.3%) patients had imperfect reductions and 30 (93.7%) patients had anatomical reduction.

In this study, 22 (68.7%) patients had excellent radiological score, 5 (14.7%) good, 2 (6.3%) fair and 3 (9.6%) poor score. Nearly similar result was obtained by Qadir and Bukhari (2015), 94% of their study population had good to excellent results. Matta (1994) showed 77% good to excellent radiographic outcome.

A Spanish study by Estrems-Diaz et al. (2012) showed no radiographic change in 52% cases yielding excellent result.

Remaining 48% had imperfect or poorly reduced radiographic outcome.

In this study, Clinical evaluation was done based on modified Merle D' Aubigne and Postel clinical criteria and evaluation of all three components (Pain, Gait and ROM) are accumulated to final scoring system. Outcome was excellent in 59.4%, good in 25%, fair in 6.3% and poor in 9.3%.

Most of the authors have reported overall good to excellent results in the range of 74-76%, (Chiu, et al., 2000; Deo, et al., 2001; Kumar, et al., 2005; Matta, 1996). Kaempffe, Bone and Border, (1991) and Wright, et al. (1994) believed that the severity of the fractures, the time required to become proficient at the surgery and experience of the surgeon were the main reasons for higher incidence of our good to excellent.

Several statistical tests were done to find out the relations among variables. Chi square test and Fischer's exact test between functional and radiological outcome showed significant association. Several studies done in different time frame by Matta (1994, 1996) showed similar radiological outcome in comparison with clinical outcome.

The studies done by Moed, WillsonCarr and Watson (2002) also found strong association between posterior dislocation of femoral head and subsequent post-operative AVN. We found positive relative risk (RR) in between these two variables thus indicating strong relation of developing AVN among those who are being exposed or suffered posterior dislocation during trauma.

CONCLUSION

In countries like Bangladesh fractures of the acetabulum are increasing in frequency due to an increase in automobile accidents proportionate to the number of vehicles. Since these fractures involve major weight bearing joints of the lower limb, hence they must be restored to as much normal as possible and this anatomical reduction is only possible with open reduction and internal fixation which would markedly reduce the hospital stay and provides good functional status and better lifestyle so that patient may join as economic workforce or resume accustomed activities as early as possible provided that it is carried out by an experienced surgeon and intervened within the first few days following the injury.

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Inside-Out Meniscus Repair – A Review

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Abstract

Meniscus tears are common knee injuries presenting to an arthroscopy surgeon. Repairing the meniscus to salvage knee function and biomechanics is indicated wherever possible, since the problems after meniscectomy are well established now. Inside-out meniscus repair is a very useful technique to repair tears in the posterior and middle third of both menisci. Proper adherence to technique and safety incisions reduce the risks and complications to almost the level of an all-inside meniscus repair. The technique allows precise placement of sutures, causes minimal meniscus tissue trauma, has produced good healing rates, is cost-effective and is basically, an indispensable tool in the armamentarium of any knee surgeon.

Key Words: Meniscus, Meniscus repair, Inside-out, Safety incision.

INTRODUCTION

Once considered expendable, the vital role of meniscus in knee biomechanics is firmly established now. They are known for contributing to knee stability and congruity, resisting capsular and synovial impingement, load distribution and contribution towards screw home mechanism¹. With advances in arthroscopy in terms of technique, instrumentation, optics and biomaterials, meniscus salvage has become a thrust area in this field today. The three basic techniques of meniscus repair: outside-in, inside-out and all-inside each have their indications, advantages and pitfalls. Henning et al first described the inside-out technique of meniscus repair, involving meniscal and menisco-synovial abrasion to promote healing, cannulated suture-needle delivery system for suture placement, a posteromedial or lateral skin incision for suture needle retrieval². Here, we review the inside-out technique of meniscus repair.

