The Journal of Bangladesh Orthopaedic Society (JBOS)

Published by

BANGLADESH ORTHOPAEDIC SOCIETY

The Journal of Bangladesh Orthopaedic Society (JBOS)

JOURNAL COMMITTEE 2012 - 2014

BANGLADESH ORTHOPAEDIC SOCIETY (BOS)

Executive Committee (2012 - 2014)

President	:	Dr. Kh. Abdul Awal Rizvi
Vice President (Dhaka City)	:	Dr. Md. Iqbal Qavi Dr. Nakul Kumar Datta
Vice President (Outside Dhaka City)	:	Dr. Hamidul Haque Khandker Dr. Md. Anowar Hossain
Secretary General	:	Dr. Md. Abdul Gani Mollah
Treasurer	:	Dr. Syed Shahidul Islam (Shahid)
Joint Secretary General	:	Dr. Monaim Hossen
Publication Secretary	:	Dr. Md. Golam Sarwar
Organizing Secretary	:	Dr. Md. Wahidur Rahman (Dhaka) Dr. Md. Mizanur Rahman Chowdhury (Chittagong) Dr. Samil Uddin Ahmed Shimul (Rajshahi) Dr. Md. Mehedi Newaz (Khulna) Dr. Md. Moniruzzaman Shahin (Barisal) Dr. Ishtiaqe ul Fattah (Sylhet) Dr. Md. Zahidul Islam (Rangpur)
Office Secretary	:	Dr. Mohammad Mahfuzur Rahman
Secretary International Affairs	:	Dr. Md. Abdus Sabur
Scientific Secretary	:	Dr. Md. Jahangir Alam
Social Welfare Secretary	:	Dr. A.K.M. Zahiruddin
Members	:	Dr. Sk. Nurul Alam Dr. Md. Mofakhkharul Bari Dr. Md. Shamim Adom Col. Dr. Md. Abdul Awal Bhuiyan Dr. S.M. Amir Hossain Dr. Md. Anisur Rahman Labu Dr. Kazi Shamim Uzzaman Dr. Md. Aminul Haque Pathan Dr. Mohammad Khurshed Alam Dr. Md. Anowarul Islam Dr. Muhammad Sieful Islam
Ex-Officeo Members	:	Dr. Ramdew Ram Kairy

INFORMATION TO CONTRIBUTORS

The Journal of Bangladesh Orthopaedic Society is published twice in a year in the month of January and July. Articles are received throughout the year in the office of BOS, NITOR, Dhaka. Acknowledgement receipt may be taken from the office. Letter of acceptance will be given on demand after initial scrutiny of the paper by the Journal committee. If any paper is found to be copied, pirated or not a genuine works as claimed by the author, will be discarded automatically without information. Authors are requested to follow the instructions outlined below:-

Preparation of manuscript:

Manuscript should be typed on white A4 size paper with liberal margins and double spacing and on one side of the paper only. Pages are to be numbered consecutively beginning with the title page.

Title page:

The title page should contain the title of the study of investigation and abstract, mentioning basic procedures, main findings, principal conclusions and keywords.

Text:

The text of the article should be divided into introduction, materials & methods, results, discussion and conclusion.

Tables & Illustrations:

Each table or illustration is to be typed on a separate sheet & numbered in roman numbers & attached at the end of the text.

Photographs should be clear, glossy and in black & white preferably. Top of the picture should be indicated by arrow sign (T). Diagrams & graphs are to be drawn by jet black ink or printed by laser printer in white sheet.

References:

References are to be numbered consecutively in the order in which they appear in the text. The form of references should be as per examples below:-

a) References for journal:- References should be written according to the following sequence-authors name, topic, name of the journal with year of publication, volume number, page numbers e.g: Ratliff ABC. Truamatic Separation of the upper femoral epiphysis in Children. J.B.J.S. (Br.) 1968. 5013:57507-70.

When there are seven authors or more the first three names will be listed & then the word 'et. al' to be added.

b) References for Complete books:

Sequence for references are - authors name, name of book, number of edition, Publishers name, Year of Publication, Page e.g: Adams J.C. Outline of Orthopaedic. 9th edition Churchill Livingstone 1981. 347.

c) Reference of articles of Magazines

Sequence of reference are - authors name, name of subject, name of magazine, year & date, Pages e.g: Zachary R.B. Result of nerve suture M. Seddon H.S. Ed. Perpheral Nerve injuries. MRC Special Report Series No. 282. London. 1954 3 5c4-88.

Authors may submit the article composed in Microsoft Word as in the journal format in two columns with pictures and diagrams. 3 copies of printed article to be submitted at Bangladesh Orthopaedic Society office along with soft copy composed in Microsoft Word in a CD or data can be transferred by pendrive or by e-mail. Original copies & digital photos in JPEG format to be attached in a separate folder.

Articles are accepted for Publication on the condition that they are contributed solely to this journal.

Address of Bangladesh Orthopaedic Society Office:
National Institute of Traumatology & Orthopaedic Rehabilitation (NITOR)
Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh.
Tele-Fax: +88 - 02 - 9135734
PABX: +88 - 02 - 9144190-4, Ext-280
Mobile: +88 - 01917-665140
web: www.bosbd.org
e-mail: bos_bdortho@yahoo.com,

FORWARDING LETTER FOR SUBMISSION TO JBOS

Date.....

To

The Editor

Dr. .....

The Journal of Bangladesh Orthopaedic Society (JBOS)

Sub: Submission of manuscript

Dear Sir,

We are submitting our manuscript entitled**,** ..... by, ... [1], ... [2], ... [3], ... [4], ... [5]. for publication in your journal. This article **has not been published or submitted for publication elsewhere.**

We believe that this article may be of value to medical professionals engaged in Orthopaedic Surgery & related subjects/..... We are submitting 3 copies of manuscript along with an electronic version (CD).

We therefore, hope that you would be kind enough to consider our manuscript for publication in your journal **as original / Review article / Case Report**.

Thanks and best regards

(1)

Professor,

Department of ..... BSMMU/NITOR/ Medical College. .....

(2)

Associate Professor,

Department of ..... BSMMU/NITOR/ Medical College. .....

(3)

Assistant Professor

Department of ..... BSMMU/NITOR/ Medical College. .....

(4)

Consultant /...../.....

.....

.....

The Journal of Bangladesh Orthopaedic Society (JBOS)

Date : .....

To

.....

.....

.....

.....

Subject : Acceptance of the Article for publication

Dear Author

Your article Titled "....." has been accepted for publication by the Editorial Board of the The Journal of Bangladesh Orthopaedic Society (JBOS)

Your article will be published in any of the coming issues.

Thanking you.

.....

Editor

The Journal of Bangladesh Orthopaedic Society (JBOS)

THE JOURNAL OF BANGLADESH ORTHOPAEDIC SOCIETY

VOLUME 28 **NUMBER 2** **JULY 2013**

CONTENTS

Editorial

Orthopedics: In the Cross Road of Development in Bangladesh

Khondker Abdul Awal (Rizvi)

Medical science is ever changing. Since the time of Hippocrates medical science has seen tremendous changes over the centuries. Medical science was basically personal attempts of wise men or religious leaders in healing their patients. It was a kind of art rather than science. However with the development of basic branches of science, medicine began to change to a unique combination of science and art. Science has enabled us to know the secret of DNA, combat heart diseases, cancer, infections, replace joints and organs.

History of medicine in Bangladesh, as part of Indian subcontinent is very old. For thousands of years people of this region are acquainted with Ayurvedi medicine, Siddha medicine and Unani medicines. These traditional medicinesare so deep rooted in the society that still today they are being practiced. Orthopedic surgery is relatively new in this subcontinent. But orthopedic conditions are managed by traditional physicians known as Manda for centuries. This village doctors are still in practice in rural areas. They use a technique of reduction without anesthesia, apply herbal medicines, massage the area, and immobilize the part with bamboo sticks wrapped with cotton tapes.This kind of treatment is known to hasten bone healing but notorious for complications.

Before the liberation of Bangladesh in 1971, we had only 2 qualified orthopedic surgeons to treat a population of 75 million. The era before that was very dark. In the latter half of the past century we had a few qualified general surgeons to treat only a handful fortunate.About a century before thattime country had no qualified surgeons. Only some half qualified doctors named national doctors and few white civil surgeons were available. Of course, traditional medicines were thereand were for centuries. Real development of orthopedic surgery begun with the treatment of wounded freedom fighters of the great liberation war of Bangladesh. After the liberation war nascent Bangladesh faced a huge problem of treating wounded freedom fighters. Some of them were sent to Germany and Hungary but huge numbers were left for local management. At that time we did not have adequate facilities to treat them. During that time DR. R.J.Garst, a philanthropist American orthopedic surgeon came to Dhaka from Ludhiana, India. DR. Garst gathered huge experience in treating orthopedic problems through his voluntary work for more than 15 years in Ludhiana.Bangubandhu SK. MujiburRahaman, father of nation of Bangladesh requested Dr. Garst to help in managing wounded freedom fighters. Soon, in April 1972, MuktiBahini Hospital was started in a small part of SahidSarwasdi Hospital. He managed wounded freedom fighters with the help of a few energetic young local doctors and eminent orthopedic surgeons from UK& USA. There was a great demand for orthopedic services from the general population. Thus, services were opened for general public. This expansion needed large number of orthopedic surgeons & bigger facilities. To produce properly trained orthopedic surgeons academic courses like MS & Dip in orthopedics were stared under Dhaka university in 1973. Demand for a new hospital was realized and a new hospital came into being named Rehabilitation Institute & Hospital for the disabled (RIHD) in 1978. These two can be considered asmile stones in the development of orthopedics in Bangladesh. Another great event was the creation of Bangladesh Orthopedic Society(BOS) in 1981.All these elements, the leadership of Dr. Garst , contribution from few visiting faculties and the dedication of some local orthopedic surgeons helped rapid development of the subject. New surgeons were produced with new zeal and skill and the number of member of BOS started to increase. Within a few decades orthopedic surgery was well established in Dhaka and in the all medical college hospitals and major cities.

Newly qualified doctors full of energy and cravings for knowledge started to go to different countries for higher

Director & Professor, National Institute of Traumatology & Orthopedic Rehabilitation (NITOR), Dhaka, Bangladesh

education and training. At the same time posts were created in different medical colleges and hospitals and set a scenario of orthopedic surgery capable of treating all kind of orthopedic conditions in the country.

The first 4 decades of orthopedic surgery in Bangladesh is the era of general orthopedic surgeons. During those decades we have seen some dedicated world class surgeons contributed in making a strong base of orthopedics in the country. Since the turn of the millennium demand and expectations of population started to change and strive for the development of sub specialty and improvement in the patient care were seen.Many hospitals begun to procure high tech. instruments and machines. They also improve infra-structure. Develop manpower in the lines of sub specialty. In 2003 first ever sub specialty in Spine and arthroscopy was established in BangaBandhu Sheikh Mujib University (BSMMU) and in 2009 subspecialty was started at NITOR in Arthroplasty, Spine, Hand and Pediatrics and deformity correction. In 2013some posts in sub specialty were created in NITOR and other medical college hospital. Some more posts are expected to be created within short time to make sub specialty units full fledge.

We live in a time where science is well advanced and moving very fast. World has become a global villageand people are almost free to move around and like to exercise personal choice in decision making. That is seen more in regards to medical treatments. That is why we see a lot of patients go abroad for medical treatment draining huge foreign currency. The reason for that the quality of care patients expect is missing in many respects. That is the area where we need to work.

Developing man power is the greatest challenge. We need to have highly trained, motivated and hardworking doctors, nurses, paramedics and other hospital stuff. Recruitment of personnel is important and it should be unbiased. Physical facilities in many of the hospitals are very poor and often underutilized. Improvement is necessaryand that has to be local need based.Quality of service delivery in our hospitals is very ordinary and often stained with malpractice. Changing this is very difficult and can be done by enforcing strict discipline, providing incentives, hiring quality work force & firing unworthy personnel. This requires strengthening local authority and can be done by providing autonomy to the institutions. Research is much neglected in our country. Further development in the subject is possible by encouraging research and improving academic environment. The kind of documentation we have at the present is completely unacceptable. So, documentation is urgently needed a change and change is possible because we need it & govt. is also helping to change.

Bangladesh Orthopedic Society is a strong organization of more than 600 members and going stronger very day. NITOR is expanding its facilities with the establishment of new expansion project. This project will provide additional 500 beds, specialty subjects, new high tech theaters, well organized OPD, emergency, lab facilities, new prosthetic center and space for academic activity.Orthopedic departments, either Govt. or non Govt.are headed by young well trained and energetic surgeons and capable of taking the subject to a higher level. I believe, the day is not far away when the world class orthopedic service will be available in all parts of Bangladesh.

Original Article

Ilizarov External Fixator in Legg-Calve-Perthe's Disease

SM Amir Hossain[1]. Golam Sarwar[2], Mohammad Mahfuzur Rahman[3], Nitaya Ranjon Ray[4], Gourango Bairagi[5]

SUMMARY

Treatment of Perthe's disease is still unsolved orthopaedic problem in world wide. We apply Ilizarov to achieve better solution of LCPD in hips of 20 boys & 2 girl (mean age 8-10year) with diagnosed case of perthe's disease underwent fixator using Ilizarov. Most of patient were caterall group III, 14(63.6%) & group IV 5 (22.7%) & group II with risk factors 2 (9%).The boys were followed for a mean of 12 month. Ilizarov were kept in situ on average of 4 month (range 3-7month) maximum boys are from rural area 15 (82%). Result were assessed by stulberg classification in which, group I&II spherical head congruency between head & acetabulum 16 patient & group III & IV spherical head in 6 patient (satisfactory 17 patient (77.27) & 5 were unsatisfactory. Most common complication were pin track infection which occurred in 14 patient. The high rate of success found that Ilizarov may be a good option for treatment of legg-calve-perthe's disease considering other option of treatment as conventional treatment of LCPD is not satisfactory according to literature.

INTRODUCTION

Perthe's disease is a symdrome in which an a vascular event affect the capital epiphysis (head) of femur. Etiology of LCPD is uncertain, but some factors are related to LCPD, such as deficiency of protein-s, protein-c & hyprofibrinolysis. Reduction of blood flow of femoral head (multiple episodes), abnormal venus drainage, trauma on predisposed child, sequelae of sinovitis & delayed age – related to chronological age with growth hormone abnormalities- play vital role in pathogenesis of LCPD. By application of Ilizarov, containment of femoral head, decreased weight bearing on affected hip, restoration of motion, reduced lateralization of collapsed head done, thereby reducing risk of femoral head deformity. As pin is introduced around sub- trochetric area and also in head of femur at sclerosed area which stimulate arteral plextus & neovascularization when patients walk. This in turn may help to eliminate subsequent ischemic episodes, giving the hip a chance to heal. By application of Ilizarov patient is benefitted in may ways- as this is a close method, no blood loss, patient can walk with external fixator, increase vascularity of femoral head, neovascularization and artho-diastasis by which induce angio-neosenesis around the joint.

Ilizarov in perthe's disease is a new dimension in our sub containment (in SARC countries). As no other convensional treatment of perthe's disease is satisfactory, we apply Ilizarov in those cases of cateral group III, IV and II with risk factors.

MATERIAL & METHODS

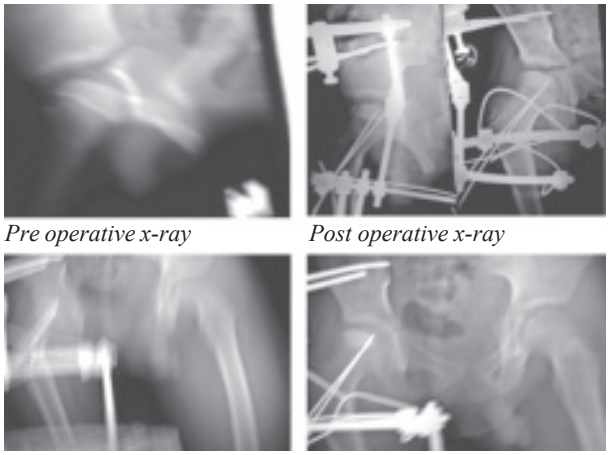
This prospective study is done in NITOR & outside NITOR (in private clinic) with aid of C-arm. Diagnosed case of 20 boys & 2 girl, all hip were underwent containment and distraction using Ilizarov external fixator between April-2009 to February-2012. Age of bodys and girl are between 7 years to 12 years (Mean 9-10 Yrs). Two girl seen affected in this study, onset of symptoms & treatment 6 months to one year in maximum cases 16 (72.7%) & more than one year in 6 (27.3%) patients. Hips graded as catteral III

1. Assistant Professor (Ortho Surgery), NITOR, Dhaka.
2. Assistant Professor (Ortho Surgery), NITOR, Dhaka.
3. Medical Officer, Department of Orthopaedic Surgery, BSMMU, Dhaka
4. Clinical Assistant (Ortho Surgery), NITOR, Dhaka.
5. Assistant Professor (Ortho Surgery), NITOR, Dhaka.

Correspondence: Dr. S.M. Amir Hossain, National Institute of Traumatology orthopaedic rehabilitation, Dhaka. E-mail-amirhossain9@live.com

14(63.6%) IV 5 (22.7%) & II with risk factors 2 (9%). According to cateral pillar classification 12 of 22 hip were class B and 10 were class C. Most of boys are undergrowth 12 (54.5%) & in rural area 13 (59%). Average follow-up is 12 month ranging 4 months to 30 months. Keeping Ilizarov is situ is 3 months to 7 months (mean 4-5 months). All patient are unilateral & right sided is more affected 15(68.2%) than left. There is history of limping is 18 cases, difficult is walking 16 patient, shortening of lower limb (.5 cm to 1.5 cm). In 19 patients pain in affected grain–12 patients. Pain increase on exercise 18 cases. Wasting of thigh muscle 16 cases. Restriction of hip movement (specially abduction & internal rotation) in all patients.

Hafiuzur Rahman of 9 years boy



Pre operative x-ray *Post operative x-ray*

6 weeks after operative x-ray *12 weeks after operative x-ray*

Fig.-1: *perthe's disease with Ilizarv and follow up.*

Surgical Technique: Patient is in fracture table under anesthesia (spinal/G.A). Traction was given with abduction 45º on affected limb with internal rotation (10to20º). Containment seen under C-arm guidance. Ilizarov external fixator application done as follow – (i) One full ring in mid-shaft of femur (ii) one Omega 3/8 ring at lesser trochentreric area to stimulate vascularization in metaphysal vessels (iii) one Italian arch in illium with two shanz screw at sapra-acctabular area/ Illium (iv) Two hinge were applied at hip joint level for flexion & extension of hip movement (v) Artho-diastais by traction & maintained by external fixator to increase vsculurity of femoral head (vi) Two/more k-wire were applied at selerosed/a vascular part of head/ epiphysis under C-arm guidance that stimulate neovascularization & increased vascularity of avascular part when patient walk/move with Ilizarov.

Tanvir Hossain 8 years boy

After operation

Fig- 2: *Patient walking with Ilizarov in situ.*

Post operatively patient was given analgesia. On 1st POD boys were walk with crutches, patients were discharged after 2nd to 6th post operative day and advised to walk with crutches. After 2-3 wks patient walk without crutches, x-ray was taken post operatively within one week and after 6 weeks intervals to see vasculurization of avascular segment.

Fig.-3: *Abu Sayed 12 years boy operated on 22-11-09 of parthe's disease by ilizarov*

RESULTS:

The result were assessed in the term of radiological containment, revascularization & stulberg classification. In this study Group I & II spherical head congruency between head & acctubullum in 16 patient. In group-III-

spherical but not congruent in 3 patient, Group IV flat head in 2 patient & Group V –loss of shape without change in acctuhullam–aspherical incongruency - 1 patient. Radiological revasculorization were in 17 patient completely & 5 patient in completely. Fragmentation heals in 16 patient & not completely heal in 6 patient. This is a short term follow up of 12 month average (rage 4 month to 30 months).

Complications- Pin tract infection (more in shanz screw) common in 7 patient, which is treated by antibiotic & local dressing. Intrusion of half ring on skin – one patient, pain during walking – 6 patient, disturbance of wearing cloths in all patient & stiffness of affected hip movement in 17 patient which resolved after exercise & physiotherapy afterward. Complication of traditional surgical technique are common & include limb shortening, scarring & stiffness. These may outweigh the benefits of intervention of Ilizarov fixator. Our preliminary result show considerable potential benefits. Early radiological finding are promising since further epiphyseal collapse has largely been arrested and are all shape of the femural head has been maintained.

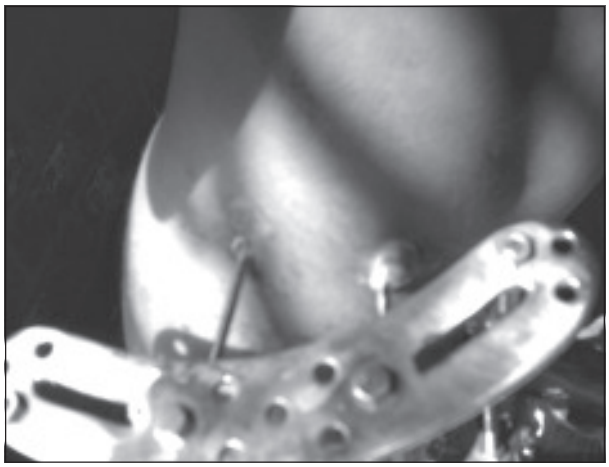


Fig.-4: *Shanzs screw infection a commoncomplication in iliazarv*

DISCUSSION:

The goal of treatment of perthe's disease by Ilizarov is to improve hip mobility, containment of hip, reduction of mechanical stress across hip joint, distraction of joint which may facilate cartilage proliferation and endochondral ossification of the proximal femoral epiphysis. This is a small series but new invention in our subcontinut with short term follow up (average – 12 month). But rapid progression of healing & containment is promising. There is some complication like pin track infection & pin breakage which correspond to study of Maxell et al.

The long-term prognosis in patient with LCPs in directly related to the shape of the healed femoral head in adulthood. Eyre brook first popularized the principle of femoral head containment and Kamhi and MacEwen proved clinically that containment treatment had superior results compared with non containment treatment method.

By Ilizarov we can provide containment & arthodiastasis by which neovascularization in the distracted tissue possible. Enhanced blood flow around the distracted joint could change the nature of the disease of ischemic etiology. By Ilizarov external fixator frame, the joint can be moved during the distraction period which enhance remodeling of the femoral head, nutrition of chondral tissue, protection of hip range of motion. The frames were left in place until there was evidence of new bone formation on the lateral pillar & flextion-extension exercise should performed with hings to avoid stiffness.

Every patient needs isotope scanning and MRI pre-operatively & follow-up. But we had lack of this facilities in out hospital. With experience surgical team & quality instrument rate of complication can be minimized. However other methods of treatment both surgical & conservative have also complication & adverse effects.

CONCLUSION:

Ilizarov external fixator in LCPD in this study shows the rapid progression of healing in a vascular head and containment of sublaxated head with revascularization is promising. Considering complication of Ilizarov preliminary result was satisfactory and with improvements of technical details the reported disadvantage will be decreased. With meticulous technical details complication can be minimized. Considering other forms of treatments Ilizarov in LCPD may be a better option.