Indications for Inside-out Repair and Technique

A meniscus tear must first be deemed suitable for repair, before deciding on the technique to be used. A non-degenerated, longitudinal tear, less than 3 centimeters and in the peripheral vascular zone is most amenable to repair³. An inside-out meniscus repair can be performed for the mid-third and posterior-third longitudinal tear of both the menisci⁴. With advances in all-inside meniscus repair

implants and technique, this has gradually become the standard method of repair for posterior third longitudinal meniscus tears, replacing the “gold standard” method of inside-out repair⁵. Middle third tears, however, are readily amenable to repair by the inside-out technique without significant risk to neurovascular structures and possibly, without the need for a safety incision. Radial tears are also better repaired by an all-inside figure-of-8 plus horizontal construct than an inside-out technique, having significantly higher failure loads and higher stiffness values⁶. The most recent systematic review comparing all-inside with inside-out isolated meniscus repairs did not reveal any difference in the failure rates, functional outcomes, and complications between the two methods⁷. However, the inside-out techniques have some distinct advantages. The zone specific suture needle delivery cannula facilitates more precise and controlled suture placement, while allowing for revision and improvisation⁸. Also, the finer needles cause less iatrogenic damage to meniscus tissue, compared with the heavier all-inside implant insertion needles. This is especially vital when the meniscus tissue is tenuous, or in case of a complex tear. The finer needles also provide greater number of fixation points and captures more collagen tissue⁹. Another important advantage of inside-out repair technique is the significant savings in terms of implant cost of expensive all-inside repair devices⁸.

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Surgical technique

Patient position for inside-out meniscus repair can be either with a leg holder and table broken or on a flat table with thigh side support. A proximal thigh tourniquet is used for good visualization. A diagnostic arthroscopy is first performed via an anterolateral portal. A high anterolateral portal is useful if a meniscus repair is planned, to allow the needles to pass over the tibial spines without struggle. The anteromedial portal is created under vision with the aid of a spinal needle to allow easy access to medial and lateral menisci⁸. Typically, for a lateral meniscus repair, the anteromedial portal is higher to allow needles to negotiate the tibial spine⁹. A 70-degree scope placed through the notch is helpful in viewing far posterior tears⁹. Assessment of the tear is done to decide whether to proceed with a repair or to resect the meniscus. Preparation of the meniscus tear is done next to potentiate healing. Granulation tissue must be debrided from both sides of the meniscus tear. Abrading the meniscal and peri-meniscal synovium, both superiorly and inferiorly, with a meniscus rasp (Acufex, Andover, MA) is a useful augment and aids in healing response¹⁰. Trephination is believed to create vascular channels and increase blood flow from a more vascular to a less vascular area^{11,12}. A useful trick in bucket handle tears is to prepare the edges of the tear while the meniscus is still displaced and access to both sides is easy⁸ (Figure 1). Fibrin clot prepared from the patient's own blood is also widely used to enhance healing. It not only provides a scaffold, but also acts as an initiator and activator of the healing process¹³. When a meniscus repair is being performed in isolation, performing a limited notchplasty of the lateral femoral condyle with a shaver to create postoperative hemarthrosis and deliver marrow elements is another method of biological augmentation⁹.



Fig.-1. Required material: 1. Zone Specific Cannula. 2. Needle for meniscal stitcher (0.03"x10"), 3. Non absorbable no-0 polypropylene (Prolene) & 4. Nonabsorbable Ultra Braid suture.

A. Technique for Medial meniscus inside-out repair⁹:

A 3-4 centimeter vertical "safety incision" (Figure 2) in the posteromedial aspect of the joint, posterior to the medial collateral ligament is first made with the knee in 60- 90° flexion, to relax the hamstrings and popliteal neurovascular bundle. Trans-illumination aids in precise placement of this incision, with two-thirds being inferior to the joint line and one-third superior to it. The saphenous vein is carefully protected and sartorius fascia is incised and split proximally and distally with Metzenbaum scissors to preserve the Sartorius, Gracilis, Semitendinosus and the Saphenous nerve, which lies posterior to the Sartorius. Deep dissection is carried out bluntly with Metzenbaum scissors to create a plane between the medial head of gastrocnemius and capsule. This dissection is better performed from distal to proximal. Dorsiflexion and plantar flexion of the foot aids in location of the proper plane. A Henning retractor or a small bent spoon is then inserted anterior to the gastrocnemius, which protects the popliteal neurovascular bundle, retracts the pes and gastrocnemius and deflects the needle medially for retrieval. Repair can then begin, starting posteriorly and working anteriorly, with the knee in 10-20° flexion. Visualization of posterior meniscus can be improved by pie crusting of the medial collateral ligament just below the joint line, while applying a valgus-external rotation force. Zone specific single and double lumen cannulae (Acufex, Andover, MA) inserted from the anterolateral portal are used to keep the meniscus reduced and for precise placement of the needles. For tears very close to the posterior root, it might become necessary to insert curved a cannula from the anteromedial portal, the curvature being directed away from the midline, to achieve proper trajectory for the suture needle. Non-absorbable multi-strand, long chain ultra-high molecular weight polyethylene (UHMWPE) sutures on 10-inch-long needles. The cannula is retracted 3-5 mm when the needle is pierced to increase the accuracy. This is done for the femoral side first, attempting to achieve a vertical mattress configuration, as this provides greater capture of strong circumferential fibers of the meniscus⁸. This might create a puckering of the meniscus, which subsides when tibial sided sutures are passed in a similar fashion to create a stacked repair and provide better coaptation of the tear area¹⁴. The needles are passed by one assistant, while a second assistant retrieves them using a needle driver, clips it using a

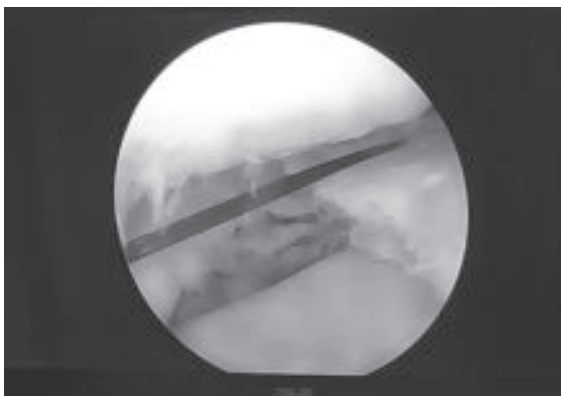


Fig-3: Nonabsorbable no-0 polypropylene (Proline)

hemostat and cuts the needles, taking care to avoid needle stick injury to anybody. If the needle is not visible after passing 1-1.5 centimeter, it must be withdrawn and reinserted at the same or different location with a different trajectory. Multiple sutures maybe passed at 3-5 mm intervals. The sutures may be tied sequentially as they are passed or at the end, after all have been passed out. When tying the knots, the knee must be kept in near or full extension to avoid imbricating the capsule, effectively causing a capsulorrhaphy and consequent flexion contracture.

B. Technique for Lateral meniscus insideoutrepair :

The general principles remain the same as for a medial meniscus repair, with some important differences. The lateral vertical safety incision is made in a similar fashion, posterior to the fibular collateral ligament, two-thirds below and one-third above the joint line. The interval between biceps femoris and iliotibial band is dissected bluntly with scissors, the common peroneal nerve being posteromedial to the biceps tendon. Dissection between the lateral gastrocnemius head and posterolateral capsule is similarly begun distally and a finger is used to assess the proper plane by flexing and extending the ankle. Staying anterior to the biceps and gastrocnemius lateral head reliably protects the common peroneal nerve A Henning retractor or bent spoon is placed as for the medial side, between the capsule and gastrocnemius. The anteromedial portal is made higher to avoid the eminence of the tibial spine, under vision over a spinal needle with the knee in a figure-of-4 position. If need be, accessory high anteromedial portal can be made to improve suture needle trajectory. The cannula is never inserted from the anterolateral portal due to the potential risk to the popliteal vessels, which lie

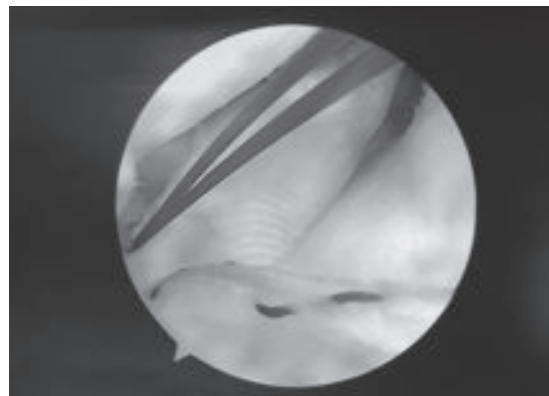


Fig-4: Nonabsorbable Ultra Braid suture

just posterior to the posterior horn of the meniscus. Though no problems have been reported, it is best to avoid the popliteus tendon and pass sutures adjacent to this structure⁹. Capsular capture is not a problem on the lateral side and hence, knot tying can be done with the knee in flexion.

Steps in an anatomical model:

Step-1: Zone specific cannula placed on capsular side.

Step-2: Needle preloaded with No-0 prolone is passed through the cannula on the capsular side.