REFERENCES:

1. Ilizrov Fixator for treatment of legg-Calve-perthes Disease Mahoret Kocaoger et al. Journal of Pediatric Orthopeadic, Part-B 8: 276-281 1999
2. Arthodiatasis in perthes disease S.L. Mazwell at ell. JBJS(hr), 2004, 86-B: 244-50
3. Catterall A. The natural history of Perthes disease. J. Bone Jont Surg Br 1971: 53:37-53.
4. Eye-Brook AL. Osteochondritis deformans coxas juvenilis or Perthes' diseas: the results of treatment by traction in recumbency. Br J Surg 1936:24:166-82.
5. Gower WE, Johnston RC. Legg-Oertges disease: Long-term follow-up of thirty-six patients. J Bone Joint Surg Am 1971:53:759-68.
6. Ilizarov GA. The tension-stress effect on the genesis and growth of tissues. In: Ilizarov GA. Transosseous osteosynthesis. Berlin: Springer-Verlag. 1992: 137-256.
7. Kamhi E, MacEwen GD. Treatment of Legg-Calve-Perthes sisease: prognostic value of Catterall classification. J Bone Joint Surg Am 1975:57:651-4.

Original Article

Outcome of Arthroscopic ACL Augmentation by Hemistrings Autograft for Partial ACL Rupture

Azizul Haque[1], Mohammad Serajus Saleheen[2], Shah Muhammad Aman Ullah[3], Fakrul Amin Khan[4], Md. Golam Sarwar[5], Molla Muhammad Abdullah Al Mamun[6], Syed Golam Samdani[7]

ABSTRACT:

The present prospective study was conducted to evaluate the results of arthroscopic ACL augmentation by hemistring graft for partial ACL rupture. A total of 41 patients aged more than 18 years presenting internal derangement of knees were included in the study.The mean age of the patients was 24 years and the youngest and the oldest one were 18 and 48 years respectively. Majority of the patients were male and students, buisnessman, service holders or housewives by occupation. According to side involvement of the knee, Right side involved 33(80.5%) and left side involved 8(19.5%). Among 41 patients, 30(73.0%) were presented with antero medial bundle of ACL injury and 11(27.0%) were posterior lateral bundle of ACL injury.Regarding the time interval between injury & operation it was observed that 26(63.0%) patients were operated within 5 months of injury and the rest of the patients 15(37.0%) was operated between 6-20 months of injury. The mean duration of hospital stay after operation was 4.9(±1.66)) days.

Evaluation of the outcome at 6 months showed that according to Lysholm score , excellent functional outcome was exhibited in 36 patients (87.80%) and good functional outcome was exhibited in 05 patients (12.09%). Pre operative versus post operative Lysholm scores showed significant improvement (p<0.001).So, arthroscopic single bundle ACL augmentation with hamstring auto graft is the effective treatment option for ACL rupture of knee.

Keyword : Arthroscopic ACL augmentation, Hemi strings graft, Partial rupture of ACL

INTRODUCTION:

Anterior cruciate ligament (ACL) injuries are common. An estimated 80,000 to 250,000ACL injuries occur yearly, with the majority of these in athletes between ages 15 and 25.[1,2] Partial tears of the ACL, though not as common as complete tears, may account for 10% to 28% of all ACL injuries, but the epidemiologic data regarding this entity are not as clearlydefined.[4] The natural history of complete ACL ruptures has been well defined and often reported in the literature.[5] Typically, patients who sustain a complete ACL tear report symptomatic instability with pivoting sports or strenuous activity. Patients diagnosed with partial tears of the ligament have a less predictable outcome.[3] Although many continue to experience instability, many do not, and identifying both groups can be challenging. In addition, diagnosing partial tears and tailoring treatment to individual patients can be difficult, as there are no clear treatment guidelines. ACL is one of the strongest ligaments in the knee joint being responsible for primary restraint to anterior tibial translation. It is largely consists of AM and PL bundle. AM bundle taught in extension and PM bundle taught in flexion. As two

1. Jr.Consultant, Charfession Health Complex, Bhola.
2. Clinical Assistant, NITOR
3. Medical Officer, Burn &Plastic Surgery Dept, DMCH.
4. Assistant Prof, Dept of Orthopaedics,DMCH.
5. Assistant Professor, NITOR
6. Medical Officer, NICVD.
7. Jr.Consultant, Nilphamary Sadar Hospital

Correspondence: Dr. Azizul Haque, Jr.Consultant, Charfession Health Complex, Bhola.

different bundle has got different function in single bundle rupture bundle specific augmentation is rational. Also single bundle augmentation provides good ligamentization proprioception and joint stability.[6,7] So that arthroscopic single bundle ACL augmentation with hamstring auto graft is one of the effective method for maintaining knee stability.

OBJECTIVES:

To evaluate the results of arthroscopic ACL augmentation by hemistrings autograft for partial ACL rupture.

METHODOLOGY:

This is a prospective study carried out at City Hospital, Lalmatia, Dhaka and Northern International Medical College and Hospital, Dhanmondi, Dhaka, from July 2010 to December 2012. 41 patients were taken for the study. Chronic partial ACL injury was selected. Quadrupled hamstring auto graft for augmentation of AM and PL bundle deficient knee. Postoperative standard rehabilitation protocol was followed for all patients. Hamstring tendon autograft was used in all cases. The semitendinosus and gracilis tendons of the ipsilateral knee were harvested with a stripper. The muscular tissue of the harvested semitendinosus and gracilis was removed. Then No. 5 Ethibond sutures were used to make the tendon in a tube shape through baseball whip stitching. Each tendon was folded into 2, making 4 strands. The tibial tunnel was located just posterior to the anterior margin of the ACL footprint for the reconstruction group and the AM augmentation group. For the PL augmentation group, the tibial tunnel was located just anterior to the posterior margin of the ACL foot print or between the bony attachment sites of the anterior and posterior horns of the lateral meniscus. The position of the femoral tunnel was aimed at 10.30 in the right knee (1:30 in the left knee) for the reconstruction group ; 11:00 in the right knee (1:00 in the left knee) for the AM augmentation group and 10:00 in the right knee(2:00 in the left knee) for the PL augmentation group.

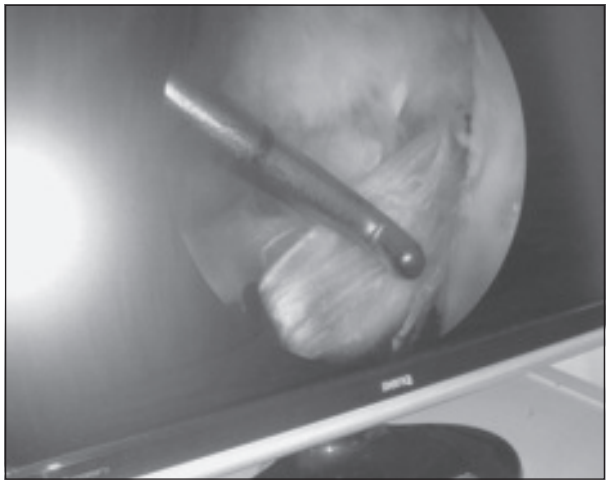


Fig-1: *partial tear of ACL seen Arthroscopically*

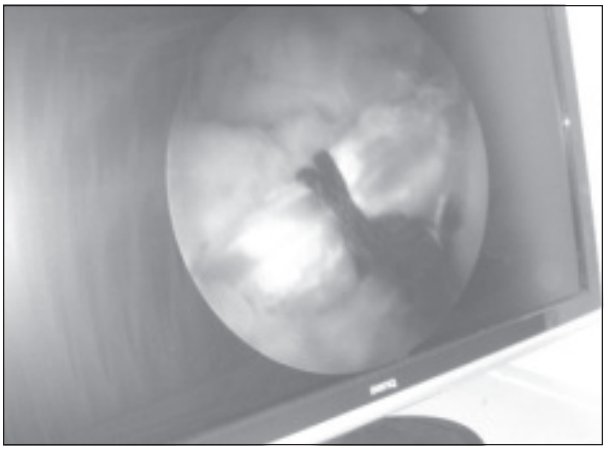


Fig-2: *Augmentation of ACLby Hemistring Autograft*

RESULTS:

This prospective study was carried out from July 2010 to December 2012. A total of 41 cases were selected for the study and followed up from 1 month to 30 months. After an average of 6th month follow up the following findings were compiled.

Table I

Age distribution of the study patients (n=41).

Age of the patients (years)	Numbers	Percentages
10-20	12	29.0
20-30	21	51.0
30-40	6	15.0
>40	2	5.0

In this study the highest number of patients 21(51.0%) were observed in 3rd decade and lowest number 2(5.0%) patients was observed in 5th decade. The mean age was 24 years.

Among the study population male was found 38(93.0%) and female was 3(7.0%). In this series out of 41 patients 10(25.0%) were service holder, 24(58.0%) student, 2(5.0%) housewife, 5(12.0%) businessman .

Regarding the associated injury it was observed that 12(29.0%) patient present with lateral collateral ligament injury, 20(49.0%) with meniscus injury, 9(22.0%) with medial collateral ligament injury.

According to side involvement of the knee, Right side involved 33(80.5%) and left side involved 8(19.5%).

Table II

Bundle involved in the study patients(n=41).

Bundle involved	Frequency	Percentage
Ant. medial	30	73.0
Post. lateral	11	27.0

Among 41 patients, 30(73.0%) were presented with antero medial bundle of ACL injury and 11(27.0%) were posterior lateral bundle of ACL injury.

Regarding the time interval between injury & operation it was observed that 26(63.0%) patients were operated within 5 months of injury and the rest of the patients 15(37.0%) was operated between 6-20 months of injury.

The mean duration of hospital stay after operation was 4.9(±1.66)) days and most of the patients stay at hospital after operation 5 days.

Final outcome according to Lysholm score , excellent functional outcome was exhibited in 36 patients (87.80%) and good functional outcome was exhibited in 05 patients (12.09%).

Table III

Comparison of pre operative and post operative Lysholm knee score (n=41)

	Number of the patients	Mean±SD	P value
Pre operative	41	60.53±6.67	0.001
Post operative	41	92.57±2.76	0.001

Pre operative Lysholm knee score was 60.53 and post operative score was 92.57.Pre operative versus post operative Lysholm scores showed significant improvement ($p<0.001$).

DISCUSSION:

The importance of the ACL in the maintenance of the stability of knee is well known. Active individual who have a partial torn ACL are frequently troubled by chronic instability and recurrent episode of giving way, which often are associated with intra articular injuries.[8]

In the present study majority of the subjects were male and the mean age of the patients was 24 years and the youngest and the oldest one were 18 and 48 years respectively.Erikson et al [9] made study over 164 patients. In his study age ranges were 15 and 45 years .Mean age was 25.7±6.9years which is comparable with present study.

In the present study, out of 41 patients 10(25.0%) were service holder, 24(58.0%) student, 2(5.0%) housewife, 5(12.0%) businessman, 20% were player in these group.

In the present series, it was observed that 12(29.0%) patient present with lateral collateral ligament injury, 20(49.0%) with meniscus injury, 9(22.0%) with medial collateral ligament injury. In this study the mean duration of hospital stay after operation was 4.9(±1.66)) days and most of the patients stay at hospital after operation 5 days. Buss et al [8] investigated 67 ACL reconstructions and found mean hospital stay was 5 days(range 3 to 8 days).

Pre operative versus post operative Lysholm knee score in this series shows significant improvement ($p<0.001$). Pre operative Lysholm knee score was 60.53 and post operative score was 92.57. Wagner et al [10] also showed significant improvement of the Lysholm score in his study ($p<0.001$). According to Williams et al [11] study mean Lysholm score improved from 55 points preoperatively to 91 points after 2 year followup over 120 patients. This is comparable with present study.

Patient with a symptomatic AM bundle tear describe anterior instability, but patients with a symptomatic PL bundle tear complain of rotational instability with pivoting sports rather than anterior instability. In this study the PL augmentation group presented with more grade 2 or 3 positive pivot-shift tests.

Merits of the augment procedure as follows –

1. It was performed under arthroscopy with 1 incision.
2. It avoided resection of the ACL remnant.
3. It preserved the ACL remnant's neural elements and mechanoreceptors.
4. It provides a favorable influence on vascularity and reinnervation to the graft.

So that preserving the ACL remnant during reconstruction not only prevented anterior displacement of the tibia but also contributed to the improvement in the proprioceptive function of the knee joint.

CONCLUSION:

ACL injury frequently occurs in young adult population, which reduces activity level and become economic burden. So, early reconstruction of the ACL is necessary to make them fit and return to their original activity level .For this reason, Arthroscopic single bundle ACL augmentation

with hamstring auto graft is the effective treatment option for ACL rupture of knee.

REFERENCES:

1. Garrick JG, Requa RK. Anterior cruciate ligament injuries in men andwomen: how common are they? In: Griffin LY, ed. *Prevention of Non-Contact ACL Injuries*. Rosemont, IL: American Academy of OrthopaedicSurgeons; 2001: 1-10.
2. Gottlob CA, Baker CL, Pellissier JM, Colvin L. Cost effectiveness ofanterior cruciate ligament reconstruction in young athletes. *Clin Orthop*.1999;(367):272-282.
3. Centers for Disease Control and Prevention, National Center for HealthStatistics. *National Hospital Discharge Survey*. Atlanta, GA: Centers forDisease Control and Prevention; 1996.
4. Lamar DS, Bartolozzi AR, Freedman KB, Nagda SH, Fawcett C. Thermalmodification of partial tears of the anterior cruciate ligament. *Arthroscopy.*2005;21(7):809-814.
5. Hawkins RJ, Misamore GW, Merritt TR. Follow-up of the acute nonoperatedanterior cruciate ligament tear. *Am J Sports Med.* 1986;14(3):205-210.
6. Taylor DC, Posner M, Curl WW, Feagin JA. Isolated tears of the anterior cruciate ligament: over 30 year follow-up of patients treated with arthrotomy and primary repair. *Am J Sports Med.* 2009;37(1):65-71.
7. Murray MM. Current status and potential of primary ACL repair. *Clin SportsMed.* 2009;28(1):51-61.
8. Buss DD, Warren RF, Wickiewicz TL, Galinat BJ, PPanariello R.Arthroscopically assisted reconstruction of ACL with use of autogenous patellar ligament graft.*The Journal of Bone and Joint Surgery.*1993;75(9):1346.
9. Eriksson K, Anderberg P, Hamberg P, Bredenberg M, Westman I,Wredmark T.A comparison of quadriple semitendinosus and patellar tendon graft in reconstruction of anterior cruciate ligament. *The Journal of Bone and Joint Surgery.*2001;83:348-354.
10. Wagner M, Kaab MJ, Schallock J, Haas NP, Weiler A. Hamistring tendonversus patellar tendon ACL reconstryction using biodegradable interference fit fixation. *Am J Sports Med.*2005;33(9):1327.
11. Williams III RJ, Hyman J, Petigliano F, Rozental I, Wickiewicz TL. ACL reconstruction with four strand hamistring tendon autograft. *The Journal of Bone and Joint Surgery*. 2004;86(2):225.

Original Article

Soft Tissue Reconstruction of Distal Leg and Foot - A Prospective Study

Md. Abdul Gani Ahsan[1], Kazi Md Salim[2], Ishtiaque Ul Fattah[3], Hamudur Rahman[4]

ABSTRACT

A soft tissue defect on distal one-third of lower leg, ankle, and foot is a complex problem. Options are available for these conditions, but each of them has advantages and disadvantages. The distally based neurocutaneous sural flap is available for this problem which has excellent results with minimum morbidity. Between 2007 and 2013, all patients with open fracture, exposed Achilles tendon, fourth degree burns, malignancy on the distal third of lower leg, ankle or foot reconstruction was performed by sural flap. The success rate and ability of the flap to create stable, durable coverage at these sites were evaluated. Fourteen patients from 14 to 72 years old were included in this study. We obtained excellent result with this type of flap in all the patients and success rate was considered as 100%, with only one patient having a 2.5 cm necrosis of distal margin of the flap. All patients were completely satisfied with the outcome of the operation. A few drawbacks of this flap and high success rate and relative simple operative technique, we recommend sural flap as a prime option for repair of soft tissue defect at distal leg, ankle and foot.

Keywords: Distally based, sural artery flap, reverse flow, fascioneurocutaneous.

INTRODUCTION

Soft-tissue reconstruction of the lower limb remains a challenging yet common problem.[1-4] To reconstruct the distal extremity with a large soft tissue defect, free flaps are currently the standard treatment.[5] But their use is limited to a specialist microsurgical team and the procedure involved may be lengthy. A cross-leg flap offers the possibility of salvaging the limb, but has the associated difficulties of immobilization and positioning of the extremities from the time of initial coverage to detachment.[6]

A distally based sural island flap was one of the recently introduced therapeutic possibilities. Since Masquelet et al.[7] described the use of a sural neurocutaneous island flap based on the vascular axis around the sural nerve in 1992, the distally based sural island flap has gained popularity for reconstruction of the lower leg and the foot.[8-11]The distally based sural island flap is perfused by the reverse flow from the lowermost perforator of the peroneal artery, and it can be elevated with the pivot point within 5–7 cm above the lateral malleolus.[10,11] With its constant anatomy and blood supply, this flap can be elevated reliably without microvascular techniques. As no major artery is needed, the flap may possibly be elevated even in cases with peripheral vascular disease, or when major arteries have been damaged in trauma.[2,9,10] The flap also has the largest arc of rotation(up to 180^0) so can be transferred to any direction. In order to achieve safe flap elevation, identification of the perforator is not necessary and may be dangerous, and a broad base facilitates flap perfusion.

Materials and methods

We studied 14 patients over a period of 5 years in whom the sural neurocutaneous flap was performed for soft tissue defects of the distal leg, around ankle and foot due to various causes. The patients included 11 males and 03 females. Their ages ranged from 14 to 72 years. The soft tissue defects were over the distal leg anteriorly and

1. Assistant Professor, Department of Orthopaedics, Sylhet Women's Medical College, Sylhet.
2. Professor and Head, Department of Orthopaedics, Sylhet Women's Medical College, Sylhet.
3. Associate Professor, Department of Orthopaedics, Sylhet MAG Osmani Medical College, Sylhet.
4. Resident Surgeon, FCPS (GS), MS Thesis(Urology), BSMMU, Dhaka

Correspondence: Dr. Md. Abdul Gani Ahsan, Assistant Professor, Department of Orthopaedics, Sylhet Women's Medical College, Sylhet.

posterior, over the medial surface distal part of tibia, medial and lateral malleoli, exposed Achilles tendon (AT), calcaneus and proximal sole and dorsum of the foot. Some patients had associated fractures of the tibia and fibula, chronic osteomyelites and chronic ulcers. The age of the defect varied from a few weeks to months. Island flaps were used in majority of patients. The dimensions of the flap depended on the size of the defect (Table-1).

Surgical procedure

All wounds were first treated by surgical debridement of necrotic tissue. In open fracture, bone fragments stabilized by external fixator (Fig-5, 6, 8). Soft tissue defects were covered with the flap as early as possible. Every operation was performed in prone position with tourniquet control. The flap was designed along the course of the lesser saphenous vein. The distal pivot point was marked 5 cm above the lateral malleolus and the flap was outlined according to the size of the defect. The upper border of the flap was first elevated and the deep fascia was also incised and fixed to the skin with 4/0 vicryl sutures. The medial and lateral borders of the flap were incised and the flap was dissected to the lower border together with deep fascia. This dissection was performed meticulously in the subfascial plane and the sural nerve and artery were included with the skin. The success rate of the flap increases when the accompanying arteries of the lesser saphenous vein are included, as these give off cutaneous perforators along its suprafascial course.[12]The skin from the lower border of flap to the pivot point was incised and lateral skin flaps were elevated so the pedicle of the flap containing superficial and deep fascia, sural nerve, lesser saphenous vein and accompanying vessels, the median superficial sural artery (neuro-veno-adipofascial pedicle),[13,14] can be dissected with a 2.5–3 cm width. The flap proper includes the skin island, subcutaneous tissue and the fascias.[15] (neuro-veno-fasciocutaneous flap).[13,14] After complete dissection, the flap was rotated as needed (90-180^0) and sutured over the defects (Fig-2,6,8). No subcutaneous pedicle tunneling was performed (Fig 6). The donor site defect was covered with a split-thickness skin graft or was closed directly for flaps less than 5 cm in width, depending on the degree of skin laxity.

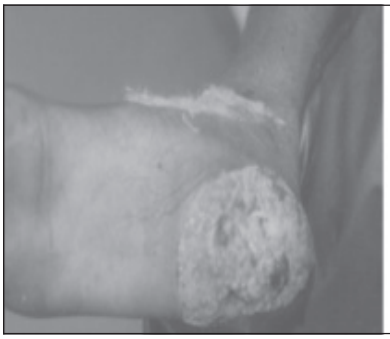


Fig. 1: *Soft tissue defect over heel*

Fig. 2: *Three weeks later flap over heel.*

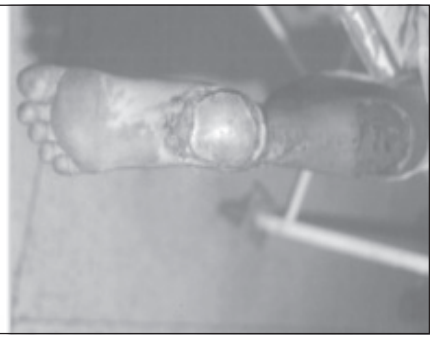


Fig. 3: *Five years later of sural flap over heel.*

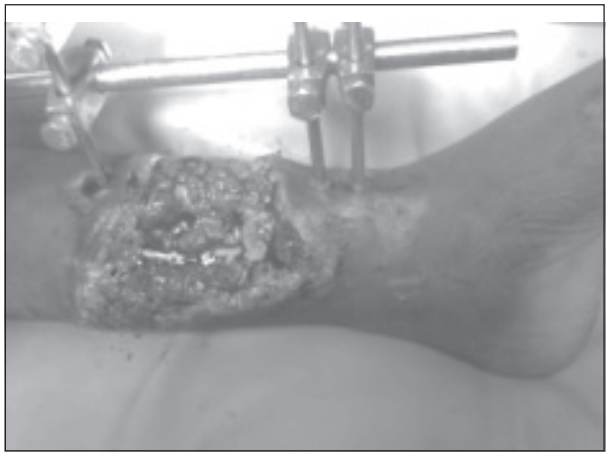


Fig. 5: *Open fracture distal tibia (Type- IIIB) with external fixator.*

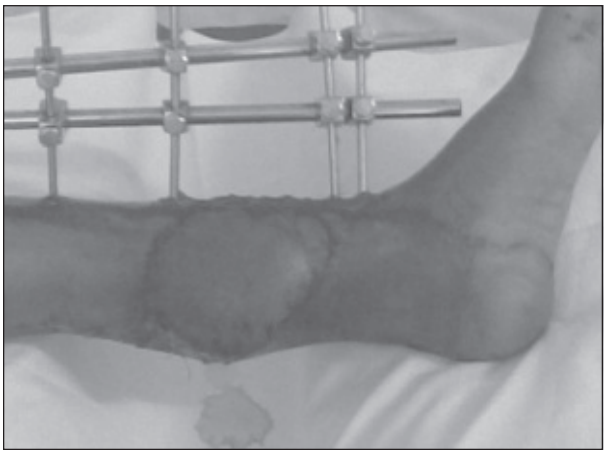


Fig. 6: *Good heeling of sural flap,3 months later.*

Fig. 7: *Open fracture distal tibia (Type- IIIB) with active pus discharge.*

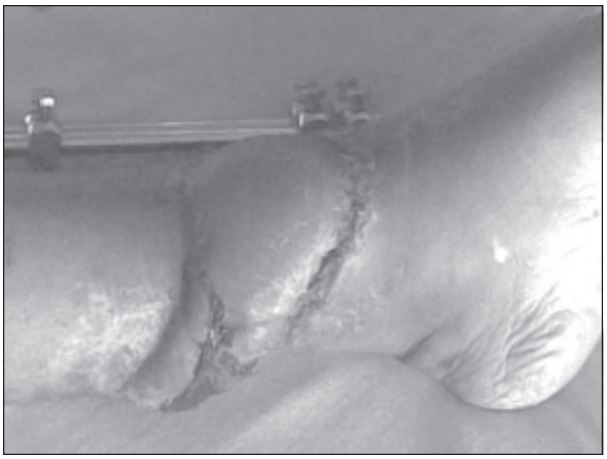


Fig. 8: Good heeling of sural flap, 3 weeks later.

RESULTS

Among the cases studied (Table-1), the injury to the lower limb was due to road traffic accidents in 7 cases, two patients were injured by Indian type toilet pan over Achilles tendon (AT), two patients had chronic diabetic ulcer, two patients had malignant ulcers and one patient injured by electric burn. Some patients had fractures of the underlying bones. Chronic osteomyelites and cavity formation were present in 2 cases. The recipient sites were over the AT in 4 cases, dorsum of the foot in 1 case, and anterior lower leg in 3 cases. In 4 patients the defects were over the heel (Fig-1). The arc of rotation of the flaps ranged from 90 to 180. In 8 cases, the flap was rotated by 180 to cover the defects over the AT and heel (Fig-2). The flaps were raised 10–20 cm above the lateral mallelous. The width of the flap ranged from 4.5 to 8cm at its widest region and length 5 to 14cm. The flap survived in all patients and the average healing time was 21 days. Only in one 72 year-old smoker patient of malignant fibrous histocytoma over dorsum of foot, had partial loss (about 2.5 cm) at distal margin of the flap but the adipofascial tissue was well irrigated and underwent debridement and resurfaced by a partial thickness skin grafting. Mild swelling was only seen in the distal portion of flaps in 3 cases, which resolved a few days postoperatively. No complications were observed in the donor site. No symptomatic neuroma was noted from the proximal stump of the sural nerve, which was buried in the surrounding muscle tissue.

Table-I

Clinical characteristics of the patients

Patient	Age	Sex	Etiology	Recipient site	Flap size(cm)	Follow- up	Complications	Smoking	D M
1	72	F	MFH	Dorsum of foot	7× 13	2 years	Marginal flap necrosis	Yes	No
2	54	M	Trauma	Over AT	5× 10	3 years	None	No	No
3	18	M	Trauma	Over AT	5 × 6	1 years	None	No	No
4	15	F	Trauma	Anterior distal tibia	7 × 9	2 years	None	No	No
5	38	M	Trauma	Anterior distal tibia	7 × 8	2 years	Superficial flap necrosis	Yes	No
6	65	M	trauma	Over AT	9× 10	6 months	None	No	No
7	42	M	SCC	Heel	5 × 7	6 months	None	Yes	
8	36	M	Trauma	Over AT	6 × 6	1 years	None	No	No
9	14	M	Trauma	Anterior distal tibia	7 × 8	1 years	None	No	No
10	40	F	Diabetic ulcer	Heel	5 × 6	6 months	Partial rejection of split skin graft		Yes
11	55	M	Trauma	Anterior ankle	6×11	5 months	None	Yes	No
12	45	M	Diabetic ulcer	Heel	7 × 6	5 year	None	Yes	No
13	42	M	Trauma	Over lateral malleolus	4 × 6	4 months	None	Yes	Yes
14	53	M	Fourth degree burns	Heel	5 × 5	5 months	None	Yes	No

SCC-squamous cell carcinoma; MFH-malignant fibrous histocytoma; AT-Achilles tendon.

DISCUSSION

In defects exposing the underlying tendons, ligamentous structures, or bone and tissue loss localized in the safeguarding areas in the distal third of the leg and foot, flaps which are durable to trauma, ensuring the weight-bearing tissue and having a more aesthetic appearance, are preferred to skin grafts. However, the choice of local flap is limited because of inadequate and tight local tissue for reconstruction and poor circulation. Distant flaps, including free flaps, have many disadvantages, such as the need for a microsurgery team and equipment, long operation times, and difficulty finding the appropriate vessels. On the other hand, regional flaps (e.g. muscle or fasciocutaneous) are quite popular. However, inferiorly based muscle flaps have a high failure rate,[16] while reverse peroneal,[17] posterior tibial,[18] and anterior tibial flaps,[19,20] sacrifice a major artery in the leg.

Masquelet *et al*.[7] who were the first describe the ''neurocutaneous island flap,'' the management of leg and foot defects became easier. They revealed that the superficial sural artery courses on the leg in two different ways, descending to the ankle in 65% or becoming an interlacing suprafacial network in 35%. In both situations, however, the superficial sural artery anastomoses constantly with the septocutaneous perforators, usually 3-5 in number, from the peroneal artery through the suprafascial network. Thus flap dissection must be performed under the deep fascia, including the pedicle, to preserve these anastomoses on the suprafascial plane.[7] A pivot point 5 cm above the tip of the lateral malleolus is the area in which the last perforator was given off. However, the mechanism of venous drainage of the reverse flow-sural artery flap has not been clarified exactly. Some suggested that the venous drainage was probably supplied via a suprafacial venous network in the pedicle.[7, 21]

Invariable anatomy of the sural region, easy and quick dissection, ensuring a reliable arterial supply, not sacrificing of any major artery, wide arc of rotation on its pedicle, harvesting in large size with little donor site morbidity, not resulting in functional deficit, not requiring microsurgery, completing in a single stage and obtaining a thin reverse-flow sural artery flap to become popular.

Excellent result was found by distally-based superficial sural neurocutaneous flap for reconstruction of the ankle and foot in children.[22] It can be safely used in paraplegic patients. A possible explanation of this phenomenon is that the dorsal root ganglia remain intact in paraplegic patients and can preserve neural characteristics in the peripheral sensory nerve system.[23] This also a recommend flap as a prime option for repair of fourth degree burn, at distal leg, ankle and foot.[24]

Arterial insufficiency is rarely encountered because the reverse sural flap has a powerful and constant arterial supply from both the reverse flow system of the median superficial sural artery-peroneal artery perforators and an additional intrinsic arterial system of sural nerves. So this flap can be applied for reconstruction of a large soft tissue defect in an open tibial fracture with occluded anterior and posterior tibial arteries.[25] Venous congestion is not uncommon in diabetic or elderly cases displaying peripheral vascular disorders,[26] or when the large flaps are planned.[9]

CONCLUSION

Sural neurocutaneous flap is a versatile, reliable procedure useful in reconstruction of the distal leg, ankle and foot. The procedure of flap elevation is simple and rapid, and can provide a large size for coverage of the defects. In addition, these flaps can also provide good texture and contour matching the recipient area. This flap, in our view, not only provides an alternative to microsurgical reconstruction, but also can be a good choice to cover the defects of the distal leg, ankle and foot.

REFERENCES

1. Tunc CO, Mehmet A, Abdurrahman K. An easy and versatile method of coverage for distal tibial soft tissue defects. J Trauma 2001;50:53-9.
2. Singh S, Naasan A. Use of distally based superficial sural island artery flaps in acute open fractures of the lower leg. Ann Plast Surg 2001;47:505-10.
3. Tu YK, Lin CH, Su JI, Hsu DI, Chen RJ. Unreamed interlocking nail versus external fixator for open type III tibial fractures. J Trauma 1995;39:361-7.
4. Tropet Y, Garbuio P, Obert L, Ridoux PE. Emergency management of type IIIB open tibial fractures. Br J Plast Surg 1999;52:462-70.
5. Udesen A, Ovesen OC, Nielsen IM, Jensen PE. Microvascular free flaps in the treatment of defects of the lower legs. Scand J Plast Reconstr Surg Hand Surg 1996;30:183-6.
6. Chen HC, El-Gammal TA, Wei FC, Chen HH, Noordhoff MS, Tang YB. Cross-leg free flaps for difficult cases of leg defects: indications, pitfalls, and long-term results. J Trauma 1997; 43:486—91.
7. Masquelet AC, Romana MC, Wolf G. Skin island flaps supplied by the vascular axis of sensitive superficial nerves: anatomical study and clinical experience in the leg. Plast Reconstr Surg 1992; 89:1115-21.

8. Jeng SF, Wei FC. Distally based sural island flap for foot and ankle reconstruction. Plast Reconstr Surg 1997;99:744—50.

9. Almeida MF, da Costa PR, Okawa RY. Reverse-flow island sural flap. Plast Reconstr Surg 2002;109:583—91.

10. Costa FA, Reis J, Pinho C, Martins A, Amarante J. The distally based island superficial sural artery flap: clinical experience with 36 flaps. Ann Plast Surg 2001; 46: 308-13.

11. Yilmaz M, Karatas O, Barutcu A. The distally based superficial sural artery island flap: clinical experiences and modification. Plast Reconstr Surg 1998;102:2358—67.

12. Nakajima H, Imanishi N, Fukuzumi S, Minabe T, Fukui Y, Miyasaka T, et al. Accompanying arteries of the lesser Saphenous vein and sural nerve: anatomic study and its clinical applications. Plast Reconstr Surg 1999;103:104–20.

13. Chang SM. The pedicle of neurocutaneous island flaps. Plastm Reconstr Surg 1996; 98:374-6.

14. Ballmer FT, Hertel R, Noetzli HP, Masquelet AC. The medial malleolar network: a constant vascular base of the distally based saphenous neurocutaneous flap. Surg Radiol Anat 1999; 21: 297-303.

15. Parrett BM, Matros E, Pribaz JJ, Orgill DP. Lower extremity trauma: trends in the management of soft-tissue reconstruction of open tibia-fibula fractures. Plast Reconstr Surg 2006;117:1315–24

16. Townsend PLG. An inferiorly based soleus muscle flap. Br J Plast Surg 1978; 31:210-3.

17. Yoshimura M, Imura S, Shimamura K, Yamauchi S, Nomura S. Peroneal flap for reconstruction in the extremity: preliminary report. Plast Reconstr Surg 1984; 74:402-9.

18. Hong G, Steffens K, Wang FB. Reconstruction of the lower leg and foot with the reversed pedicled posterior tibial fasciocutaneous flap. Br J Plast Surg 1989; 42: 512-6.

19. Wee JTK. Reconstruction of the lower leg and foot with the reversed- pedicled anterior tibial flap: preliminary report of a new fasciocutaneous flap. Br J Plast Surg 1986; 39:327-37.

20. Morrison WA, Shen TY. Anterior tibial artery flap: anatomy and case report. Br J Plast Surg 1987;40:230—5.

21. Hasegawa M, Torii S, Katoh H, Esaki S. The distally based superficial sural artery flap. Plast Reconstr Surg 1994; 93: 1012-20.

22. Enrique VA. Distally-based superficial sural neurocutaneous flap for reconstruction of the ankle and foot in children. Journal of Plastic, Reconstructive & Aesthetic Surgery. 2008; xx, 1-7

23. Erba P, Wettstein R, Tolnay M, Rieger UM, Pierer G, Kalbermatten DF. Neurocutaneous sural flap in paraplegic patients. Journal of Plastic, Reconstructive & Aesthetic Surgery 2008; xx, 1-5.

24. Naser M, Mehdi SM, Mehdi R. The distally based neurocutaneous sural flap: A good choice for reconstruction of soft tissue defects of lower leg, foot and ankle due to fourth degree burn injury. Burns 2008; 34:406– 11.

25. Hsieha CH, Lianga CC, Kuehb NS, Tsaib HH, Jenga SF. Reconstruction of a large soft tissue defect in an open tibial fracture with occluded anterior and posterior tibial arteries—a case report. The British Association of Plastic Surgeons 2005; 58: 112–5.

26. Yildirim S, Akan M, Akoz T. Soft-tissue reconstruction of the foot with distally based neurocutaneous flaps in diabetic patients. Ann Plast Surg 2002;48:258-64.

Original Article

Evaluation of Results of Fixation of Nonunion of Fracture Shaft of Humerus by Locking Plate and Screws Augmented by Autogenous Cancellous Bone Graft

Apel Chandra Saha[1], Rafique Ahmed[2], Muhammad Awlad Hossain[3], Anjan Lal Ghosh

ABSTRACT

Humeral shaft fracture is not uncommon. Union rate in conservative procedure is good. Following fracture nonunion is a common complication is most troublersome for management. Our aim to achieve the union with restoration the length of humerus and satisfactory function of elbow and shoulder. This study is prospective study at NITOR from January,2007 to December,2008 in 16 patient with both sexes male 14 and female 02, age of the patient ranges from 28-60 yrs, all fracture shaft of humerus.. With all surgical aseptic procedure and anaesthesia we expose the shaft at non union site of humerus. Good reduction of fracture site and proper fixation of the locking plate and screws done. Then Autogenous cancellous bone graft kept in situ at the nonunion site. With establishing the proper haemostasis we close the wound with keep a drain in situ. Post operative proper follow up done. Out of 16 patients age incidence from 28-60yrs.Union time ranges from 13-24 months. We assay the function of the limb with Modified scoring system of Constant and Murley. Functional outcome is Excellent in 31.25%, good in 56.25% , satisfactory in 6.25% and poor in 6.25% With the procedure the acceptable outcome achieve in 14 patients out of 16patients (87. 5%). So this procedure can acieve the union at nonunion fracture shaft of humerus and trauma surgeon can safely use this procedure.

INTRODUCTION

The humerus or arm bone is the longest and largest bone of the upper limb. Fractures of humeral shaft are commonly encountered by the orthopaedic surgeons, accounting approximately 3% of all factures. Humeral shaft fractures occur most commonly in the young or older age groups (less than 30 years old or greater than 50 years old) (Gustilo 1993). They usually result from direct violence , although indirect trauma may also be implicated. Particularly in the young, direct trauma from motor vehicle accidents, falls and direct blows often result in transverse or comminuted fractures, with a significant number being open injuries. Indirect trauma from falls on the out stretched hand, twisting injuries or even violent muscle contraction result in spiral or oblique fractures. Fractures from muscular contraction have been reported in athlets while throwing and occur most frequently just distal to deltoid insertion

Humeral shaft fractures can be treated by both conservative & operative methods. Most humeral shaft fractures generally unite in an acceptable position conservatively within 6-10 weeks in 95% cases. Operative treatment is usually indicated for non union, polytrauma patients, bilateral humeral shaft fractures, floating elbow, fracture with neurovascular complications, segmental fractures.

A recent trend in internal fixation has been a more towards locking plating system. With locking plating system the

1. Jr.Consultant, Upazilla Health Complex,Debidwar,Comilla.
2. Jr.Consultant, Upazilla Health Complex,Bhairob,Kishoregang
3. Jr.Consultant, OSD DG attached to Kurmitola General Hospital, Dhaka
4. Assistant Professor of Orthopaedic Surgery, Z.H. Sikder Women's Medical College & Hospital

Correspondence: Dr. Apel Chandra Saha, Jr.Consultant, Upazilla Health Complex,Debidwar,Comilla.

locking serews are locked with plate which stabilizes the screw and gives better rigid fixation. The friction between the plate & bone is less that provides less disturbance of periosteal blood supply .

Locking Plating system with autogenous cancellous bone grafting is an effective method of treatment for aseptic non-union of humeral shaft fracture. The advantages of this method over other modalities of treatment are as follows: stable,rigid fixation , more angular stability, less periosteal vascular disturbance.

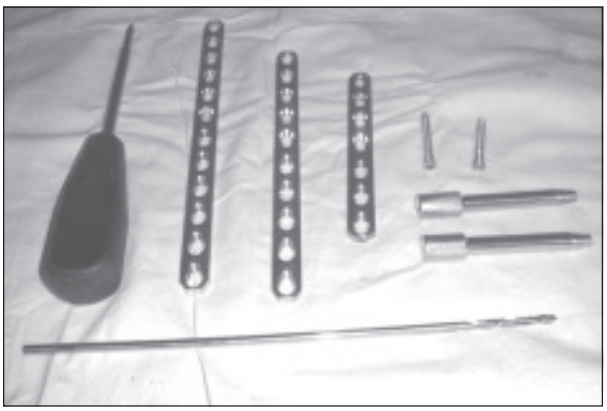
PATIENTS AND METHODS:

This is a Prospective non randomized observational study. This study was carried out at National Institute of Traumatology and orthopaddic Rehabilitation (NITOR), Dhaka, Bangladesh , during the period from January 2007 to December 2008. Sixteen patients with nonunion of the fracture shaft of the humerus were selected consecutively for the follow up for 18 months. Cases were diagnosed on clinmical and radiological basis. Both Sexes, age 18 years and above,Non union of humeral shaft fracture.The criteria for assessing the outcome after surgery had been done by Constant and Murley score of functional assessment (Ring, Perey and Jupiter)

SURGICAL PROCEDURE:

With regional anaesthesia (Brachial block) ,patient in Supine ,Antero-lateral Henry approach,incise the skin in line with the anterior border of the deltoid muscle from a point midway between its origin & insertion, distally to the level of its insertion and proceed in line with the lateral border of the biceps muscle to within 7.5 c.m of the elbow joint. Dividethe superficial & deep fascia and ligate the cephalic vein. In the proximal part of the wound , retract the deltoid laterally and the biceps medially to expose the shaft of the humerus.

Distal to the insertion of the deltoid expose the brachialis muscle, split it longitudinally to the bone and retract it subperiosteally; the lateral half to the lateral side and the medial half to the medial. Retraction is easier when the tendon of the brachialis is relaxed by flexing the elbow to a right angle. The lateral half of the brachialis muscle protects the radial nerve as it winds around the humeral shaft. Fracture site was then exposed and the fracture was reduced. Locking plate and screws was applied on the anterolateral surface of the humerus centering the fracture site. Autogenous cancellous bone grafting was taken from iliac crest and placed at the fracture site. The wound was closed in layers after maintaining the hemostasis. A closed suction drain was kept in-situ. Dressing was given.



Set of Instruments for humerus locking plate and screw operation

Postoperative Care: Adequate sedation and analgesics was given. Upper limb elevation was maintained for the first 48-72 hours. Antibiotics were prescribed as stated earlier.

Active/passive finger exercises were begun immediately after the recovery from the anaesthesia.Wounds were inspected in ^{51h} post-operative day. Stitches were removed at 10-12 days.Patients were discharged from the hospital in 3^{rd} – 7^{th} postoperative days. In cases of infection, patients were kept in hospital for longer duration.

Follow up: At the beginning patients were followed up at three weeks interval. There after at monthly interval till the fracture union was achieved. Patients were also advised to attend the OPD or contact personally if in case of any problems.Pendulum shoulder exercises were started after 2 weeks. Long arm back slab was removed after 3 weeks and was allowed to move the elbow joint.In each follow up visit the following things were checked.

History of pain, infection, any deformities,on clinical examination,look : wound site, deformity, condition of the skin, feel: Tenderness, fracture site mobility, move: both active and passive movement of shoulder and elbow joint distal neurovascular status examination.Radiological findings to see the fracture site union,to see the position of the locking plate and screw.

RESULTS:

This prospective study of treatment of nonunion of humeral shaft fracture by locking plate and screws augmented with autogenous cancellous bone grafting was carried out in 16 patients to find out the common cause of fracture, age and sex incidence and to propose a protocol for treating such cases.

Table I

Age distribution of the patients (n=16)

Age in years	Number	Percentage
<30	1	6.25
30 – 39	8	50.00
40 – 49	4	25.00
> 50	3	8.75
Mean ±SD	38.19	±10.04
Range	(28-60)	

Table-II

Occupational distribution of patients (n=16)

Occupation	Number	Percentage
Serviceman	4	25.00
Businessman	3	18.75
Farmer	3	18.75
Shopkeeper	4	25.00
House wife	2	12.50

Table III

Mean duration of injury of the patients (n=16)

Duration of injury (months)	Months
Mean ±SD	15.38±3.91
Range	(9-20)

Table IV

Post operative hospital stay (n=16)

Hospital stay (days)	Days
Mean ±SD	4.81±1.22
Range	(3-6)

Table V

Time of union by radiological evaluation (n=16)

Radiological evaluation	Weeks
Time of union	
Mean ±SD	16.38±2.78
Range	(13-24)

Table VI

Distribution of patients by post operative complications (n=16)

Post operative Complications	Number	Percentage
Infection	1	6.25
Loosening of the screw	0	0.00
Shoulder pain	1	6.25
No complication	13	81.25

Among them 5(31.25%) cases were excellent, 9 (56.25%) cases were good, 1(6.25%) case fair and 1(6.25%) case was poor. The overall result was analyzed by categorizing satisfactory (Excellent and good) 14(87.50%) cases and unsatisfactory (Fair and poor) 2 (12.50%.)

DISCUSSION

When a humerus fracture fails to unite in 3 to 4 months, it is termed as delayed and if union is delayed and arrested beyond 6 to 8 months, it is nonunion Rosen (1990). Nonunion is established when minimum of 9 months has elapsed since injury and the fracture shows no visible progressive signs of healing for 3 months (La Velle, 1998). Though a number of treatment methods have been documented none of the method seems to be superior to others.

Orthopaedic surgeons in several countries contributed to the foundations that led to the concepts, techniques and instruments used today. Various methods of surgical treatment are known, such as, fixation by plate and screws and bone grafts, intramedullary nails, intramedullary interlocking nails with bone grafts, inlay and onlay tibial grafts with bone pegs or bone screws, dual tibial onlay grafts dual fibular onlay grafts, cerclage wire, external fixators, llizarov technique.

A recent trend in internal fixation has been a more toward locking plating system. Specific advantage of locking plating system includes 1. stable rigid fixation, 2. direct reduction, 3. less periosteal vascular disturbance. Modabber and jupiter (1998) reviewed twenty-one cases of humeral nonunion after the failure of locked humeral nails. The study revealed that open reduction and internal fixation with plating and bone grafting was successful in nine of nine cases and exchange nailing was successful in four of ten cases.

Ramchander siwach , Roop singh (2008) published their studies of treating displaced proximal humeral fracture in elderly patients with osteoporosis by locking plate & screws of 25 patients (12 males & 13 females) with 28%. excellent outcome, 64% good functional outcome & 8% had moderate outcome. All fractures united with an average union time of 18 weeks.

The humerus is often osteoporotic when nonunion occurs. It becomes difficult to achieve rigid fixation in terms of loosening of screws. There is always tendency to posterolateral bowing of humerus in its fracture at middle third. Hence there is always prone to failure of union. By using locking plate & screws in nonunion of humeral shaft fracture in osteoporotic bone it gives better rigid fixation & chance of loosening of screws is less.

At NITOR the treatment of humeral shaft nonunion by locking plate & screws with autogenous cancellous bone grafting has gained acceptance in the recent years. This prospective study was carried out during the period from January 2007 to December 2008 at National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh, to find out the result of locking plate and screws with autogenous cancellous bone grafting in the non union of fracture shaft of humerus.

A total number of 16 patients were included in this study. All the patients were treated by locking plate & screws augmented with autogenous cancellous bone grafting. Minimum follow up time was 6 months & maximum 18 months. In this study, age ranges from 28 to 60 years. The mean age incidence was 38.19 (+ 10.04) years. The high incidence in young adult age group points to higher rate of mobility as well as social violence in this age group. 51

Male population in this study constitutes 14 cases (87.5%) while the female's made up remaining 2 cases (12.5%). Christensen (1976) observed a male predominance of 61.53%, while Wright, Miller and Vander Griend (1993) and Pandey (2003) showed males to made up 55.55% and Ring et al. (2000) 60%. Males being the major working force of our society and are thus more consistently exposed to external environment which probably accounts for this predominance.

Motor vehicle accidents were found to be the most common causative factor in this study 81.25% . Christensen (1976), Ring et al. (2000) observed motor vehicle accidents as the major reason for humeral shaft fractures occupying 50% and 40% respectively (Swanson and Gustilo, 1993). Second common cause was fall from a height counting 12.50% . In this study right side was affected more (62.5%) than left side (37.5%). Ring (2000) found 66.76% of the cases with left humeral fractures in his series. In 4 cases, there were associated injuries, 2 had soft tissue injuries, one had ipsilateral fracture shaft of femur, one had radial nerve injury. Among the 16 cases, 2 of them were treated by open reduction and internal fixation with DCP, one treated initially with external fixator, the rest of them were treated conservatively with U slab, long arm back slab.