Step-3: Prolone loop is passed through the capsular side.

Step-4: Non absorbable Ultra Braid suture is passed through the capsule by pulling of prolone loop.

Step-5: Non absorbable Ultra Braid Suture is taken out through the capsule.

Step-6: Zone specific cannula placed on meniscal side.

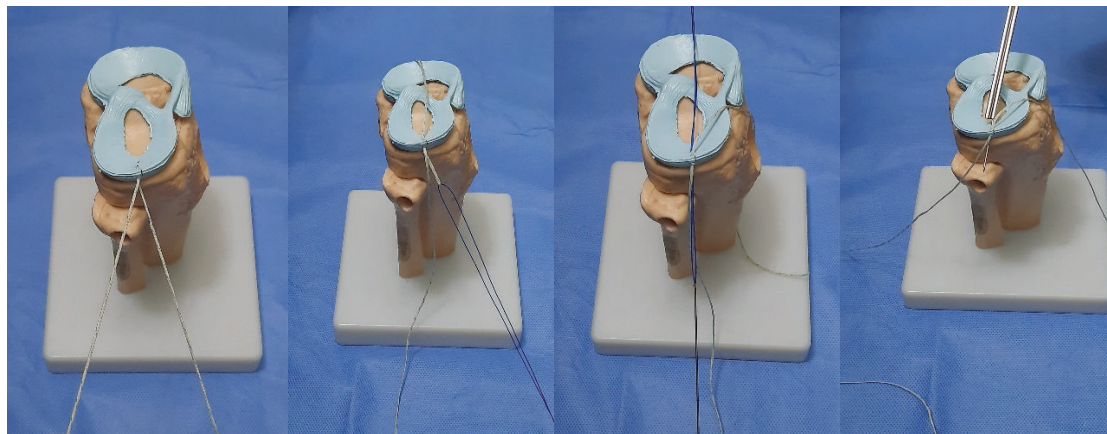
Step-7: Needle preloaded with No-0 prolone is passed through the cannula on the meniscal side.

Step-8: Prolone loop is passed through the meniscal side.

Step-9: Non absorbable Ultra Braid suture (end of previous) is passed through the meniscal side by pulling of prolone loop.

Step-10: Both ends of Non absorbable Ultra Braid Suture is taken out through the joint capsule.

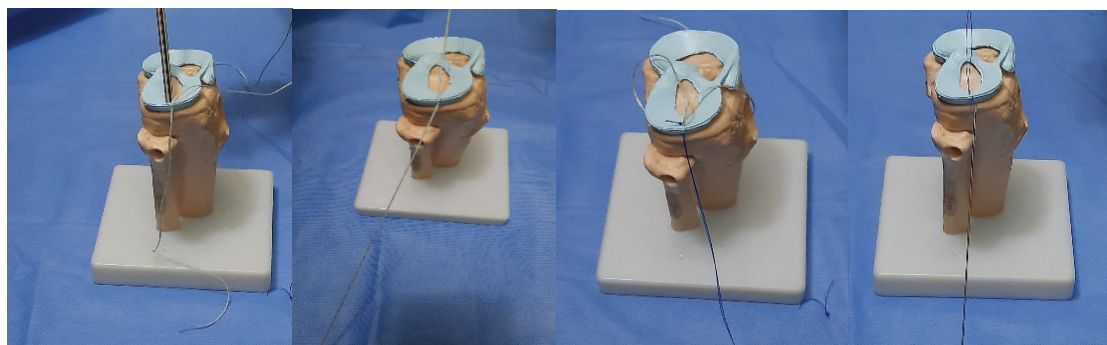
Step-11: Sliding or non-sliding knot is tightened against the capsule. Definitive repair with a non-absorbable suture in a vertical mattress fashion.



Step-1

Step-2

Step-3 Step-4

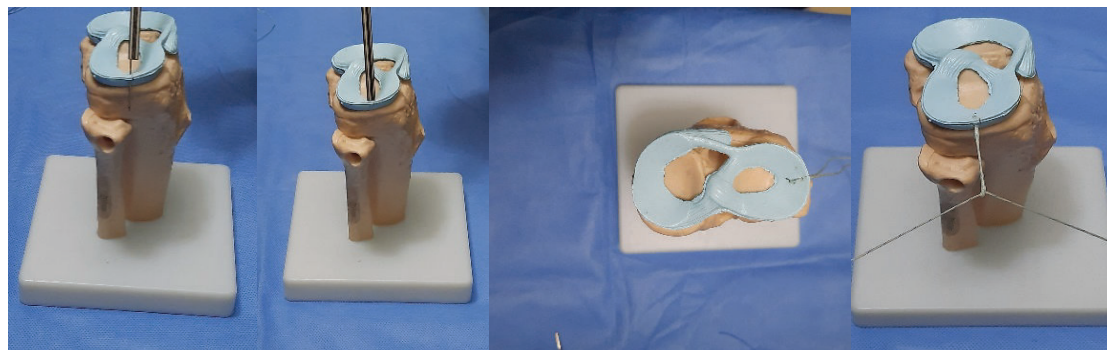


Step-5

Step-6

Step-7

Step-8



Step-9

Step-10

Step-11

DISCUSSION

The inside-out repair technique offers a success rate of 60% to 80% for isolated meniscus repairs and between 85% and 90% when performed with a concomitant ACL reconstruction⁵. Horibe et al performed second look arthroscopy for 132 meniscus repairs by inside-out technique. They report 74% excellent (completely healed) and 17% good (incomplete healing, partial thickness defect, stable on probing) result in their cohort¹⁴. Choi et al compared the results of suture repair of meniscus tears with concomitant ACL reconstruction, by allinside and inside-out techniques using polydioxanone sutures. They

found no difference in the healing rates on magnetic resonance imaging and no difference in Lysholm scores or Tegner activity scales between the two groups¹⁵. A systematic review by Grant et al was done to compare the effectiveness and complications of isolated inside-out and all-inside meniscus repairs. There was no statistical difference in clinical failure rate- 17% for all-inside and 19% for inside-out techniques. Subjective outcome, as measured by Lysholm score and Tegner activity scale was also comparable between the two groups. Insideout repairs however, require 50% greater operative time. Nerve related symptoms were commoner (9%) in the inside-out group

than in the all-inside group (2%). Upon pooling of all complication data, the Odds ratio was 0.55 (95% confidence interval = 0.27, 1.10). 0.55 (95% confidence interval = 0.27, 1.10)¹⁶. In a more recent systematic review, Fillingham et al compared current all-inside repair devices with the classical inside-out repair for isolated meniscus tears. They reported no significant differences in clinical or anatomic failure rates (clinical failure: 11% for inside-out versus 10% for all-inside, respectively, $p=.58$; anatomic failure: 13% for inside-out versus 16% for all-inside repairs, $p=.63$). Mean \pm SD Lysholm score and Tegner score for inside-out repair were 88.0 ± 3.5 and 5.3 ± 1.2 , while the respective scores for all-inside repair were 90.4 ± 3.7 and 6.3 ± 1.3 . Complications occurred at a rate of 5.1% for inside-out repairs compared to 4.6% for all-inside repairs⁷.

Complications and Problems:

The various anatomic structures in the needle trajectory can potentially be injured. By deploying safe surgical practices, they can be avoided. These are some of the commonly encountered problems:

1. Saphenous nerve injury- It can be avoided by the medial safety incision and keeping the nerve, which lies posterior to the Sartorius, retracted behind the pes tendons.
2. Common peroneal nerve injury- The nerve lies posteromedial to the biceps femoris. Injury is avoided by keeping the knee in flexion while making the lateral skin incision and carefully developing the plane between the biceps femoris and iliotibial band.
3. Popliteal vessels- are most at risk while doing a posterior lateral meniscus repair. Careful placement of retractor and always passing suture needles from the anteromedial portal with careful retrieval, avoids injury to the vessels.
4. Flexion contracture may develop- when the medial side sutures are tied with the knee in flexion, thus over tightening the posteromedial capsule.
5. Needle stick injury to the surgeon or assistants- avoided by careful, unhurried movements⁸. The inside-out technique also has an increased operative time, compared to all-inside technique by about 50%¹⁶.

CONCLUSIONS

The inside-out method of meniscus repair is an excellent technique to repair tears in the middle and posterior-third

of both menisci. With the rapid development of all inside meniscus repair devices, this technique may not remain the “gold standard” but still has an important role, especially in repairing large and complex tears. When care is taken to protect the neurovascular structures posteriorly, and with due diligence to correct surgical technique, it is a safe, cost effective and proven method to salvage the menisci whenever possible

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