Post operative hospital stay is one of the important parts of this study. In this series minimum 3 days and maximum 6 days. Mean post operative stay 4.8 (+1.22) days. Longer hospital stay was required for patients having postoperative infection and other complication. 52

Union time of fracture in this series was minimum 13 weeks and maximum 24 weeks. Mean 16.38 (+2.78) weeks. In the study of Robinson et al. (1992) men time of union 18 weeks (8-96 weeks) but 7 patients required treatment for delayed union. In the study of Habernek and Orthner (1991), average union time was 2 months.

In this series postoperative infection (Superficial wound infection) developed in 1 patient (6.25%) which was controlled by regular dressing and sensitive antibiotic. Shoulder pain in 1 (6.25%) case. In the study of Habernek and Orthner (1991), there was no infection in 19 cases and no rotator cuff lesion, In my study infection rate was 6.25%. In this study 5 cases (31.25%) had excellent functional outcome according to Constant and Murley scoring , 9 cases (56.25%) had good, 1 case (6.25%) had fair outcome and 1 case (6.25%) had poor outcome. In this series there was excellent result in 5 cases (31.25%), good in 9 cases (56.25%), fair in 1 case (6.25%) and poor in 1 case (6.25%). In this study overall a satisfactory result was found in 14 (87.50%) cases and unsatisfactory in (12.50%) cases.

CONCLUSION

Based on the results shown above it is concluded that "treatment of nonunion of humeral shaft fracture by locking plate and screws augmented with autogenous cancellous bone grafting" is an effective modality of treatment for the nonunion of humeral shaft fracture and is especially recommended in osteoporotic bones and elderly patients with compromised bone quality .

RERERENCES

1. Brumback RJ, Bosse MJ, Poka A, Burgess AR. 1986. Intramedullary stabilization of humeral shaft fractures in patients with multiple trauma. *J Bone Joint Surg 68-* . A: 960-970.
2. Brachear HR. 1965. Diagnosis and prevention of nonunion. *J Bone Joint Surgery* 47-A (1): 174-198.
3. Carroll SE. 1963. A study of the nutrient foramina of the humeral diaphysis. *J Bone Joint Surgery 45-B (1): 179-181.*
4. Christensen NO. *1976.* KÜntscher intramedullary reaming and nail fixation for nonunion of the humerus. *Clin Orthop 116: 222-225.*
5. Crenshaw AH. 2003. 'Fractures of the shoulder, arm and forearm', in Canale ST (ed), Campbell's Operative Orthopaedics, Vol. 3, 10th ed, Mosby Inc., St. Louise: pp. 3004-3013.
6. Epps CH Jr. 1988. 'Nonunion of the humerus', in Bassett FH (ed), Instructional course lecture, volume XXXVII, American Academy of Orthopaedic Surgeons: pp. 161-166.

7. Esterhai JL, Brighton CT, Heppenstall RB, Thrower A. 1986. Nonunion of the humerus. *Clin Orthop 211: 228-234.*

8. Foster RJ, Dixon GL, Bach AW, Appleyard RW, Green TM. 1985. Internal fixation of fractures and nonunion of the humeral shaft. *J Bone Joint Surgery 67-A: 857*-864

9. Healy WL, White GM, Mick CA, 1987. Nonunion of the humeral shaft. *Clin Orlhop* 219: 206-213.

10. Habernek H, Orthner E. 1991. A locking nail for fractures of the humerus. *J Bone Joint Surg [Br] 73-B: 651-653.*

11. Haque A. *2004.* Management of humeral shaft fracture by antegrade intramedullary interlocking nail at NITOR. MS Thesis, BSMMU, Dhaka, Bangladesh.

12. Ingman AM, Waters DA. 1994. Locked intramedullary nailing of humeral shaft ***fractures.*** *J Bone Joint Surgery* 76-B: 23-29.

13. Jupiter JB. 1990. Complex non-union of the humeral diaphysis. *J Bone Joint Surgery* 5-A: *701-707.*

14. Klenerman L. 1966. Fractures of the shaft of the humerus. *J Bone Joint Surgery 43-B: 105-111.*

15. Laing PG. *1956.* The arterial supply of the adult humerus. *J Bone Joint Surgery* 38-A: 1105-1116.

16. La velle DG. 1998. 'Delayed and nonunion of fractures', in Canale ST (ed), Campbell's Operative Orthopaedics, Vol 3, 9th ed, Mosby Inc., St. Louise: pp. 2579-2629.

17. Mast JW, Spiegel PG, Harvey JP, Harrison C. 1975. Fractures of the humeral shaft. *Clin Orthop 112: 254-262.*

18. Modabber MR, Jupiter JB. 1998. Operative management of diaphyseal fractures of the humerus plate versus nail. *Clin Orthop* 347: 93-104.

19. Muller ME, Thomas RJ. 1979. Treatment of nonunion in the fractures of long bones. *Clin Orthop 38: 141-153.*

20. Murray WC, Lucas DB, Inman VT. 1964. Treatment of non-union of fractures of the long bones by the two plate method. *J Bone Joint Surgery* 46-A: 1027-1048.

21. Netter FH. 1997. 'Upper limb', in Atlas of human anatomy, Novartis, New Jersey: pp. 395-410.

22. Pandey BK. 2003. Comparative analysis of the results of treatment of delayed and nonunion of humeral shaft by plate and screws with cancellous bone grafting augmented by intramedullary fibular graft and by plate and screws with cancellous bone grafting at NITOR. MS Thesis, University of Dhaka, Bangladesh.

23. Pritchett JW.1985. Delayed union of humeral shaft fractures treated by closed flexible intramedullary nailing, *J Bone Joint Sorg [Br] 67-B: 715-718.*

24. Ray RD, Sankaran B, Fetrow K. 1964. Delayed union and nonunion of fractures, Instructional Course Lecture, Vol XXXXVI, American Academy of Orthopaedic Surgeons: pp. 627-643

25. Ring D, Jupiter JB, Quintero J, Sanders RA, Marti RK. 2000. Atrophic ununited diaphyseal fractures of the humerus with a bony defect. *J Bone Joint Surgery* 82- B: 867-871.

26. Ring D, Perey BH, Jupiter JB. 1999. The functional outcome of operative treatment of ununited fractures of the humeral diaphysis in older patients. *J Bone Joint Surgery 81 -A: 177-190.*

27. Rosen H. 1990. The treatment of nonunions and pseudoarthrosis of the humeral *shaft. Orthop Clin North Am 21(4): 725-742.*

28. Rosen H. 1979. Compression treatment of long bone pseud oarth roses. *Clinical orthopaedics and related research 138: 154-166.*

29. Robinson CM, Bell KM, Court-Brown CM, McQueen MM.1992. Locked nailing of humeral shaft fractures: experience in Edinburgh over a two- year's period. *J Bone Joint Surg [Br] 74-B: 558-562.*

30. Ring D et al. 2008, Ununited fractures of the humerus, *Harvard orthopaedic Journal.*

31. Sarmiento A, Zagorski JB, Zych *GA,* Latta LL, Capps CA. 2000. Functional bracing for the treatment of fractures of the humeral diaphysis. *J Bone Joint Surgery* 82-A: 478-486.

32. Swanson TV, Gustilo RB. 1993. 'Fractures of the humeral shaft', in Gultilo RB, Kyle RF, Templeman DC (eds), Fractures and Dislocations, Vol 1, Mosby-Year book Inc., St. Louise: *pp. 365-385.*

33. Siwach R et al., 2008, Internal Fixation of proximal humeral fracture with locking proximal humeral plate (LPHP) in elderaly patient with osteoporosis, *J orthoped Traumatol, Springer-Verlag.*

34. Templeman DC, Schmidt AH. 2001. Management of humeral shaft fractures CME. l'On-lineI Release date: December 20, 2001. Available from: http://www.medscape.com/viewprograrn/150 (Accessed 9 January 2005).

35. Trotter DH, Dobozi W. 1986. Nonunions of the humerus: rigid fixation, bone grafting and adjunctive bone cement. *Clin Orthop* 204: 162-168.

36. Urist MR, Mazet R, Mclen FC. 1954. The pathogenesis and treatment of delayed union and nonunion. American academy of Orthopaedic Surgeons 36-A: 931-968.

37. Whitson RO. 1954. Relation of the radial nerve to the shaft of the humerus. *J Bone and Joint surgery 36-A: 85-88.*

38. Williams PL, Warwick R, Dyson M, Bannister LH. 1989. 'The skeleton of upper limb, Humerus; Muscles; Nerves; Vessels of arm', in Gray's anatomy, 37th ed, - ELBS with Churchill Livingstone, Edinburgh: pp. 406-410, 610-616, *756-760,* 1130-1137.

39. Wright TW. 1997. Treatment of humeral diaphyseal nonunions in the patients with severely compromised bone. *J South Orthop Assoc 6 (1): 1-7.*

Original Article

Walk for Life

The Bangladesh Nationwide Clubfoot program since 2009

A. H. M. Abdur Rouf[1], Monaim Hosen[2], Mahfuzur Rahman[3], Kamal Mahmud Khan[4], Jahangir Alam[5]

CLUBFOOT IN BANGLADESH

Every year in Bangladesh an estimated 5000 children are born with a clubfoot deformity (a condition where the feet are turned inside at birth), which is approximately one of every 1000 children born in our country. Left untreated, the condition leads to lifelong deformity causing individual disability and potential unproductively. This causes the children to grow up as burdens of the family and ultimately leads to significant poverty. This is visible in the fact that many of the beggars in Bangladesh have visible clubfeet.

For older children and adults, expensive corrective orthopedic surgery is the only option for treatment which is not often affordable by the generally poor population of our country.

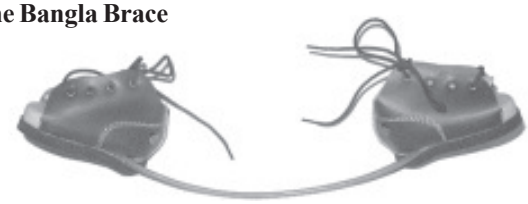
THE PONSETI METHOD

Corrective orthopedic surgery is the only alternative for older children and adults suffering from clubfoot to avoid life-long disability, however there is an effective, inexpensive, and permanent treatment alternative for children . The method was developed in the 1950s by Dr. Ignacio Ponseti.

The Ponseti Method involves a gradual correction of one or both of the affected feet by casting them in a progressively closer-to-normal foot position. Essentially the foot is slowly stretched back into a normal position. This, of course, takes time, and is most successful while the child is still young and the tissues are soft and pliable.

When the final cast is removed the child is fitted with foot abduction braces

The Bangla Brace



Bracing is critical to the success of treatment. The children wear a brace for a month full time after the casting is completed. They then wear the brace at night time for 2-3 years.

The children return for regular check ups and to be fitted for new braces as their feet grow.

The braces are manufactured in Jessore, Bangladesh for under $5 each and are free of cost to children at Walk for Life clinics.

The braces are similar to the Steenbeek brace produced for the Ugandan Club Foot project. Muzira David from Uganda supplied our jigs and came to Jessore for the initial training.

Before treatment

1. Asst. Professor (Ortho-Surgery), Jessore Medical College Hospital, Jessore, Bangladesh, Hon'y Medical adviser WFL, Bangladesh Sustainable Clubfoot Project.
2. Assistant Professor, NITOR, Dhaka
3. Medical Officer, BSMMU, Dhaka
4. Senior Consultant, 250 Beded General Hospital, Tongi
5. Assistant Professor, NITOR, Dhaka

Correspondence: Dr. A. H. M. Abdur Rouf, Asst. Professor (Ortho-Surgery), Jessore Medical College Hospital, Jessore, Bangladesh, Hon'y medical adviser WFL, Bangladesh Sustainable Clubfoot Project.

After Treatment

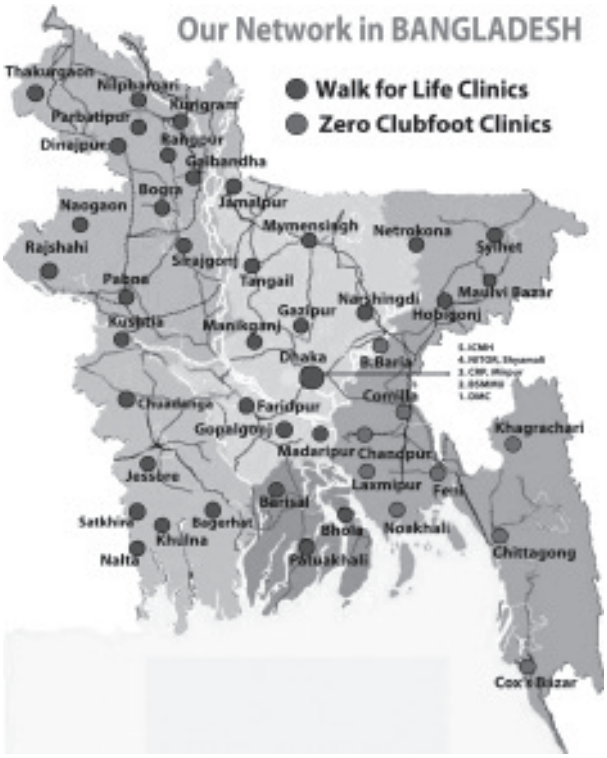
WALK FOR LIFE INFORMATION

Walk for Life is a project of The Glencoe Foundation started from September 2009 at Jessore Medical College Hospital as a pilot project by Colin Macfarlane from Australia. The vision:" within 3 years all children born in Bangladesh with club feet have the opportunity to have suitable treatment before their 2nd birthday. He incolaboration with Bangladesh Government opened up the Window of Ponseti in the name of Walk For Life (WFL) – The Bangladesh Sustainable Club Foot Project.

After its success with in last 4 years Walk for Life provided Ponseti treatment and cure club foot children all over the country all most at 43 district which covers by 48 clinics at government medical college hospital, district hospital and NGO -hospital.

Walk for Life made such a network by that no children with Club foot have to travel more than 60km to get the treatment.

- Walk for Life, is the Bangladesh's Sustainable Club Foot Program that provides free treatment to children under the age of three by the Ponseti Method.
- This technique considered a gold standard of treating club feet children in developed countries.
- Besides providing free treatment, we are focused in supporting various important Government Medical facilities by providing appropriate training with international trainers and also by providing with material and manpower for running clinic.
- There about 9464 children's 14425 feet become corrected up to October 2013.



- There about 67960.5 pieces of plaster given to the patient up to October 2013.
- There about 14187 piece of braces given to the patients up to October 2013.
- There about 14187 piece of braces given to the patients up to October 2013.
- 8650 number of tenotomy done up to October 2013.
- Average Casting : 5
- Bangladesh coverage upto 2012- 55%
- Some Failures dueto – Non compliance of Brace, Missings & Associated problems of the patient.

Help us eradicate neglected clubfoot. Your generosity can help us to end the suffering of many children in the future.

Original Article

Evaluation of Result of Treatment of Giant Cell Tumor (GCT) by Curettage, Chemical Cauterization and Autogenous Cacellous Bone Graft

Kamal Mahmood Khan[1], Md. Saidul Islam[2], Indrojit Kumar Kundu[3]

ABSTRACT:

The treatment of giant cell tumor by curettage,chemical cauterization and autogenous bone grafting was prospective study carried out at different hospital in Dhaka,Bangladesh ,between July 2006 to July2010.Total 16 were taken but one patient was droped out from the study due to lack of follow-up. So total 15 patient were included in the study. Among 15 patient 08 were female and 07 were male. The mean age of the patient was 28.6 years(range 19 to 55 years). Cases were classified according to Campanacci's grading system. Only grade 1 and grade 2 were incluled in this study. 13 cases were Campanacci's Grade 2 and 2 cases were Campanacci's Grade 1.GCT in proximal Tibia were 08 cases, distal femur 05 cases and distal radius in 2 cases. There was wound infection in one case and recurrence in one case. Satisfactory result (Excellent and good) were in 80% cases and unsatisfactory result in 20% cases.

INTRODUCTION:

Giant cell tumor (GCT) of bone is a benign but locally aggressive osteolytic tumor of uncertain origin that usually involves the ends of long bones and characteristically it extends right up to the subarticular bone plate. It occurs most frequenty in young adult. The most common site are the distal femur,proximal tibia,proximal humerus and distal radius but other bones may be affected[1]. They represent 5% of all bone tumors.(16)

Most of the patient have pain at the of the lesion ,sometime there is swelling and history of trauma is not uncommon[1].

On radiography shows a radiolucent area situated eccentrically at the end of a long bone and bounded by the subchondral bone plate.It is an well defined lesion but in aggressive lesions it is ill-definedMacroscopicallyit is a reddish,fleshy appearance; it comes away in pieces quite easily when curetted but is difficult to remove completely[3].

Histologically,the striking feature is an abundance of multinucleated giant cells scattered on a background of stromal cells with little or no visible intercellular tissue.Aggressive lesions tend to show more cellular atypia and mitotic figures, but histological grading is unreliable as a predictor of tumour behaviour[1].

GCT of the bone has an unpredictable behavior[6]. This makes the treatment of the disease a subject of constant debate. The aim of best treatment should ensure local control of disease and maintain function of adjacent joint. Many earlier studies had shown very high (25-50%) local recurrence rates after curettage and bone grafting[5,6,15]. The use of modern imaging techniques and extended curettage through the use of power burrs and local adjuvants have improved outcome with reduced recurrence rates (10-20%). Phenol, liquid nitrogen, bone cement, hydrogen peroxide, zinc chloride and more recently, argon beam cauterization have been employed as local adjuvants. Chemical or physical agents work by inducing an additional circumferential area of necrosis to "extend" the curettage[16].

In this study evaluation of the outcome of GCT of the bone treated by curettage, chemical cauterization and bone grafting is done from July 2006 to July 2010.

1. Senior consultant (Ortho-surgery), 50 bed Hospital, Tongi, Gazipur, Dhaka.
2. Assistant professor(Ortho-surgery),Dhaka Medical College and Hospital, Dhaka.
3. Medical Officer, BSMMU, Dhaka

Correspondence : Dr. Kamal Mahmood Khan, Senior consultant (Ortho-surgery),50 bed Hospital, Tongi, Gazipur, Dhaka

MATERIALS AND METHOD:

This was a prospective study carried out at different hospital in Dhaka, Bangladesh during the period from July 2006 to July 2010.A total number of 16 patient were selected consecutively. Out of these 1 patient was lost during follow-up. Therefore excluding from follow-up. Hence this study comprising 15 cases for follow-up for a period of 12 months to 48 months. Among these 15 cases 08 were female and 07 were male. The average age of the patient was 28.6 years(range 19 to 55 years).The patient were diagnosed as a case of GCT by History, physical examination and relevant investigations. Diagnosis was confirmed pre-operatively by core biopsy .

Cases were classified according to Campanacci's grading system.[2,4] Only grade 1 and grade 2 were incluled in this study. 13 cases were Campanacci's Grade 2 and 2 cases were Campanacci's Grade 1.GCT in proximal Tibia were 08 cases, distal femur 05 cases and distal radius in 2 cases.

After exposure of tumor at most accessible location wide exteriorization was made in the most lytic area and thorough curettage was done. The soft tissues were covered and protected with Vaseline gauge. Cavity was washed several times with hydrogen peroxide and saline. Then cauterized with 5% phenol and kept for 30 to 40 seconds . Cavity was rinsed with 70% alcohol for 3 to 4 minutes .The cavity was then lavaged vigorously with normal saline .After curettage, and chemical cautery cavity was tightly filled with Autogenous bone graft. After operation limb was protected by posterior slab which was kept for 4 to 8 weeks depending on the site of tumor and extent of the lesion. The cases were followed up at six-week intervals until six months and then at three-month intervals till one year and then at six-month intervals. The follow-up visit included a clinical examination and radiograph of the affected part.

RESULTS:

All the 15 cases were evaluated clinically and radiologically at regular interval. Maximum follow-up was 4 years and minimum one year with a mean follow-up was 2.5 years. There was wound infection in one case and recurrence in one case which was treated again by curettage ,chemical cautery and bone graft.Functional evaluation was done as per Mankin et al(10).All patient was graded as excellent,good,fair and poor.Excellent and good results were considered as satisfactory and fair and poor as unsatisfactory. Satisfactory result (Excellent and good) were in 80% cases and unsatisfactory result in 20% cases

Table -I

Age distribution of patient

Age in years	No. of patients	Percentage
11-20	01	6.66%
21-40	13	86.66%
41-60	1	6.66%

Table -II

Showing the site of lesions

Site	No. of patient	Percentage
Proximal Tibia	08	53.33%
Distal femur	05	33.33%
Distal radius	02	13.33%

Table -III

Distribution of patient by result

Result	No. of cases	percentage
Excellent	6	40%
Good	6	40%
Fair	2	13.33%
Poor	1	6.66%

Table -IV

Final clinical out come

Result	No. of patient	percentage
Satisfactory	12	80%
Unsatifactiry	3	20%

DISCUSSION:

Giant cell tumour of the bone accounts for approximately 5% of all bone tumours[1]. Most of the lesions reportedly occur in patients in the third or fourth decade of life, corresponding to our own findings. Only thre one patient in our study group were outside this age range. Male(46.66%) to female (53.33%) ratio in this study correspond to larger series that show a female preponderance for GCT. The most frequent tumour site in our study was the proximal tibia, corresponding to the results of other groups who have reported that approximately 75%of tumours occur around the knee[8].

Pain was the most common clinical symptom (90%). Swelling developed in only 31% of the patients. The duration of complaints varied greatly, corresponding to the unpredictable course of the tumour[16].

The remarkable local aggressiveness of GCT as a benign bone tumour continues to be a surgical challenge. Until 1912, amputation was the preferred method of treatmentat which time intralesional resection and bone grafting was introduced.(4)With no further treatment, local recurrencemay develop in 80% in such cases.3) due to the anatomical location of the tumour, a less destructive approach is often desirable. Several methods of adjuvant treatment have been advocated .Radiation therapy, first described by Ewing,[12] is associated with a high rate of secondary malignancies and is no longer applicable in routine cases. Cryosurgery, introduced in 1964 showed recurrence rates of less than 10%, but was also associated with considerable complications, such as fractures and delayed bone and wound healing[11]. In recent reports low recurrenc shown by groups who used additional cementation, (2) Acrylic cementation have local effect of hyperthermia and the immediate stabilization of the defect without further surgery for bonegraft harvesting. In a series of 38 consecutive patients, a recurrence rate of 8% was reported using this technique[2]. But have negative influence of acrylic cementation to the adjacentjoint cartilage[13]. Another method based on the hyperthermic approach, CO2 laser cauterization, is currently being evaluated[9].

Since its introduction for the elimination of recurrences in benign tumours[3], a local application of phenol has been commonly used in the treatment of GCT[7]. two large studies by the same study group have provided data on the use of phenolization alone in the treatment of GCT[7]. In the first study, 69 patients were treated with adjuvant phenol applied with swabs and 14patients were treated with autologous or homologous bonegrafting. In this series, one recurrence was seen after the application of phenol (7%), whereas recurrence occured in 26 of 55 patients without phenolization (47%). Our study shows recurrence in one patient (6.66%) which correspond with their study.More over bone graft provide biological healing and preserve bone stock.

We conclude that phenolization is an effective and safe local adjuvant therapy for GCT. Curettage, chemical cauterization and bone graft is a viable treatment option of giant cell tumor of bone.

REFERENCES:

1. Apley A.G and Soloman L Apley'sSystem of Orthopaedic and Fracture 9th edition.
2. Bini SA, Gill K, Johnston JO. Giant cell tumor of bone. Curettage and cement reconstruction. *Clin Orthop* 1995; **321**: 245–50.
3. Bloodgood JC. Benign bone cysts, ostitis fibrosa, giant cell sarcoma and bone aneurysms of the long pipe bones. *Ann Surg* 1910; **52**: 145–85
4. Bloodgood JC. The conservative treatment of giant-cell sarcoma with the study of bone transplantation. *Ann Surg* 1912; **56**: 210–39.
5. Campanacci M, Baldini N, Boriani S, Sudanese A. Giant cell tumor of bone. J Bone Joint Surg Am. 1987;69:105–44. [PubMed]
6. Campanacci M. Giant cell tumor. In: Gaggi A, editor. Bone and soft-tissue tumors. Bologna, Italy: Springer-Verlag; 1990. pp. 17– 53.
7. Capanna R, Sudanese A, Baldini N, Campanacci M. Phenol as an adjuvant in the control of local recurrence of benign neoplasms of bone treated by curettage. *Ital J Orthop Traumatol* 1985; **11**: 381–8.
8. Gupta Ak, Nath R, Mishra, MP. Giant cell tumors of bone: Multimodal approach. IJO 2007;41(2):115-120
9. Kenan S, Kirby EJ, Buchalter J, Lewis MM. The potential role of the laser in marginal sterilization of giant cell tumor following curettage. *Bull Hosp Jt Dis Orthop Inst* 1988; **48**:93–101.
10. Mankin HJ, Homicek FJ. Treatment of giant cell tumors with allograft transplant. *Clinical Orthopaedics and related research 2005; 439: 144-150*
11. Marcove RC, Weis LD, Vaghaiwalla MR, Pearson R. Cryosurgery in the treatment of giant cell tumors of bone: a report of 52 consecutive cases. *Clin Orthop* 1978; **134**: 275–89
12.. McCarthy EF. Giant-cell tumor of bone: an historical perspective. *Clin Orthop* 1980; **153**: 14–25
13. Persson BM, Ekelund L, Lo¨vdahlR,Gunterberg B. Favourable results of acrylic cementation for giant cell tumors. *Acta Orthop Scand* 1984; **55**: 209–14.
14 Quint U. Recurrence of giant-cell tumour of bone after the use of cment. *J Bone Joint Surg (Br)* 1998; **80**: 370.
15. Rao PT. Management of giant cell tumor of bone. *Kini memorial oration. Indian J Orthop. 1993;27:96–100.*
16. Sung HW, Kuo DP, Shu WP, Chai YB, Liu CC, Li SM. Giant cell tumor of bone: Analysis of two hundred and eight cases in Chinese patients. *J Bone Joint Surg Am. 1982;64:755–61.*
17 . Turcotte RE. Giant cell tumor of bone. *Orthop Clin North Am. 2006;37:3*

Original Article

Evaluation of Results of One Stage Tendon Reconstruction for Old Injury of Flexor Tendons at Zone II of Hand

Provash Chandra Saha[1], Krishna Priya Das[2], Nakul Kumar Datta[3], Md. Shafiqul Alam[4]

ABSTRACT:

Flexor tendon injury in zone 2 of hand is particularly disabling resulting significant deficiency of hand function. Many studies have evaluated one-stage tendon grafting zone 2 of hand in which primary repair was not considered because of delay in treatment or for other circumstances. In most of them follow up periods were longer. However, we followed up patients for a relatively shorter period of time about 6- 8 months. 16 patients were operated having injury to both Flexor Digitorum Profundus and Flexor Digitorum Superficialis at zone 2 of hand involving 20 digits. In all patients, injured fingers were exposed by Brunner's zigzag incision. Using Palmaris Longus / Flexor Digitorum Superficialis free tendon graft distal juncture was made by modified Kessler's technique and proximal juncture of the graft with FDP was made after measuring adequate tension at zone III by Pulvertuft technique. Post-operative mobilization was done by 'Early mobilization (controlled passive flexion and active extension' technique. Outcome parameters of hand function like post operative range of active motion, combined extension deficit, free nail margin to distal palmer crease distance were assed according to the Buck-Gramco II (1976) evaluation criteria. Out of 16 patients functional results were excellent in 7(35%) digits, very good in 9(45%) digits, good in 3(15%) digits and fair in 1(5%) digit. Moderate amount of adhesion was found in 3(15%) in digits, one digit (5%) developed neurological deficit and 16(80%) digits recovered without any complication. Digital nerve injury, type of tendon graft, and injury mechanism of did not significantly affect the outcome. One stage tendon reconstruction is a satisfactory method of treatment for old injured flexor tendons on fingers at zone II of hand.

Key words: Old flexor tendons injury at Zone 2 of hand, One stage tendon reconstruction.

INTRODUCTION

Hand function is grossly impaired if flexor tendon is injured as muscle activity is finally carried out by intact tendon attached to the bone. For injured flexor tendon in the hand, the goal of treatment is recovery of functionally acceptable digital motion with intact tendon[1]. Secondary reconstruction, remains the mainstay of treatment for old injuries to the Flexor Digitorum Profundus and Flexor Digitorum Superficialis in zone II of hand**.** Flexor tendon injuries account for less than 1% of all hand injuries[2]. Flexor tendon repair for old injury of the FDS & FDP at zone II is particularly difficult as fibro osseous sheath with pulley systems are there to prevent bow-stringing[3]. The Palmaris Longus tendon was the best donor tendon, but there was little difference noted when a good Superficialis tendon was used. A post injury delay of 3 weeks or longer is recommended for tendon grafting. Factors that need to be considered are age of the patient, mechanism and extent of trauma, level of tendon laceration, healing response of the patient[4]. The procedure can yield

1. Junior Consultant, Orthopaedic Surgery, NITOR, Dhaka.
2. Associate professor, Orthopaedic Surgery, Department of Orthopaedic surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka
3. Professor and Chairman, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka.
4. Associate professor, Orthopaedic Surgery, Department of Orthopaedic surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka

Correspondence: Dr. Provash Chandra Saha, Junior Consultant, Orthopaedic Surgery, NITOR, Dhaka, Phone: 01718112539 email: provash.saha@yahoo.com

surprisingly good results when done with the correct indications[5].

Today, a single-stage reconstruction is indicated most commonly when a delay in treatment makes a primary repair impossible. Hand injury with flexor tendons injury is increasing day by day due to increased social and political violence, urbanization and industrialization all over the country. Injuries to the flexor tendons at zone II of hand found commonly as late presentations. Surgical repair of flexor tendon requires an exact knowledge of anatomy, careful attitude to basic surgical principles, sound clinical judgment and a well-planned post-operative programme.[6] Our study has been conducted with an aim to evaluate the outcome of single stage tendon reconstruction for old injury of flexor tendons (FDP & FDS) at zone II of hand.

PATIENTS AND METHODS

This prospective interventional study was carried out in the department of Orthopedic surgery, Bangabandhu Sheikh Mujib Medical University from April 2011 to December 2012 among the patients having Flexor tendons (FDS & FDP) injuries at zone II of hand those had undergone single stage tendon reconstruction, within the age range 15 to 44 years. Out of 16 study population 13(81.25%) were male and rest 3(18.75%) were female, involved digits were 20 in number. According to Boyes[7] criteria we included patients with sharp cut or machinery injury with complete divisions of FDP and FDS tendon at zone II of hand without fracture of the digits, age of injury from 4 weeks to 12 weeks, normal or near normal passive range of motion of joints of finger.

We excluded –

- Lacerated injury with extensive scar,
- Injury less than 4 weeks old or more than 12 weeks,
- Stiffness of joints of fingers,
- Injury to both digital nerves,
- Medical problems- like paralytic hand, Reynaud's disease, arthritic hand, etc.

Informed written consent was taken from every patient before enrollment in the study.

Particular important part of local examination was to assess the passive range of motion of joints of the fingers.The cut tendons were exposed by Brunner's *zig-zag*incision. Graft was harvested from the tendon of Palmaris Longus by two incisions (one at the wrist and other in the mid forearm) or in some cases from FDS tendon of the same finger where it was intact.Graft was placed through the pulleys in the sheath. Distal juncture with cut distal stump of flexor Digitorum Profundus when distal 1 cm was possible to preserve by modified Kessler method with epitendinous suture by prolene, distal skin wound was closed first. Proximal juncture of the graft to flexor digitorumprofundus tendon at zone III as given by Pulvertuft (1960) technique after measuring adequate tension.

On third postoperative day patient were advised for controlled passive flexion (2-3mm) and active extension of fingers in plaster slab for 2 weeks, they were advised to do it 8-10 repetitions 2 times daily. At 1 month, the patients were advised to remove the cast at day time and controlled active flexion exercise to continue. After 6 weeks, the cast was totally removed and patients were instructed to start light activity like to hold glass or take cup of tea. At the end of 8 weeks, the emphasis was given on the grip strengthening of the fingers along with controlled hyperextension of the fingers. All the patients were followed up and assessed for a period of 6-8 months, at least for 6 months.

At the last follow-up, functional evaluation of results were done by measuring "Modified total active motion" of joints of fingers, Extension deficit, Free nail palm distance, duration of regain of full or near full range of motion, observing the condition of grip, pinch and hooking function, sensory regain of fingers, functional deficiency due to withdrawal of Palmaris longus tendon and esthetics of fingers and recording of complications. Evaluation of functional outcome was studied according to Buck-Gramcko II[8] criteria.

Buck-Gramcko II criteri*	Units	Points
Free nail palm crease distance	0.0–0.5 cm	6
measured from the free nail margin	0.6–1.5 cm	5
to the distal palmar crease	1.6–2.5 cm	4
	2.6–4.0 cm	3
	4.1–6.0 cm	2
	>6.0 cm	1
Total extension deficit	0º–30º	3
(MPJ+PIP+DIP)	31º–50º	2
	51º–70º	1
	>70º	0
Modified total active motion	>400º	8
(MPJ+2xPIP+3xDIP) MTAM	>320º	6
	>280º	4
	>240º	2
	>240º	0
Classification		
Excellent	-	16–17
Very good	-	14–15
Good	-	11–13
Fair	-	7–9
Poor	-	0–6

* MPJ denotes metacarpophalangeal joint, PIP proximal interphalangeal joint, and DIP distal interphalangeal joint

RESULTS

Study population was divided into six groups according to age distribution where 13 (81.25%) were male and 3 (18.75%) were female. Mean was 27.68; SD+6.354.

The sex distribution according to age group is represented in Figure I.

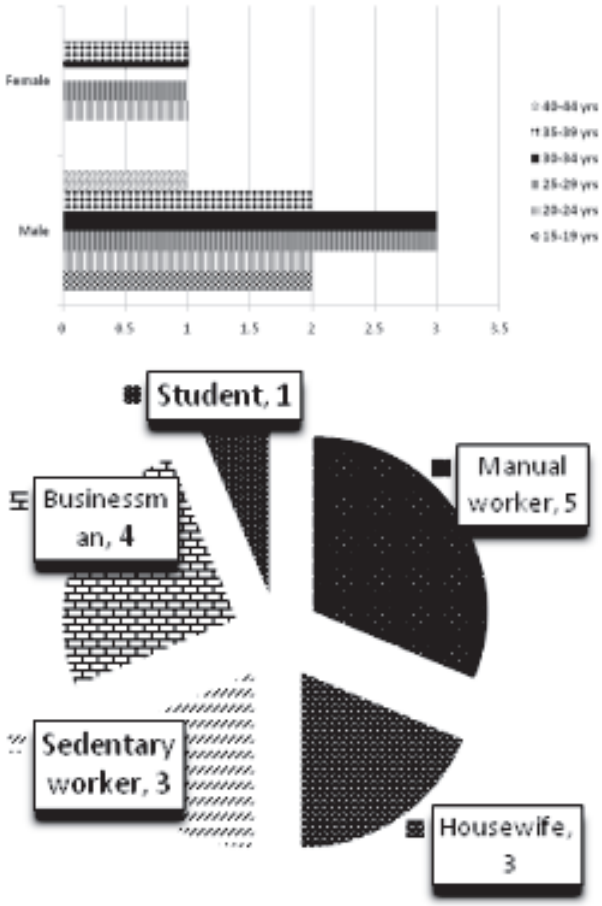


Fig. II. The variety of occupation of study population is depicted in Figure I. Highest number of patients were manual workers.

Table-I

Distribution of involvement of digits (n=20)

Involved digit	Number of digits	Percentage
Index	94	5.0
Middle	4	20.0
Ring	4	20.0
Little	31	5.5
Total	20	100

Majorities of the digits were without any digital nerve injury 16(80%) followed by injury to the Digital nerve of Ulnar side (UDN) in 3(15%) digits and Digital nerve of Radial side (RDN) in one digit (5%).

Total follow-up period ranged from 6-8 months, with an average of 6.45 months. Out of 20 operated digits, 3(15%) developed moderate amount of adhesion, one (5%) developed neurological deficit and 16(80%) digits recovered without any complication.

Highest gained limit of post operative finger flexion (MTAM) was found 460^0 in 1(5%) digit; the lowest limit being 300^0 in 1(5%) digit. In 17(85%) of digits the range was of 410^0- 450^0.

Preoperative photograph ,FDS,FDP injury

Postoperative: Full flexion of Ring finger

Peroperative: Establishment of graft with distal juncture

Regarding the postoperative extension deficit the maximum deficit was found 50^0 in 1(5%) digit. The minimum is 15^0 in 1(5%) digit. The most frequently occurring deficit is 20^0 in 6(30%) digits. The minimum Post operative free nail margin to distal palmer crease distance was found 0.5 cm in 1(5%) digit; the maximum distance found 3.8 cm in 1(5%) digit. The most frequent distance found 1 cm 6(30%) digits.

Table-II

Depicts final outcome based on Buck- GramcoII (1976) scoring system. (n=20)

Remark	Frequency	Percent
Excellent	7	35
Very good	9	45
Good	3	30
Fair	1	5
Total	20	100

There is no significant difference in Post operative outcome between digits having digital nerve injury and without digital nerve injury. (P value 0.14, Chi Square test), between digits reconstructed with Palmaris Longus and Flexor Digitorum Superficialis tendon graft (P value 0.11, Chi Square test) and between digits injured by sharp cutting and machinery injuries (P value 0.18 according to Chi Square test).

Table-III

Depicts distribution of incidence postoperative of complication (n=20)

	Number of fingers	Percentage
Adhesion formation	3	15
Neurological deficit	1	5
None	16	80
Total	20	100

DISCUSSION

Improving results in zone II flexor tendon injuries of hand remains a challenge to hand surgeons[9]. In our socioeconomic context patients need proper management with early return to their activities. But the procedure and aftercare is lengthy to achieve a full functional recovery. In this study, an 'Early mobilization programme' was used which had been adopted in many other studies. It has many advantages. Gelberman and his colleagues demonstrated that application of early motion stress to repaired tendons led to a more rapid recovery of tensile strength, fewer adhesions, improved excursion, better nutrition, and minimum repair site deformation compared with immobilized tendons[10]. Early mobilization programme helped to allow tendon healing by decreasing surrounding adhesion formation[11].

The patients who were treated in this series belonged to different occupation. Among them, 3 (18.75%) were housewife, 3 (18.75%) sedentary worker, 5(31.25%) manual worker, 4 (25%) businessman, 1(6.25%) was student. Highest number of patients was manual workers, housewives were least.

Flexor tendon injury is more common in right dominating hand. But in our series, right dominating side was involved in 6 (37.5%) and left non dominating side involvement was in 10 (70%) patients. This disparity is probably incidental occurrence.

Incidence of involved digits shows that highest number of involvement was index finger in 9 (45%) cases, middle finger in 4 (20 %), ring finger in 4 (20 %) and little finger in 3 (15 %) cases. The results of this study nearly corresponds to the study by Sakellaridis HT and Papadopoulos G which number of index was 9, middle 12, ring 11 and little 18.[12]

In our study there is significant difference in number between sharp cut 16(80%) and machinery injury 4(20%). Trevor Starnes (2012) in their study showed that mechanism of injury significantly influenced the outcome of tendon repair. They describes that tearing types of injury, such as those caused by saws, led to poorer outcomes for Zone II flexor tendon injuries compared with sharp injuries at an average follow-up of 4 years.[13] But in our study there is no significant difference in outcome between these two groups (P value is 0.18 by Chi square test).

In our study single stage reconstruction was done by using Palmaris Longus free tendon graft in 16 digits and by tendon of Flexor Digitorum Superficialis in 4 digits where palmars longus was insufficient for reconstruction. There was no significant difference in post operative outcome between Palmaris Longus and flexor Digitorum Superficialis grafted digits (P value is 0.11 by Chi square test).

In this series, Majorities of the tendon injuries were without any digital nerve injury, 16(80%). UDN injury was found in 3(15%) digits, RDN injury in one digit (5%). All the digital nerve injuries were repaired during tendon grafting. But the final outcome had not been affected significantly with presence or absence of digital nerve

injury. Similarly Atakan et al showed that the mean active movement of 20 fingers in which digital nerve injury was present with tendon injuries, was %54.1+/- 19.2; while of 21 fingers with only tendon injury was %60.9+/-19.1 and there was no significant difference between two groups.[14]

In our study the mean duration of post injury delay of surgery was 8.55 weeks with SD + 2.544. This nearly correlates with study of Atakan et al, 2004 where the interval was 3-6 weeks. In this study total follow-up period ranged from 6-8 months, with an average of 6.45 months. Out of 16 patients, 11 (68.75 %) were followed up for a 6 months, 2(12.5 %) for 7 months, 3 (18.75%) for 8 months. This did not correspond with the study of Atakan et al 2004 where the mean follow-up was 35 months (range 4 to 83 months).[14] Out of 20 operated digits, 3(15%) developed moderate amount of adhesion, one (5%) developed neurological deficit and 16(80%) digits recovered without any complication.

In our study excellent result was found in 7(35%) digits, very good in 9(45%) digits, good in 3(15%) digits and fair in 1(5%) digit. There is no case of poor outcome. Among the patients involved excellent result was found in 5(31.25%) patients, Very good in 9(56.25%) patients, good in 1(5%) patients and fair in 1(5%) patients. So, satisfactory results were found in 16(7+9) digits (35%+45%=80%).

This result is similar with study of Sakellarides HT where the results where 16(32%) were excellent, 24(48%) good, and 10(20%) were fair.[12] There was no case of tendon rupture or infection during the study period.

CONCLUSION

In our study type of tendon graft, digital nerve injury, and mechanism of injury did not affect the final outcome significantly. Considering all these issues our study suggested that one stage tendon reconstruction seems to be a satisfactory method of treatment for old injury of flexor tendons at zone II of hand where early repair is not feasible and thereby regaining full hand function.

REFERENCES

1. Strickland JW. Flexor Tendons: acute injuries. In: Green DR Notchkiss RN, Pederson WC, Editors. *Green's operative hand surgery.* New York: Churchill Livingstone 1998; 2, 4th ed. : pp. 1851-97.
2. Freilich A,Chhabra B. Secondary flexor tendon reconstruction, a review. *J Hand SurgAm*2007; 32(9): 1436–42.
3. Holm CL, Ernblck RP. Anatomical consideration in the primary treatment of tendon injuries of the hand.*J Bone Joint Surt* 1959; 41A: 599-608.
4. Taras JS, Kaufmann RA. Flexor Tendon Reconstruction. In: Wolfe SW, Hotchkiss RN, Pederson WC, Kozin SH, editors, Green's operative hand surgery, vol. 1. 6th ed. Elsevier, Philadelphia, 2011: pp. 207-8.
5. Strickland J. Delayed treatment of flexor tendon injuries including grafting. *Hand Clin,* 2005; 21: 219–43.
6. Ahmed M, Hussain SH. Flexor Tendon Injuries of Hand Experience in Pakistan. *J Ayub Med Coll* 2007; 19(1):6-9.
7. Brian M. Derby, MDa, Bradon J. Wilhelmi, Elvin G. Zook, Michael W. Neumeister,Flexor Tendon Reconstruction, Clin Plastic Surg 38 (2011) 607–619
8. Buck-Gramcko D, Dietrich FE, Gogge S. Evaluation criteria in follow-up studies of flexor tendon therapy [in German]. *Handchirurgie*1976;8:65–9.
9. Denju O, Satoshi F, Kazuya T, Tetsuhiko Y, Akira I, Koichi S. Flexor Tendon Repair in Zone II With 6-Strand Techniques and Early Active Mobilization, *The Journal of Hand Surgery* 2006; 31A (6): 987
10. Strickland JW. Development of Flexor Tendon Surgery: Twenty-Five Years of Progress.The Journal of Hand Surgery 2000; 25A: 218.
11. Baktir A, Tusrk C. Kabak Y, Sahin V. and Kardas Y. Flexor tendon repair in zone 2 followed by early Active mobilization, *Journal of Hand Surgery (British and European Volume,)* 1996; 21B(5): 624-628
12. Sakellarides HT, Papadopoulos G. Surgical treatment of the divided flexor digitorumprofundus tendon in zone 2, delayed more than 6 weeks, by tendon grafting in 50 cases. Journal of Hand Surgery (British and European Volume,) 1996; 21B: 63- 6.
13. Trevor S, Rebecca JS, Kenneth R M Jr. Clinical Outcomes of Zone II Flexor Tendon Repair Depending on Mechanism of Injur.*J Hand Surg*, 2012, (37A) 2532–40.
14. Atakan A, Murat T, Ali M et al. Single-stage flexor tendoplasty in the treatment of flexor tendon injuries.*ActaOrthopTraumatolTurc*2004; 38(1): 54-9.

Original Article

Non Union of Femoral Shaft and Supra-condyle Fracture Our Experience

SK Roy[1], AMS Sohel[2] , Mahboob[2], Shyamal Debnath[3], RR Kairy[4]

ABSTRACT

Non union of femur fracture is a common problem in practice. Here we include non union of fracture shaft of femur and supra condyle femoral fracture. In our retrospective study we included 25 patients who gained union among which 18 patients were male and 7 patients were female, 16 patients had shaft of femur fracture and 9 patients had supracondylar fracture, mean age is 37.2 years, mean duration of non union is 16.2 months, mean time to union is 9.9 months and mean follow up period is 14.9 months.

Different options we followed to solve the problem, eg- exchange nailing, refixation by different implant, bone grafting, bone marrow injection, Ilizarov fixation etc.

There are different reasons of non union, common causes we observed in our study are – open fracture, segmental bone Loss , infection , open fixation, massive and rough tissue handling, deperiostization, inappropriate implant use, inadequate stabilization , implant failure ,prolonged distraction, poor supervision , poor patient's compliance, lack of rehabilitation etc.

Nonunion management is difficult. Close intrameudllary nailing or minimally invasive technique and meticulous tissue dissection has less incidence of non union. Assessment of non union type and preoperative planning is very important to handle the problem.

INTRODUCTION

Fracture non union of bone describes as fracture that lacks potential to heal without further intervention. Fracture of long bone shaft should not be considered non union until at least 6 months post injury, FDA describes as 9 months elapsed time with no healing progress for 3 months [1].

Non union of femur , regardless of the anatomic site, are most common due to severely open fracture with extensive communition and bone loss and second common cause is infection [2,3].

Causes of non union [4] can be described as follows:

Predisposing factors

- Mechanical instability:
  - Inadequate fixation
  - Distraction
  - Bone loss
  - Poor bone quality
- Inadequate vascularity:
  - Severe injury
  - Excessive soft tissue stripping
  - Vascular injury
- Poor bone contact:
  - Soft tissue interposition
  - Malposition or malaligment

Contributing factors:

- Infection
- Nicotine or cigarette smoking
- Certain medication (like- NSAIDs)
- Advanced age
- Systemic medical condition
- Venous stasis
- Burns
- Radiation
- Obesity
- Alcohol abuse

1. Orthopaedic surgeon, Former Registrar- Apollo Hospitals Dhaka, Bangladesh.
2. Registrar- Apollo Hospitals Dhaka, Bangladesh.
3. Associate Professor, NITOR, Dhaka, Bangladesh
4. Former Professor, NITOR, Dhaka, Bangladesh

Correspondence: Dr. Suman Kumar Roy, E-mail: drssroy@gmail.com

- Metabolic bone disease
- Malnutrition
- Vitamin deficiency

The basic principles of treatment of closed fracture femur are restoration of position and alignment, maintenance of length, immobilization until bone union occurs and restoration of normal function after union. Treatment of open fracture femur requires debridement, stabilization and closure (including primary closure, delayed primary closure, secondary debridement, secondary closure and closure by secondary intention). And other principles are just like closed fracture [5].

The treatment of long bone fracture nonunion has been extensively discussed in orthopaedic literature. The evolution of treatment began with traction and prolonged immobilization as described by Watson-Jones [6].

There are different method of treatment for providing stability and implant use [2,7,8].

Most nonunions of the femur can be successfully treated by osteosynthesis with or without bone grafting, electric stimulation, ultrasound and growth factor administration. However, bone defects, osteopenia and poor bone quality at the non union site after repeat surgeries and widening of the canal as well as a thin cortex in the proximal and distal femoral regions render the treatment of femoral nonunion difficult [9].

In this retrospective study authors reviewed the results of conventional osteosynthesis combined with or without bone graft (allograft/ autogenous graft) for nonunion fracture of the femur including supracondyle fracture and diaphyseal fracture.

Authors followed different surgical procedure(Osteosynthesis method) like- exchange nailing, refixation by plate (DCP or Locking plate), bone grafting, bone marrow injection, fixation with or without bonegrafting, illizarov fixation etc.

Method and Materials:

We performed a retrospective review of 25 patients who had been managed by us for supracondyle and shaft nonunion of femur at Apollo Hospitals Dhaka and National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka between February 2009 to February 2013.

The study group, therefore, consisted of 25 patients (18 men and 7 women), nine of whom had nonunion fracture supracondyle femur and sixteen had nonunion fracture shaft of femur. The mean age of the patients at the time of presentation was 37.2 years (ranging from 18 years to 55 years). Fifteen nonunion involved the right femur and 10 involved left femur. Fourteen patients had open injury and rest 11 patients had closed injury. We only included the trauma patients in our study. Seventeen patients had road traffic accident (11 patients of motor vehicle accident and 6 patients were of motor cycle accident), seven patients had mode of injury of fall from height and one patient was of physical assault. Mean duration of nonunion was 16.2 months (10 months to 34 months).

Eight patients were smoker and used to smoke about one packet of cigarettes a day.

All hospital inpatient and outpatient records were reviewed to determine the following factors: patient age, gender, type of fracture, mode of injury, AO classification, primary treatment, duration of nonunion, additional treatment (treatment for nonunion), time to union, range of motion of knee [preoperative (after nonunion) and postoperative (after union)], status at follow up and duration of follow up.

After brief analysis of 25 nonunion femur patients we put our view about probable cause of nonunion and the management of nonunion.

Patients treatment is provisionally classified into prior treatment or initial treatment which we like to mean treatment since injury till nonunion (defined at 9 months post injury) and additional treatment means treatment after establishment of nonunion till union. Initial treatment we documented were: debridement, surgical toileting, intramedullary nailing (closed or open), “K” nail fixation, open reduction and internal fixation by DCP/Condylar buttress plate, autogenous or allogenic bone grafting, traction , traction & casting, skin grafting, vascular repair by vascular surgeon. etc.

Treatment of the established nonunion was also varied and included several forms of internal and external fixation as well as adjunctive treatment with bone grafting.

In details we followed the following modalities of treatment for nonunion: exchange nailing, onlay bone grafting, refixation by broad locking LCP / locking distal femoral condylar LCP/ locking condylar buttress plate , onlay plating and bonegrafting, dynamization, antibiotic impregnated cement bead application and later on refixation, ilizarov fixation, bone marrow injection.

Chart-1:

Case No.	Age /Sex	Type of Fracture	Mode ofInjury	Orthopaedic Trauma Association Classification / AO Classification	Prior surgery (PrimaryTreatment)	Duration of Nonunion (Month)
1	36/M	Open G-IIIA # SOF (Rt.)	Motor Cycle Accident (MCA)	32-B2	Debridement Close IM Nailing	16
2	25/M	Closed comminuted # SOF(Rt.)	Motor Vehicle Accident (MVA)	32-C1	ORIF with DCP	14
3	40/F	Open G-II # SOF (Lt.)	MVA	32-A3	Minimally opening "K" nail fixation	10
4	39/M	Closed # S/C with IC extension (Lt.)	Fall from height (FFH)	33-C3	ORIF with DCS	12
5	55/M	Closed comminuted # SOF(Rt.)	FFH	32-C2	ORIF with IMIL nail	18
6	30/M	Open G-IIIB # SOF (Lt.)	MVA	32-B3	External fixationORIF with IMIL nailAllogenic bone grafting	14
7	26/M	Open G-I # S/C (Rt.)	MCA	33-B1	Surgical toileting Percutaneous "K" wire fixationPlaster immobiliztion	10
8	38/F	Closed comminuted # SOF(Rt.)	FFH	32-C2	ORIF with IMIL nail Autogenour bone grafting (ABG)	14
9	18/M	Closed # S/C (Rt.)	MCA	33-A3	ORIF with DCS	11
10	41/F	Closed and Comminuted # S/C with IC extension (Lt.)	MVA	33-B3	ORIF with DCS	17
11	33/M	Open G-II # SOF (Rt.)	MCA	32-A2	Surgical toleting ORIF with IMIL nailAllografting	12
12	40/M	Open and comminuted G-II # SOF (Rt.)	FFH	32-A1	Surgical toileting Skeletal traction ORIF with Broad LC DCP	14
13	30/M	Closed comminuted # S/C with IC extension (Lt.)	MCA	33-C3	ORIF with DCS	23
14	45/F	Closed # S/C with IC extension (Lt.)	MVA	33-B2	Skeletal traction Casting Brace	15
15	27/M	Closed # SOF(Rt.)	Fall from height	32-A3	ORIF with IM nail	19
16	30/F	Open G-I # SOF(Rt.)	FFH	32-A2	Surgical toleting ORIF with IMIL nail	12
17	30/M	Open G-III C # SOF(Lt.)	MVA	32-A1	Surgical toileting Vascular repair External fixation ORIF with Broad Locking LCP	34
18	46/M	Open G-IIIB # SOF (Rt.)	FFH	32-A1	Surgical toileting External fixation ORIF with IMIL nail	24
19	33/M	Open G-II # S/C with IC extension (Rt)	MVA	33-C3	Surgical toiletingORIF with DCSSkin grafting	26
20	38/M	Open G-IIIB # SOF (Rt.)	Physical assault	32-C1	Surgical toileting ORIF with DCP	17
21	49/F	Closed # SOF (Lt.)	MCA	32-A3	Closed "K" nail Surgical	13
22	39/F	Open G-III C # S/C (Rt.)	MCA	33-B2	toileting,Vascular repair External fixation ORIF with distal femoral condylar locking buttress plate Skin grafting	18 18
23	40/M	Undisplaced closed comminuted # S/C with IC extension (Rt.)	FFH	33-C3	Percutaneous "K" wire fixation and Plaster immobilization	12
24	55/M	Open G-I # SOF (Lt.)	MVA	32-A2	Surgical toileting CRIF with IMIL nail	11
25	48/M	Open G-IIIB # SOF(Lt.)	MVA	32-A2	Surgical toiletig External fixation	19

The open fracture were classified according to the system of Gustilo et al. [10]

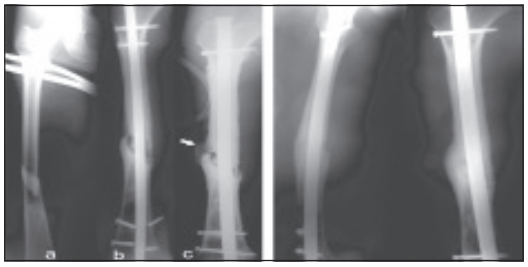
Chart-2

Case No.	Additional Treatment (Rx for nonunion)	Time to union (Months)	Range of Flexion (Degree) Pre-op.	Post-op.	Probable cause of Non union	Status at follow up(Months)	Duration of follow-up (Months)
1	Exhange nailing	6	0-100	0-110	Implant failure Smoker	Returned to full activity	9
2	Onlay bone grafting	9	0-100	0-135	Bone loss	Returned to full activity	15
3	Refixation by IM nail	10	5-110	0-125	Implant failure Obesity DM	Returned to full activity	12
4	Refixation by Lockingdistal femoral condylar buttress plate Qadricepsplasty done	12	5-80	5-100	Instability DM Smoker	Used walking stick 7 degree varus	20
5	DynamizationABG	5	0-110	0-130	Bone lossAtrophy Smoker	Returned to full activity	8
6	Refixation by broad locking LCPABG + Allografting	6	0-120	0-110	InstabilityAtrophic non union	Used one crutch	12
7	Refixation by DCS Interfragmentary screw Qadricepsplasty advised	7	5-100	5-90	Instability	Used wheel chair 10 degree varus	10
8	Exchanging nailingABG	5	0-110	0-125	Atrophic non union Alcohol abuse	Returned to full activity	11
9	Refixation by DCS and bilpalar plate ABG	8	5-110	5-100	Implant failure Obesity	Carried normal activity	13
10	Refixation by DCS.ABG	13	0-90	0-115	Firbous nonunion H/O Rheumatoid Arthritis	Carried normal activity	20
11	Removal of implant Illizarov fixation	16	10-40	10-80	InfectionSmoker	Used crutchesLimb length discrepancy (3cm shortening)	23
12	Removal of implantAntibiotic impregnated cement bead application ORIF with Broad Locking LCP.ABG Qadricepsplasty advised	22	10-80	5-80	InfectionDM	Used wheel chair	36
13	Removal of implant Refixation by locking distal femoralcondylar buttress plate ABG	5	10-80	0-100	Implant failure (Broken)	Used walker	8
14	Refixation by DCS Interfragmentary screw ABG	8	0-110	0-110	InstabilityDM H/O Hyperuricemia	Carried normal activity	12
15	Exhange nailing byIMIL nail Additional Small DCP fixation across the nonunion site and	5 ABG	0-100	0-120	Instability	Returned to full activity	9
16	Implant removalIllizarov fixation Qadricepsplasty advised	13	10-80	10-70	Infection	Used walker	19
17	Implant removal ORIF with Broad LCPABG+ Allografting	8	0-90	0-110	Instability H/O RA Smoker	Carried normal activity	15
18	Removal of implantAntibiotic impregnated cement filled “K” nail fixationORIF with Broad Locking LCP	15	5-70	5-90	Infection	Used walker Limb length discrepancy (2 cm shortemomg)	23
19	Removal of implantAntibiotic impregnated cement bead application Refixation by DCS Qadricepsplasty done	11	0-80	0-90	Infection	Used walkerLimb length discrepancy (5cm shortening)	18
20	ABG	5	0-120	0-125	Fibrous non union H/O Hypothyroidism Smoker	Returned to full activity	10
21	Exhange nailing by IMIL nailABG	9	0-110	0-110	Instability DM Osteopenia	Returned to full activity	16
22	Refixation by DCS Interfragmentary screw ABG	4	5-100	0-110	Instability	Returned to full activity	9
23	Refixation by distal femoral condylar plateABG	10	0-100	0-115	Atropic nonunion Instability DM Smoker	Returned to full activity	15
24	Bone marrow injection	5	0-125	0-130	Osteoporosis	Returned to full activity	8
25	Illizarov fixation Qadricepsplasty advised	14	0-60	0-80	Infection Smoker	Used wheel-chair outside home Limb length discrepancy (2 cm shortening)	22

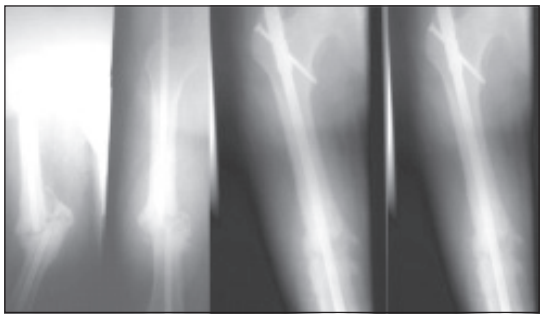
Rehabilitation of the quadriceps muscle with isometric exercise was begun immediately after the operation and continuous passive motion was initiated as tolerated 48 hours later. All patients were allowed progressive weight bearing at 6 weeks and returned for radiographic examination at 6, 12 and 24 weeks and then every 6 months postoperatively. Union was judged by a radiographic examination.

This is only analytical study so we didn't do any statistical analysis and didn't also compare with other results. We only documented our view regarding causes of non union and the successful modalities of treatment for nonunion.

ROENTGENOGRAMS ANALYSIS:

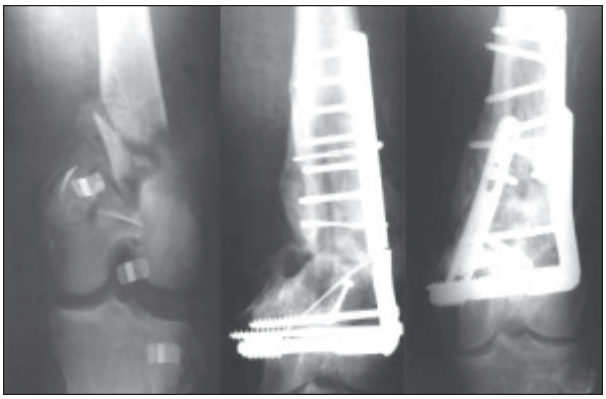


Case-1: Implant failure, Union gained after exchange nailing.

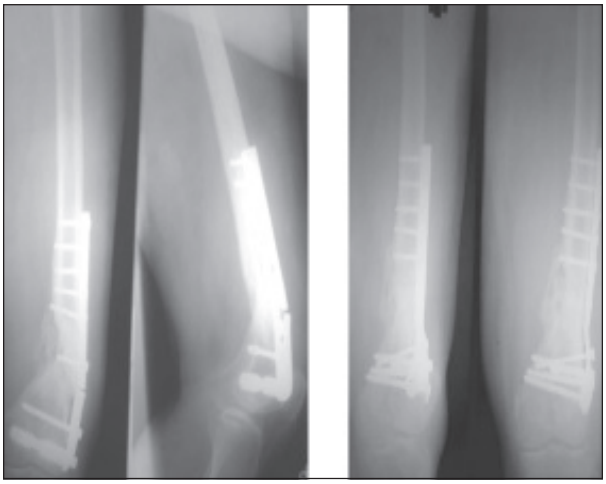


Case-3: "K" nail broken with hypertrophic callus. Union achieved after refixation by IM nail

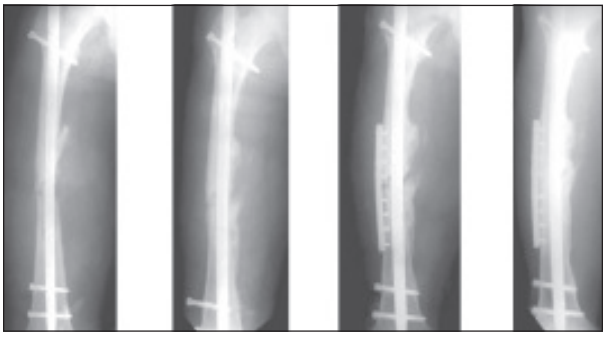
Case-4: Union achieved after fixation with locking distal femoral condylar buttress plate



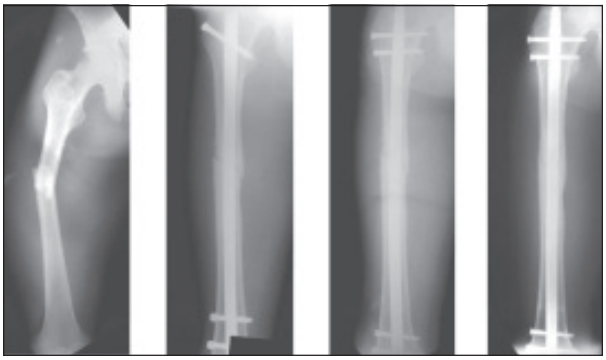
Case-9: Nonunion due to implant failure. Union obtained after refixation with DCS and biplaner plate along with bone-grafting.



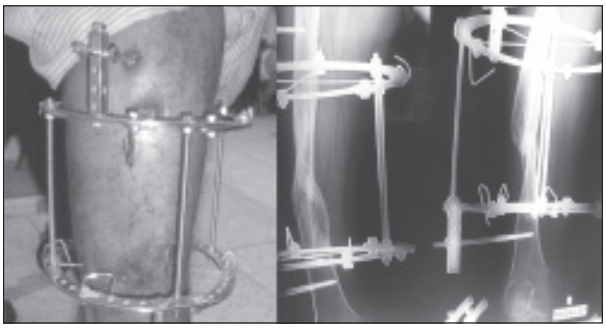
Case-13: DCS removal and refixation by distal femoral condylar buttress plate and ABG



Case-15: The fracture had been fixed initially with a reamed intrmedullary interlocking nail. Fracture went to nonunion, the nonunion was treated with reamed exchange nailing but it was not healed, then AO 6 holes plate was fixed across the nonunion site with autogenous bone grafting and we achieved union. (Back out 2nd last distal screw was also replaced)



Case-24: Union gained after bone marrow injection.



Case-25: Infected non union fracture shaft of femur is treated by Ilizarov ring fixators.

RESULTS

The average duration of follow up is 14.9 months (8- 36 months). Average time to union for nonunion fracture supracondyle femur is 8.7 months and for nonunion facture shaft of femur is 9.6 months.

Mean range of motion of knee after union for supracondyle is 103 (0-115) degree and for shaft of femur is 108 (0-135) degree.

Authors found that knee range of motion has significantly increased after union and even more increased after removal of implants (where carried out).

Radiological analysis revealed that significant predictors of poor outcome included bone stock and malalignment in the antero-posterior and lateral planes.

Quadricepsplasty was advised for 6 patients (3 for fracture SOF and 3 for fracture S/C femur), among them 2 patients of fracture supracondyle femur underwent quadricepsplasty and one still to agree and one patient of fracture shaft of femur underwent quadricepsplasty and two yet to give consent.

In two patients of nonunion fracture supracondyle femur developed varus angulation of 7-10 degree.

Four patients developed shortening, among them three had fracture shaft of femur and one had fracture supracondyle femur. In infective case operation done after quiescent period of infection which is determined by normal ESR and negative CRP for at least 6 weeks.

DISCUSSION:

Various literatures show that nonunion of long bone fractures has been the subject of intensive study in the orthopedic. The matter undoubtedly stems not only from the inherent difficulty in treating this complication, but also from the enormous physical and psychological demands placed on the patient. In our retrospective analytical study we only included established nonunion supracondyle and shaft of femur fracture and exclude our fail case of treated nonunion.

As most of the patient were of young age so primary osteoporosis was not problem in healing, problem was disuse atrophy due to prolonged inactivity and immobilization. Other important problems are heavy weight, smoking and of course infection.

Rigid fixation and early rehabilitation were noted as the key factors in the success of this management[10, 11]

Our data highlight significant risk factors in the treatment of femoral non unions are advanced age, unjustified surgery, patient's general medical condition and nutritional status, infection, synovial pseudoarthrosis at the nonunion site, open fractures, injuries resulting from high energy trauma , smoking etc.

Synovial pseudoarthrosis are thought to result from gross motion at the fracture site due to inadequate immobilization [12]

Management of nonunion fracture supracondyle and shaft of femur is very difficult. Assessment of predisposing factors (offending factor) and pre-operative & post-operative planning is very important.

Meticulous, secure, layered closure of the quadriceps mechanism and the knee joint capsule is essential for rehabilitation of the muscles and quadriceps mechanism. Good cooperation on the part of the patient and a carefully supervised postoperative exercise program are essential for restoring and maintaining motion of the knee. Our patients begun isometric exercises and passive range of motion exercises of the knee with a continuous passive motion device as soon as the operative drain is removed, which is normally within twenty four to forty eight hours postoperatively.

The development of newer implants, as well as the use of bone graft (as BMP no so available in our set up) may substantially improve the results of treatment of femoral fracture nonunion as others also suggest [13, 14]

Soft tissue debridement and reconstruction, meticulous dissection, preservation of the blood supply to the bone, use of proper implant , rigid and strong internal fixation, use of copious autologous bone graft and a vigorous rehabilitation program and overall good supervison and patients compliance are the key to success.

REFERENCES

1. Wheel's Textbook of Orthopaedics
2. Chapmann MW, Finkemeier CG. Treatment of supracondylar nonunions of the femur with plate fixation and bone graft. J Bone Joint Surg Am 1999;81:1217-28.
3. Koval KJ, Seligson D, Rosen H, Fee K. Distal femoral nonunion: treatment with a retrograde inserted locked intramedullary nail. J Orthop Trauma 1995;9:285-91.
4. Mark R. Brinker, M.D. Nonunion: Evaluation and Treatment, Elsevier Science (USA): 20; 507-604.
5. LLOYD W. TAYLOR,M.D.,Principles of Treatment of Fracture and Non-Union of the Shaft of the Femur. The Journal of Bone and Joint Surgery, Vol. 45-A, NO. 1, JANUARY 1963
6. P.K. BEREDJIKLIAN , M.D. et al. Results of Treatment of 111 Patients With Nonunion of Femoral Shaft Fractures. The University of Pennsylvania Orthopaedic Journal, 12:52-56, 1999
7. Beall MS Jr, Nobel E, Bailey RW. Transarticular fixation in the treatment of nonunion of supracondylar fracture of the femur: A salvage procedure. J Bone Joint Surg Am1979;61:1018-23.
8. Wu CC, Shih CH. Distal femoral nonunion treated with interlocking nailing. J Trauma 1991;31:1659-62.
9. Lin-Hsiu Weng, MD; Jun-Wen Wang, MD. Nonunion of the Femur Treated with Conventional Osteosynthesis Combined with Autogenous and Strut Allogeneic Bone Grafts.Chang Gung Med J Vol. 27 No.4
10. Gustilo, R. B., and Anderson, J. T.: Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones. Retrospective and prospective analysis. *J. Bone and Joint Surg.,* 58-A: 453-458, June 1976.
11. Klemm KW: Treatment of infected pseudarthrosis of the femur and tibia with an interlocking nail. *Clin Orthop* 212:174–181, 1986.
12. Heppenstall RB, Brighton CT, Esterhai JL, et al.: Synovial pseudarthrosis: A clinical, roentgenographic, scintigraphic, and pathologic study. *J Trauma* 27:463–470, 1987.
13. Johnson EE, Urist MR, Finerman GA: Bone morphogenetic protein augmentation grafting of resistant femoral nonunions. A preliminary report. *Clin Orthop* 230:257–265, 1988.
14. Muller ME: Treatment of nonunion by compression. *Clin Orthop* 43: 83–91, 1966.

Original Article

Evaluation of Percutaneous Bone Marrow Transplantation in the Treatment of Non-union and Delayed Union of Long Bone

ABM Golam Faruque[1], AHM Tanvir Hasan Siddiquee[2], SK Nurul Alam[3], AFM Ruhal Haque[4]

Abstract

Bone marrow is a source of osteoprogenitor cells that are the key elements in the process of bone formation and fracture healing. The purpose of the study was to ascertain the osteogenic potential of autologous bone marrow grafting and it's effectiveness in the management of delayed union and non-union. This study was done from April 2000 to June 2012 on 150 patients. Among these cases, 76 were femur, with 41tibia, 22 humerus, 5 ulna and 6 radius. The average time duration between the injury and the procedure was 25 weeks (14-53 weeks). The bone marrow was aspirated from the metaphysis of tibia and injected per-cutaneously at the fracture site. The procedure was carried out mainly as an outpatient procedure and the patients rarely needed admission. Union was observed in 140 (93.33%) cases. The average time of healing after the procedure was 13 weeks (7-19 weeks). The technique of per-cutaneous autologous bone marrow injection provides a very safe, easy and reliable alternative to open bone grafting, especially for the early intervention in fracture healing process.

Key words : Non-union, delayed union, percutaneous, bone marrow.

INTRODUCTION

Bony union is a complex phenomenon bringing together many different processes. At first, osteoblast appear, then callus and finally complete bone tissue is regenerated without any scarring. [1] Cells aspirated from the bone marrow are shown to provide osteogenic stimulus in animal experiments and in clinical evaluation of bone graft and bone substitutes. [2] Despite this osteogenic character, the clinical use of the bone marrow as an osteogenic source has remained limited. The marrow is harvested by needle aspiration from the patient's tibial metaphysis and is then injected percutaneously at the non-union site. This method offers the advantage of treating fracture healing problems without operative exposure of either the donor or recipient site.[3]

Fracture healing is a specialized type of wound healing response in which the regeneration of bone leads to restoration of skeletal integrity. The stages of healing in a fractured bone are:

1. Stage of hematoma.
2. Stage of subperiosteal and endosteal cellular proliferation.
3. Stage of callus formation.
4. Stage of consolidation &
5. Stage of remodeling. [4]

All these stages are not sharply demarcated and 2 or more stages may be seen at the same time in different parts of fractured bone. In most of the fractures, healing occurs at a biologically optimum level. However, in sizeable number

1. Asst. Professor, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka.
2. Junior Consultant (Orthopaedics), MOHFW, Dhaka.
3. Prof. of Orthopaedics & Ex Director, National Institute of Traumatology and Orthpaedic Rehabilitation (NITOR), Dhaka.
4. Prof. of Orthopaedics & Hon'ble Minister, MOHFW, Dhaka

Correspondence: Dr. ABM Golam Faruque, Asst. Professor, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka.

of cases, it is either delayed or impaired. The time at which a given fracture will unite cannot be arbitrarily stated, as different bones heal in variable period of time, depending upon many factors but, as a general rule, delayed union is deemed to be delayed if the fracture fragments are appreciably mobile even 3-4 months after injury. In delayed union there is clinical and radiographic evidence that healing is taking place but it has not advanced at the average rate for the location and type of fracture. [5]

Non union is said to exist only when actual evidence of cellular activity at the fracture site ceases and fracture is not uniting. According to Boyd and Lipinski, diagnosis of non-union is based on the presence of one or more of the following criteria:

- Painless unnatural mobility (false motion),
- A bony defect,
- Sclerosis surrounding the bone ends,
- Obliteration of the medullary canal. [6]

FDA panel has defined non-union as established when a minimum of 9 months have elapsed since injury and the fracture shows no visible progressive signs of healing for the last 3 months. [7]

Autologous bone grafting has been the standard operative method for decades since the work of Chutro and later Phemister and others which involves the operative removal of bone from a donor site, usually pelvis and operative implantation at the site of delayed or non-union. [8] Autologus bone potentially contributes 3 vital components for healing which are osteo-conduction, osteo-induction and osteogensis. [9] But operative harvesting and implantation at the fracture site has not been without complications both at the donor and recipient sites, like painful scar, hematoma, infection, fracture or subluxation,gait disturbances,etc. [10]

Although percutaneous bone marrow injection does not promote healing more rapidly than would standard operative grafting, it has many distinct advantages over the latter. It is safe, easy, practical, and time-saving. It is economical and involves minimal trauma. It avoids donor site problems and can be repeated easily. It can be done under local anesthesia and avoids the risks of generL L I anesthesia, infection and surgery. It can he done in cases which are not fit for open bone grafting because of poor condition of the skin. [11]

Bone marrow is a source of osteoprogenitor cells that are the key elements in the process of bone formation and fracture healing. Bone marrow contains bone morphogenetic protein (BMP), insulin- like growth factors (IGF), transforming growth factor beta (TGF), Acid and basic fibroblast growth factor (FGF) and platelet-derived growth factor (PDGF). It also has the capacity of osteoinduction, osteoconduction and osteogenetic effect. [12]

In this study, the objective was to evaluate the effectiveness of bone marrow in the treatment of non-union and delayed union of long bone.

MATERIALS AND METHODS

This prospective study was carried out from April 2000 to June 2012, in the Department of Orthopaedic Surgery,Bangabandhu Sheikh Mujib Medical University (BSMMU),Dhaka, & National Institute of Traumatology and Orthpaedic Rehabilitation (NITOR), Dhaka and different private hospitals in Dhaka, Bangladesh.

The total number of cases were 150; among which 76 were femur, 41 tibia, 22 humerus, 5 ulna and 6 radius.

OPERATIVE TECHNIQUE

The patient was placed in supine position. Then both the aspiration site as well as the non-union or delayed union site were aseptically prepared. Bone marrow was aspirated from the ipsilateral or contralateral metaphysis of medial side tibia in between upper margin of tibia and tibial spine under spinal anesthesia, general anesthesia or even local anesthesia and sedation and under C-arm, X-ray or manual guidance. Multiple wide bore 14 gauze metallic needles were introduced at different angles in and around the non-union or delayed union site. Then, in the donor site a stab incision with no. 11 surgical blade was given. The bone was drilled with a 2.5 mm drill bit & a wide bore 14 gauze metallic needle was introduced. A 10 cc disposable plastic syringe was connected to the needle & bone marrow was aspirated. About 10cc aspirated marrow was introduced in the recipient site through the 1st needle and the needle was withdrawn .The process was done substantially through the other needles . Usually 40-50cc marrow was introduced in each sitting. We have the experience of taking a maximum of 80cc marrow from a single donor site. The needle of the donor site was withdrawn and the wound was closed without any stitch, just strapping the skin. Oral antibiotics were given for 5 to 7 days. In case of stable fixation, simple dressing was given; but in case of unstable fixation, plaster cast was given.

RESULTS

In this study, a total of 150 cases were included. Among these, 76 (50.67%) were femur, with 41 (27.33%) tibia, 22 (14.67%) humerus, 5 (3.33%) ulna and 6 (4%) radius. The average time duration between the injury and the procedure was 25 weeks (14-53 weeks).

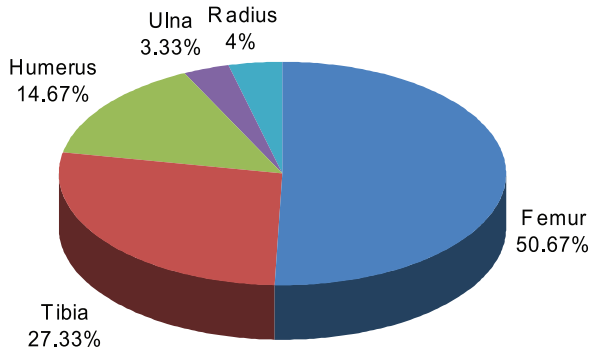


Fig.-1 : *Pie chart of percentage of bones involved*

The mean age of the patients was 31 years, ranging from 19 to 50 years. Among the patients,120 were males with 30 females, with a male female ratio of 4:1.

131 (87.33%) cases were initially closed & remaining 19 (12.67%) were open fractures. Regarding the previous treatment, 35 (23.33%) out of 150 cases were treated conservatively. Among the remaining 115 (76.67%) cases, 47 were previously treated by intra medullary nails (41 femoral shaft fractures by K nails, 3 humerus shaft fractures & 3 radius-ulna fractures by rush nails); 30 cases were treated by intramedullary interlocking nail (26 femur, 4 tibia) ; 26 were treated by plating (6 femur, 7 humerus, 5 tibia & 8 radius-ulna) ; 9 cases by external fixator (7 tibia, 2 femur) and 3 cases were treated by dynamic hip screw.

The average time duration between the injury and the procedure was 25 weeks (14-53 weeks); In 131 (87.33%) cases, the preocedure was performed under C-arm guidance & in remaining 19 (12.67%) cases, it was done under manual guidance. In 79 (52.67%) cases, the procedure had to be given for 2 times, in 35 (23.33%) cases 3 injections, in 5 (3.33%) cases 4 injections & in 31 (20.67%) cases, single attempt of percutaneous bone marrow injection sufficed.

The patients were followed up regularly at 3 months intervals. Till the last follow up, 140 (93.33%) out of 150 cases achieved union both clinically & radiologically. The average time of healing after the procedure was 13 weeks, ranging from 7-19 weeks.

DISCUSSION

Bone marrow contains the osteoprogenitor cells that are important in bone formation and fracture healing. In 1934 , McGaw and Harbin were among the first to demonstrate the osteogenic activity of bone marrow. [13] The work of Paley et al showed that, marrow produces optimal effects when used early in the fracture healing process, with the poorest results encountered when used in the treatment of non-unions. [14] Successful results in our patients agrees with the result obtained by Connolly et al[15] and Garg et al, [11] who used percutaneous autogenous bone marrow grafting to achieve the healing of non-unions.

Regarding the outcome, a study by Goel revealed clinical and radiological bone union following percutanous injection of bone marrow in 15 out of 20 patients (75%), with an average time to union following the first injection of 14 weeks. The study concluded that percutanous bone marrow grafting is a safe, simple, and reliable method of treating tibial non-union with minimal deformity. [16] In a study by Vergava, 28 patients with delayed union and three with nonunion of fracture of the long bones were treated with this procedure. The average time duration between procedure and injury was 25 weeks. The bone marrow was aspirated from the anterior iliac crest and injected percutaneously at the fracture site. Union was observed in 23 cases. The average time of healing after the procedure was 12 weeks (range 7-18 weeks). [17]

In another study by Ma in 2009, 29 consecutive cases of fractures nonunion were treated with percutaneous autologous bone marrow grafting included 20 males and 9 females; All the cases were performed 3 times injection, the interval was 1 month. 25 cases obtained bone union during 3 to 8 months with an average of 4.5 months. [18]

In this study on 150 cases, 140 (93.33%) out of 150 cases achieved union both clinically & radiologically. The average time of healing after the procedure was 13 weeks, ranging from 7-19 weeks.

Although percutaneous bone marrow injection does not promote healing more rapidly than would standard operative grafting do, it has many advantages over the open bone grafting. It is a relatively simple technique, minimally invasive, can be done as a day case and therefore is cost effective. The complications both at the donor and recipient sites is minimum , simple pain for 1 or 2 weeks.It can be done in cases that are not fit for open bone grafting because of poor skin conditions, and can be repeated easily. In the future as stimulatory growth factors become available, the osteogenic effectiveness by injecting it together with this factors is expected to be enhanced.

An injectable preparation that combines marrow with osteoinductive agents should virtually eliminate the need for open harvesting and operative grafting as well as the problems associated with fracture healing.

CONCLUSION

The technique of percutaneous autologous bone marrow injection provides a very safe, easy and reliable alternative to open bone grafting, especially for early intervention in fracture healing process.

REFERENCES

1. Hernigou P, Poignard A, Manicom O, Mathieu G, Rouard H, The use of percutaneous autologous bone marrow transplantation in nonunion and avascular necrosis of bone, *J Bone Joint Surg (Br)* 2005, 87-B:896-902
2. Beresford JN , Osteogenic stem cells and stromal system of bone and marrow, *Clin Orthop Relat Res* 1989; 240 : 270 – 9
3. Burwell RG , The function of bone marrow in the incorporation of a bone graft, *Clin Orthop Relat Res* 1985 ; 200 : 125 -41
4. Padha V, Mahajan N, Kalsotra N, Salaria A, Sharma S, Role of Percutaneous Bone Marrow Injection In Delayed Union & Non Union , *The Internet Journal of Orthopaedic Surgery*, 2010, vol 18, no 1
5. Healy JH, Zimmerman PA, McDonnel JM. Percutaneous bone marrow grafting of delayed union and non-union in cancer patients. *Clin Orthop Relat Res* 1990; 256; 281-5.
6. Peterson DC, Lewis G. Treatment of delayed union and nonunion with an implanted direct current stimulator. *Ciin Orthop Relat Res* 1980; 148: 117-28.
7. Campbell MC. Onlay bone graft for ununited fracture. *Arch Surg* 1939; 38: 313-27.
8. Phemister DB. Treatment of ununited fracture by only bone graft without screw or tie fixation and without breaking down of the fibrous union. *J Bone Joint Surg* 1947 ; 29 946-60.
9. Turek S, Orthopaedics, The principle and application, 4th ed, 2004, 50-67
10. Forbes DB. Subcortical iliac bone grafts in fracture of the tibia. *J Bone Joint Surg (Br)* 1961; 43: 672-9.
11. Garg NK, Gaur S, Sharma S. Percutaneous autogenous bone marrow grafting in 20 cases of ununited fractures. *Acta Orthop Scand* 1993; 6: 671-2.
12. Gray. JC, Elves MW. Early osteogenesis in compact bone isografts. A quantitative study of the contributors of the different graft cells. *Clacif Tissue Int* 1979; 29: 225-30
13. McGaw WH, Harbin M. The role of bone marrow and endostium in bone regeneration. An experimental study of bone marrow and endosteal transplants. *J Bone Joint Surg* 1934; 14: 816-21.
14. Paley D, Yound MC, Wiley AM et al. Percutaneous bone marrow grafting of fractures and bony defects. An experimental study in rabbits. *Clin Orthop Relat Res* 1986; 208: 300-12
15. Connolly J, Guse R, Lippiello L, Dehne R, Development of osteogenic bone-marrow preparation, *J Bone Joint Surg (Am)* 1989 ; 71: 684-91
16. Goel A, Sangwan SS, Siwach RC, Ali AM, Percutaneous bone marrow grafting for the treatment of tibial non-union. *Injury* 2005 Jan;36(1):203-6.
17. Bhagava R, Sankhla SS, Gupta A, Changani RL, Gagal KC, Percutaneous autologus bone marrow injection in the treatment of delayed or nonunion, *Indian J Orthop.* 2007 Jan-Mar; 41(1): 67–71.
18. Ma JT , Yu M , Zhang MChu XJ , Xu HY , Liang GJ , Clinical observation on percutaneous autologous bone marrow grafting for treatment of fracture nonunion , Zhongguo Gu Shang, 2009 Jan;36(1):203-6.

Original Article

Biar's Block Anesthesia for Below Elbow Surgery, Using Tourniquet in Arm and Forearm – Analysis of 824 Cases in One Centre

Alam ASMM[1], Haque F[2], Chakrabarty A[3], Chowdhury AKMA[4], Nuruzzaman M[5]

ABSTRACT

The goal of the study was to investigate the regional intravenous anesthesia procedure in upper limb surgery and to evaluate the effects of lidocain anesthesia block and comparison of occurrence of tourniquet pain ,complications ,need of added anesthetics between the two group(tourniquet applied in arm and forearm). 824 patients who had surgery below the elbow were enrolled. We took those cases in which procedures were supposed to be completed within one hour. After monitoring, a peripheral IV line was inserted. The venous blood in the upper extremity was evacuated with a tourniquet, and the proximal cuff (BP machine) was inflated. Then 10ml 1% lidocain injected, after 4-5minutes 2nd tourniquet was applied distally in arm/Forearm and another 10-20 ml lidocain was injected. The patients were randomly split into two groups, according to the type of surgery- a) tourniquet in arm b) tourniquet in forearm. We recorded onset time of the sensory block, end time of the sensory block, the time when the patient verbally reported tourniquet pain and surgical pain, duration of tourniquet tolerance, operative time, hemodynamic parameters, name of surgery, patient's age and sex. Out of 824 patient , 237 were female and rest 587 were Male. The patient's age was ranging from 17 to 76 year (mean 41.3 years). Distal Tourniquet was applied in Lower arm in 369 patient, and in rest of 455 patient tourniquet was applied in upper forearm. Additional medication were required in 73 cases. Minor complications were felt by the patient in 87 cases. Complications were more in patients with tourniquet in upper forearm. In 298 (36.17%) patients tourniquet pain was felt after 45 minutes. Regarding presence of complication in both group of patient(p< .05) the difference between two group was significant. But difference in frequency of feeling tourniquet pain and need of additional anesthetics between two group of patients were in significant(p> 0.05). No clinically significant morbidity or mortality as a consequence of lidocaine Bier's block was demonstrated in this study. Distal tourniquet can be use in forearm ,although minor complication is more than arm group. It is a safe, easy and cheaper way of anesthesia for procedure's require less than one hour.

INTRODUCTION

Regional intravenous anesthesia (RIVA) was first described by Bier in 1908 and gained popularity following modifications made by Holmes in 1963.[1] The most important advantages of using the technique are that it's easy-to-apply, reliable, and cost-effective.[2] It has gained wide popularity in upper extremity surgery due to its reported success rates of between 94-98%[2].

IVRA is easy to perform and the only necessary technical skill is inserting an intravenous (IV) cannula. Traditionally,

1. Assistant professor (Orthopaedics)OSD,DGHS,Dhaka
2. Medical Officer, INM & Ultrasound, BSMMU campus,Dhaka
3. SMO, Anesthesia department,Dhaka Community Hospital.
4. Junior Consultant(Ortho),THC Gazaria,Munshiganj.
5. Junior Consultant(Ortho),THC Sakhipur,Tangail.

Corespondance: Dr. Abu Saleh Mohammed Monirul Alam, Assistant professor (Orthopaedics), H-1, Flat 10/A, Genetic Huq Garden, Ring Road, Shyamoli, Dhaka 1207, E-mail: asmmalam@yahoo.com

an upper arm tourniquet has been used for these procedures. However, the recommended doses of local anesthetics for upper arm IVRA do have the potential risk of systemic toxicity[4,5]. Forearm IVRA, however, allows the dose of local anesthetic to be decreased by up to 50% without affecting the quality of analgesia[6,7]. In addition, the forearm tourniquet can be tolerated longer and was consistently rated as less painful when compared with the upper arm tourniquet [8]. IVRA may be used to provide anesthesia for surgery involving both the upper and lower extremities. The need for supplemental medication is ordinarily minimal, so the technique is particularly suitable for short procedures in an ambulatory surgery centre. Yet, prolonged surgery may be performed using a "continuous technique." Although various local anesthetic agents may be used to induce IVRA no drug has been demonstrated to be superior to lidocaine.[9] Bier block can also be used in the emergency department (ED) to provide rapid and complete anesthesia, as well as muscle relaxation and a bloodless operating field.[11–14]

Methods of anesthesia and analgesia for upper-extremity injuries requiring reduction include hematoma block, nerve block, Bier block, IV procedural sedation, and general anesthesia. Although Bier block has many advantages and is likely commonly used, there are limited studies describing the ED or outpatient application of this technique. Bier block has been shown to be effective when used by pediatric orthopedic surgeons in the ED management of children's upper-extremity fractures.[11–13] The "mini-dose" Bier block technique (lidocaine 1.5 mg/kg), using a simple blood pressure cuff and cross-clamp tourniquet technique, has been demonstrated to be safe when used by emergency physicians to perform closed reduction of upper-extremity fractures and dislocations.[14]

Bier block is very useful for procedures lasting less than 60 minutes involving the extremities. It avoids the need for general anesthesia or procedural sedation in patients with full stomachs or complex medical problems. Bier block can be used to reduce fractures or dislocations, remove foreign bodies, incise and drain abscesses, and débride burns. [15]

MATERIALS AND METHOD

This was a prospective randomized study done on the patient. The study was done in Dhaka Community Hospital. The data was collected from patient's record file of Hospital. Study period was between January 2006 to December 2012. Most of the procedure were done as Day case surgery and patient discharged after 2 hour of surgery. We selected those cases in which procedures were supposed to be completed within one hour. In all cases inflated BP machine was used as first tourniquet, and second rubber tourniquet was applied distally either in fore-arm or in lower arm according to site of surgery. Previously tourniquet was use only in arm, now a days in many centre distal tourniquet is applied in forearm , to reduce the anesthesia drug dose.

Fig.-1: *Evacuation of Blood from forearm.*

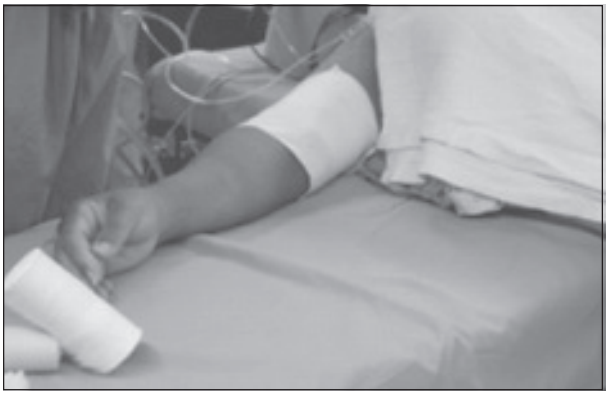


Fig.-2: *Application of torniquate.*

Procedure: Before beginning to perform the block, the patient's blood pressure should be measured. An intravenous cannula is then inserted in a distal vein in the limb . It is good practice to place a cannula in another limb. The tourniquet is then applied to the upper arm. The limb is exsanguinated (blood removed) before the tourniquet is inflated. Traditionally, this is done by tightly wrapping the distal part of the limb with an Esmarch rubber bandage, before inflating the tourniquet . If this procedure cause pain(in case of Fracture bone), then simply elevate the arm for 20-30 seconds. This will allow venous blood to drain from the limb & preventing further arterial blood entering. The Blood pressure machine is then inflated to a pressure of 50mm Hg or more above the patient's systolic blood pressure. local anesthetic solution(1% Lidocain) is then slowly injected , patient warned that the limb may start to feel hot and that the skin will take on a mottled

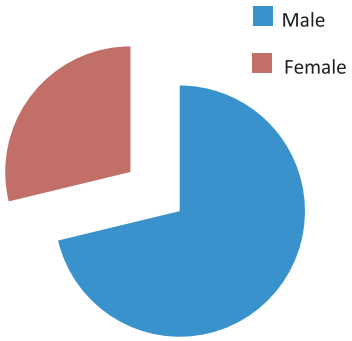
appearance. Analgesia will occur within 3-4 minutes and another tourniquet was applied distal to BP machine (which act as a tourniquet) in arm or forearm. Then surgery could be commenced. Second (Distal) tourniquet was remove at least after 30 minutes of 1% Lidocain injection. After deflation of 2nd tourniquets, a pain killer Injection(Diclofenac/Ketorolac) was given to every patient.

RESULT

Out of 824 patient , 237 were female and rest 587 were Male. The patient's age was ranging from 17 to 76 year (mean 41.3 years).

Distal Tourniquet was applied in Lower arm in 369 patient, and in rest of 455 patient tourniquets was applied in upper forearm. Additional medication were required in 73 cases to complete the procedure due to tourniquet pain and due to lack of anesthesia effect. In 808 cases (98.06%), procedure could be completed within one hour.

Minor complications were felt by the patient in 87 cases. No major complications were encountered. Complications were more in patients with tourniquet in upper forearm. In 298 (36.17%) patients tourniquet pain was felt after 45 minutes.



Pie Chart 1 : *Sex distribution.*

Table 1

Data regarding duration of surgery, Tourniquet pain time, complication, needs for aditional medication.

Position of 2nd Torniquate	Duration of Procedure less than 30 min.	Duration of Procedure between 30 -59 min.	Duration of Procedure more than 60 min.	Tourniquet pain felt before 30 min.	Tourniquet pain felt between 30 -45 min.	Tourniquet pain felt after 45 min.	Complication Found	Additional medication require for complete the procedure
1.Lower arm	45	312	12	08	52	106	24	28
2.Upper Forearm	156	295	04	21	85	192	63	45
Total	201	607	16	29	137	298	87	73

Table II

Showing Presence of tourniquet pain in both group of patients

Tourniquet Pain	Lower Arm tourniquet	Upper Fore-arm tourniquet	Total case
Present	166	198	364
Absent	203	257	460
Total	369	455	824

X^2 value, 0.18, df = 1, So p> .05, the difference between two group is not significant.

Table III

Showing presence of complication in both group of patient

Complication	Lower Arm tourniquet	Upper Fore-arm tourniquet	Total case
Present	24	63	87
Absent	345	392	737
Total	369	455	824

X^2 value, 11.63, df = 1, So p< .05, the difference between two group is significant.

Table IV

Showing need for additional medication in both group of patient

Tourniquet Pain	Lower Arm tourniquet	Upper Fore-arm tourniquet	Total case
Present	28	45	73
Absent	341	410	751
Total	369	455	824

X^2 value, 1.34, df = 1, So p> .05, the difference between two group is not significant.

COMPLICATION

In our study very few complication related to Lidocain toxicity was found. In no case anaphylaxis was seen. Perioral numbness in 14 patients, Bradycardia in 24 case, Tinnitus in 6 patient, Feeling faint (without arrhythmia or hypotension) in 12cases, and dizziness in 23 patients. Transient Hypotension in 3 cases. These complications required no intervention besides assurance. These are better to call side effects than complication.

Twelve of these complications occurred while the cuff was fully inflated, the remaining 75 occurred shortly after the cuff was deflated.

DISCUSSION

Tourniquet pain is a common complain from the patient's in Bier's block anesthesia. Less than half (44.17%) of patient feel pain at certain time of procedure in our series. The onset of tourniquet pain was almost same between two group of patients. The difference was not significant (X^2 test value 0.179,df 1, p>.05).

In this series tourniquet pain was felt before 30 minutes in 29 cases. But require additional drug (Ketamine Inj,) for complete the procedure in 73 cases. Patient felt pain in surgical site in some cases and need additional drug of anesthesia. The number of cases require additional anesthetic drug were 28 and 45 respectively in lower arm and upper forearm group. The difference of outcome between the two group was insignificant(x^2 test value 1.34, df 1, p>.05).

However, this technique was unpopular in the past because it was thought that "compression forces of an inflated forearm tourniquet cannot obliterate the anterior and posterior interosseous arteries seated in the deep 'valley' between the prominent radius and ulna"[9]. It was therefore assumed that tourniquet leakage was inevitable, thus increasing the possibility of local anesthetic toxicity and block failure. A quantitative study showed that forearm IVRA results in tourniquet leakage comparable with upper arm IVRA[10]. In our study only few patient's has shown minor complications and no serious anaphylaxis or any other morbidity. Regarding complication the outcome was significant between two group (X^2 test value, df 1, p < .05). Minor complications were significantly more encountered in Forearm tourniquet group.

In the large series of Mohr et al, they found Bier block was an extremely safe and effective technique for the management of forearm injuries by primary care physicians in an outpatient diagnostic and treatment facility. Over a 5-year period they found no cases of mortality or serious morbidity attributable to the Bier block procedure.[15] Significantly, over a period of 20 years, Brown et al observe no mortality or major morbidity. The incidence of adverse reactions was 1.6 per cent and consisted of minor events such as transient dizziness, tinnitus or mild bradycardia.[16]There were no reports of anaphylaxis, convulsions, hypotensive episodes requiring medical intervention, significant arrhythmias, collapse or death resulting from the use of lidocaine Bier's block in this retrospective study.[17]

The risk mainly comes from an inadequate tourniquet application or equipment failure at the beginning of the procedure. These can be avoided by following precautions:

- Every precaution should be undertaken to ensure that the tourniquet is reliable and the pressure is maintained
- Gradually release the tourniquet in two steps to prevent a massive "washout" of local anesthetic
- When the surgical procedure is completed, within 20 minutes after injection of local anesthetic, gradually release the tourniquet in several steps, with 2-minute intervals between deflations.[2]

The advantages of a Bier block include that it is easy to perform, is not dependent on knowledge of peripheral nerve anatomy, requires minimal personnel, avoids the potential side effects of general anesthesia and systemic sedation, and provides rapid and complete anesthesia, muscle relaxation, and a bloodless field[18]. Bier's block is superior to hematoma block in terms of efficacy, radiological result, and re-manipulation rate; transit times are equal, both procedures are practical in the A&E environment, and there were no complications[19].

CONCLUSION

For below elbow hand surgery , procedure which usually require less than 60 minutes time can be perform under Bier's block anesthesia. No matter whether distal tourniquet is use in arm or forearm . The incidence of adverse reactions less and consisted of minor events such as transient dizziness, tinnitus, peri-oral anesthesia or mild bradycardia. Our recommendation is use tourniquet in lower arm , so we can avoid the minor complications. Only disadvantages is ,in few cases (3.64% in this study) early tourniquet pain occur which need additional medication. It is easy, safe and less hazardous anesthesia procedure .

REFERENCES

1. Hilgenhurst G. The Bier block after 80 years: a historical review. Reg Anesthesia. 1990;15:2-5.
2. Casey WF. Intravenous regional anaesthesia (Bier's block). Update Anaesthesia 1992;1:1-3. Available: www.nda.ox.ac.uk/wfsa/html/u01/u01_003.htm(accessed 2006 May 30).
3. Chilvers CR, Kinahan A, Vaghadia H, Merrick PM. Pharmacoeconomics of intravenous regional anaesthesia vs general anaesthesia for outpatient hand surgery. Can J Anaesth. 1997;44:1152-6.
4. Heath m: Deaths after intravenous regional anaesthesia. *British Medical Journal*; 1982, 285:913-4.

5. Auroy Y, Narchi P, Messiah A,: Serious complications related to regional anesthesia: results of a prospective survey in France. *Anesthesiology*; 1997, 87:479-86.

6. Chan CS, Pun WK, Chan YM, Chow SP: Intranvenous regional analgesia with a forearm tourniquet. *Can J Anaesth*; 1987, 34:21-5.

7. Rousso M, Drexler H, Vatashsky E, et al: Low i.v. regional analgesia with bupivacaine for hand surgery. *Br J Anaesth*; 1981, 53:841-4.

8. Ng ES, Ting JR, Foo SL, Akram SA, Fadzlina AA, Alywiah JS, Ahmad TS: The comparison of discomfort level between upper arm and forearm tourniquet. *Med J Malaysia*; 2006, 61 Suppl B:23-6-8.

9. Cotev S, Robin GC: Experimental studies on intravenous regional anaesthesia using radioactive lignocaine. *Br J Anaesth*; 1966, 38:936-9.

10. Coleman MM, Peng PW, Regan JM, et al: Quantitative Comparison of Leakage Under the Tourniquet in Forearm Versus Conventional Intravenous Regional Anesthesia. *Anesth Analg*; 1999, 89:1482-6.

11. Olney BW, Lugg PC, Turner PL, et al. Outpatient treatment of upper extremity injuries in childhood using intravenous regional anesthesia. *J Pediatr Orthop* 1988;8:576-9.

12. Bolte RG, Stevens PM, Scott SM, et al. Mini-dose Bier block intravenous regional anesthesia in the emergency department treatment of pediatric upper-extremity fractures. *J Pediatr Orthop* 1994;14:534-7.

13. Blasier RD, White R. Intravenous regional anesthesia for management of children's extremity fractures in the emergency department. Pediatr Emerg Care 1996;12:404-6.

14. Farrell RG, Swanson SL, Walter JR. Safe and effective regional anesthesia for use in the emergency department. Ann Emerg Med 1985;14:239-43.

15. Bruce Mohr, MD Whistler Health Care Centre, Whistler,Safety and effectiveness of intravenous regional anesthesia (Bier block) for outpatient management of forearm trauma EM Advances BC *CJEM* 2006;8(4): 247-250

16. Brown EM, McGriff JT, Malinowski RW. Intravenous regional anaesthesia (Bier block): review of 20 years' experience. *Can J Anaesth.* 1989 May;36(3 Pt 1):307-10.

17. Nicola Jakeman1, Philip Kaye1, James Hayward2, David P Watson1, Stacy Turner :Is lidocaine Bier's block safe? Author Affiliations[1]Emergency Department, Royal United Hospital, Bath, UK [2]Bristol Medical School, Bristol, UK Published Online First 23 May 2012 .

18. Kristi L. Koenig*, MD, FACEP* Bier Block for Upper-Extremity Anesthesia Journal Watch Emergency Medicine *August 4, 2006*

19. J M Kendall, P Allen, P Younge, S M Meek,S E McCabe Haematoma block or Bier's block for Colles' fracture reduction in the accident and emergency department—which is best? *J Accid Emerg Med 1997;14:352-356 doi:10.1136/emj.14.6.352*

Original Article

Functional Outcome In Patients with Delayed Secondary Repair of Zone V Flexor Tendon Injury

Syed Shamsul Arefin[1], K M Rafiqul Islam[2], Mohammad Serajus Saleheen[3], Md. Motiur Rahman[4], Anup Mostafa[5], Shah Muhammad Aman Ullah[6], Md. Golam Sarwar[7], R.R. Kairy[8]

ABSTRACT

Flexor tendon injury is one of the most common hand injuries. Zone-V flexor tendon injuries may involve major nerves and arteries as well as the wrist and finger flexors. Although these injuries are not infrequent, few studies have reported functional outcomes. The purpose of this study is to evaluate functional outcome of hand after delayed secondary repair of flexor tendon at zone-V. This prospective study was conducted at National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka from July 2009 to June 2011. A total 18 patients with repaired zone v flexor tendon injuries were enrolled in this study and they followed up for an average of 6.8 months, range 5 to 11 months. Functional results were excellent in 33.3%, good in 50.0%, fair in 11.1% and poor in 5.6%. The result of wrist was 33.3% excellent, 50.0% good, 11.1% fair and 5.6% poor. In digit 24.6% excellent, 54.1% were good, 13.1% were fair and 8.2% were poor. Nearly eighty percent (77.8%) of the patients returned to their original occupations. In final outcome satisfactory (excellent plus good) result was found 83.3% and unsatisfactory (fair and poor) 16.7%.Satisfactory functional results can be obtained when proper surgical technique is coupled with careful postoperative management in patients with zone-v flexor tendon injuries.

INTRODUCTION

The hand and wrist are structures which play a very important role in performing activities of daily living independently. While the hand is the most active part of the upper limb, it is also the least protected one[12]. As a result, the incidence of hand injuries is quite high, and flexor tendons are commonly affected[19].

Flexor tendon injury is one of the most common hand injuries. It often occurs in young individuals in the prime of their lives. Partial tendon injury can be difficult to diagnose. Prolong disability following such an injury can result in physical and emotional suffering and socioeconomic disaster for the patient [1,2,5] .Based on the anatomy of the fibrous sheath and the insertion of the flexor digitorum profundus and superficialis, the palmar aspect of the digits and hand are divided in five zones. Zone V extends from the proximal border of the transverse carpal ligament to the musculotendinous junctions of the flexor tendon. Injuries in this zone may involve the median and ulnar nerves, radial and ulnar arteries, as well as the wrist and finger flexors[5,6,7].

Flexor tendon injury at zone V has been labeled "spaghetti wrist", "suicide wrist" and "full house syndrome" by various authors. Because zone V is proximal to the transverse carpal ligament tendon, gliding after repair usually is better here than in more distal zone[11,12,21].

1. Jr. Consultant of Orthopaedics, Upzilla Health Complex, Gabtoli, Bogra.
2. Research Assistant, Dept. of Orthopaedics, BSMMU.
3. Clinical Assistant, NITOR.
4. Jr. Consultant, NITOR.
5. Lecturer, Dept. of Anatomy, Comilla Medical College.
6. Medical Officer, Dept. Of Burn & Plastic Surgery, DMCH.
7. Assistant Professor , NITOR.
8. Professor (Rtd.), NITOR.

Correspondence to: Dr. Syed Shamsul Arefin, Jr. Consultant of Orthopaedics, Upzilla Health Complex, Gabtoli, Bogra, Cell: 01712512371

Until the advent of early mobilization of flexor tendon repairs, it was believe that repair of divided flexor digitorum superficialis (FDS) tendons following wrist lacerations in which both superficialis and deep digital flexor tendons had been divided caused adhesions with limitation of excursion of the associated fingers[6,15].

Repair of all divided flexor tendons in zone-5 has been encouraged because of the contributions of the FDS tendons to grip strength, their action in making pinch and flexion of the proximal interphalangeal (PIP) joint more stable and their effect in providing superior individual finger flexion [12,14,15]. Primary treatment with restoration of normal anatomy in a single operation is required to achieve the best possible outcome. Delayed repair in any zone may be necessary in the face of severe wound contamination, crushing or avulsing injuries, soft tissue loss, multiple comminuted fractures or lack of available surgical skill[13,14].

Delayed repairs of tendons are responsible also if other injuries required immediate surgery. In such circumstances, a patient's condition might not permit definitive management of tendons and nerves and it is appropriate to clean the limb as well as possible and close the wound or leave it open but covered with sterile bandage and splint. Prolong delay may permit unacceptable retraction of tendons and nerves especially in zones III, IV and V[20,21].

Adhesion formation may occur, causing gliding impairment of tendons if not properly handled and repaired. The zone-2 is also important as two tendons (Flexor digitorum superficialis and Profundus) pass through the same fibro osseous sheath system of fingers except the thumb which has only one tendon (Flexor pollicis longus) [3,4,21].Adhesion formation that prevents the tendon from gliding is the most frequent cause of failure after flexor tendon repair[8,9,10] . Tendon injuries in zone V commonly become markedly adherent to overlying skin and fascia, but these adhesions generally are not problematic because adhesions form between the tendon and paratenon. Because the paratenon is a loose connective tissue, adhesions are not as restrictive as those that form between tendons and the firm, well-anchored flexor retinaculum or fibro osseous tunnel [16].

In recent years, a tremendous amount of basic research has been conducted in an effort to better understand the structure of tendons, the kinesiology of their function, the biomechanics of their action at the joints they move, their biologic response to injury and repair, and the effect of post-repair motion stress on tendon strength and healing. These investigative efforts have given rise to improve methods of tendon repair, a great emphasis on flexor sheath preservation and restoration, and protocols for the early application of passive and active wrist and digital motion as a means to more rapidly increase the strength and gliding of repaired tendons. A review of the most relevant research is critical to understanding the rationale for the current clinical approaches to flexor tendon repair and rehabilitation.[17,18]

METHODOLOGY

This clinical study was conducted from July, 2009 to2011at National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka. Purposive sampling was done according to availability of the patients and strictly considering the inclusion and exclusion criteria. A total 18 number of cases were selected for this study. Inclusion criterias are: a. Age of the patients : 6 years and above, b. Flexor tendon injury at zone-V, c. Time since injury : 3 weeks to 12 weeks. Exclusion criterias are: a. Flexor tendon injury associated with fracture radius or ulna or both, b. Flexor tendon injury with infected wound.

OBSERVATIONS AND RESULTS

After an average of 6.8 months with range from 5 to 11 months follow up the following findings were compiled.

Table-I

Age distribution of the study patients

Age in years	Number of patient (n=18)	Percentage
<10	1	5.6
11-20	6	33.3
21-30	7	38.9
>30	4	22.2
Mean± SD	24.1	±8.6
Range(min-max)	(6-40)	

Table I shows distribution of patients by age. In this study the highest number of patients 7(38.9%) were observed in 21-30 years and lowest number 1(5.6%) patients was observed in <10 years. The mean age was 24.18.6 years with range from 6 to 40 years.

Out of 18 patients, male was found 16(88.9%) and female was found 2(11.1%).

According to occupation status of the patients it was found that 6(33.3%) were business, 5(27.8%) student, 2(11.1%) farmer, 2(11.1%) housewife and 3(16.7%) were service holder.

According to the diagnosis distribution of the study patients, regarding tendon injury, FDS+FDP were found 15(83.3%), 1(5.6%) FDP only, 5(27.8%) FPL, 1(5.6%) FCR, 2(11.1%) FCU.

Regarding associated injury, MN+UN were found 8(44.4%), 3(16.7%) MN only, 4(22.2%) UN only and 3(16.7%) had no associated injury.

Regarding the time since injury it was observed that 2(11.2%) patients in 3-4 weeks, 8(44.4%) were observed in 5-8 weeks and 8(44.4%) patients were observed in 9-12 weeks. The mean time since injury was 8.4±3.0 with range (3-12) weeks.

According to study population, it was observed that 8(44.4%) patients were left hand injured 10(55.6%) patients were right hand injured.

According to the cause of injury of the study patients it was found that 11(61.1%) by glass cut, 5(27.8%) by knife and 2(11.1%) by machineries.

Table-II

Distribution of the study patient according to comparative grip strength (Pre-operative)

Comparative grip strength (Pre-operative)	Number of patient (n=18)	Percentage
Impaired	4	22.2
Absent	14	77.8

The above table shows the pre-operative comparative grip strength of study patients. Comparative grip strength (pre-operative) was found absent 14(77.8%) and impaired in 4(22.2%).

Table III

Distribution of the study patient according to comparative grip strength (Post-operative)

Comparative grip strength (Post-operative)	Number of patient (n=18)	Percentage
20%-30%	2	11.1
31%-50%	7	38.9
51%-70%	3	16.7
>70%	5	27.8
Absent (0%)	1	5.6

The above table shows the comparative grip strength (post-operative) of the affected hand in the study patients. Comparative grip strength (post-operative) was found in 2(11.1%) patients within 20%-30% of normal hand grip, in 7(38.9%) patients within 31%-50%, 3(16.7%) within 51%-70% and 5(27.8%) were found >70%. Only 1(5.6%) failed to recover grip strength due to severe adhesion.

Table-IV

Distribution of the study patient according to functional outcome

Result	Number of patient (n=18)	Percentage
Excellent	6	33.3
Good	9	50.0
Fair	2	11.1
Poor	1	5.6

The above table shows the result of the study patients. 6(33.3%) were excellent, 9(50.0%) were good, 2(11.1%) were fair and 1(5.6%) were poor.

Table V

Distribution of the study patient according to functional outcome of wrist and digit.

Result	Wrist (n=18)		Digit (n=61)	
	n	%	n	%
Excellent	6	33.3	15	24.6
Good	9	50.0	33	54.1
Fair	2	11.1	8	13.1
Poor	1	5.6	5	8.2

The above table shows the result of wrist of patients and found that 6(33.3%) were excellent, 9(50.0%) were good, 2(11.1%) were fair and 1(5.6%) were poor. In digit 15(24.6%) were excellent, 33(54.1%) were good, 8(13.1%) were fair and 5(8.2%) were poor.

Table VI

Final functional outcome of the study patient.

Result	Wrist(n=18)		Digit(n=61)	
	n	%	n	%
Satisfactory (Excellent + good)	15	83.3	48	78.7
Unsatisfactory (Fair + poor)	3	16.7	13	21.3

The above table shows the final outcome of the study patients. According to the wrist 15(83.3%) were

satisfactory and 3(16.7%) were unsatisfactory and according to digit 48(78.7%) were satisfactory and 13(21.3%) were unsatisfactory.

DISCUSSION

This prospective study was carried out with an objective to evaluate the functional outcome of hand after delayed secondary repair of flexor tendon at zone-V. A total of 18 patients with flexor tendon injury at zone-V within 3 weeks to 12 weeks of incidence were enrolled in this study, admitted and attended in hand clinic, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) during the period from July-2009 to June-2011.

In this present study it was observed that most (38.9%) of the study age belonged to 3rd decade followed by 33.3% in the 2nd decade, 22.2% in the 4th decade and only 5.6% observed in 1st decade. The mean age was 24.1±8.6 years with range from 6 to 40 years.

In this present study it was observed that male and female patients were 88.9% and 11.1% respectively and male female ratio was 8:1, which indicates that male was predominant in this study.In this present study it was observed that one third of the injured patients were businessman, followed by 27.8% student, 16.7% service holder, 11.1% farmer and 11.1% housewife.

Regarding the diagnosis of the patients it was observed that FDS+FDP 83.3%, FDP 5.6%, FPL 27.8%, FCR 5.6%, FCU 11.1%. Regarding the associated injury it was observed that MN+UN were 44.4%, MN only 16.7%, UN only 22.2% and no never injury was 16.7%.

In this present study it was observed that average number of structures per wrist were injured 8, tendon 6 range from 1 to 11 and nerves 1 range from 1 to 2.

In this present study it was observed that the most common finger involvement were middle, ring and little, which were 23.0%, 24.6% and 15(24.6%) respectively. Only 8.2% thumb involvement was found in this current study.

Regarding the age of injury it was observed in this present study that most of the patients age of injury was more than 4 weeks, 11.2% patients in 3-4 weeks, 44.4% observed in 5-8 weeks, 44.4% patients were observed in 9-12 weeks, and mean age of injury was 8.4±3.0 weeks with range from 3 to 12 weeks.

In this current study it was observed that all patients were right hand dominant and found most (55.6%) of the injured hand was right and 44.4% left.

Regarding the cause of injury it was observed in this present study that 61.1% by glass cut, 27.8% by knife and 11.1% by machineries. In this current study it was observed that comparative grip strength was absent 77.8% and impaired 22.2% during preoperative period. The grip strength in the affected hands were varied from 0% to 85% of normal hand grip during the post operative period and found average grip strength was 56.1% in this study. Most (38.9%) of the studied patients had recovered hand grip 31%-50% of normal hand grip, 27.8% patients recovered >70%, 16.7% patients recovered 51-70%, 11.1% patients recovered 20% – 30% and one patient could not recovered grip strength at all.

In this current study it was observed that 77.8% patients return to previous work. In a study Rogers et al.[18] reported 87.5% returned to their previous work. Regarding the complications it was observed in this current series that no infection was found in this study patient but 2 patients developed skin slough out, 1 patient recovered by secondary healing and 1 patient underwent groin flap.

In this current study it was observed that the average follow-up duration was 6.8 months with range from 5 months to 11 months and most (55.5%) of patients came to follow-up up to 6 months and rest 45.5% more than 6 months follow-up.

Functional outcome was 33.3% were excellent, 50.0% were good, 11.1% were fair and 5.6% poor. Regarding the result of wrist of the present study patients it was found that 33.3% excellent, 50.0% good, 11.1% fair and 5.6% poor. In digit 24.6% excellent, 54.1% were good, 13.1% were fair and 8.2% were poor. In this present study it was observed that satisfactory (excellent plus good) result was found 83.3% and unsatisfactory (fair and poor) 16.7%.

CONCLUSION

The superficial location of tendons, nerves and vessels at zone V put these structures in jeopardy with any penetrating injury. The problems associated with management are primarily related to basic anatomic structure. There is no conservative treatment of flexor tendon injury. So the establishment of anatomic integrity is the treatment of choice. Satisfactory functional results can be obtained when proper surgical technique is coupled with careful postoperative management in patients with zone-v flexor tendon injuries.

REFERENCES

1. Adamson, JE, Wilson, JN 1961, 'The history of flexor tendon grafting', *J Bone Joint Surg,* vol 43-A , pp. 709-16.

2. Ahmad, M, Hussain, SS, Tariq, F, Rafiq, Z, Khan, MI, Malik, SA 2007, 'Flexor tendon injuries of hand: experience

at Pakistan Institute Medical Sciences, Islamabad, Pakistan' *J Ayub Med Coll Abbottabad,* vol.19, no.1, pp.6-9.

3. Baker, DS, Gaul, S, Williams,VK, Graves, M 1981, 'The little finger superficialis clinical investigation of its anatomic and functional shortcomings' *Journal of hand Surgery,* vol. 6, pp. 374-78.

4. Bircan C, Ozlem EI, Akalin E, Bacakoglu AK, Gulbahar S, Sahin E, Ozkan M, Kizil R, 2005, 'Functional outcome in patients with zone v flexor tendon injuries'*Arch Orthop Trauma Surg,* vol. 125, pp. 405-409.

5. Boyes, JH, Stark, HH 1971 'Flexor tendon grafts in fingers and thumb', *J Bone Joint Surg,* vol. 53-A, pp. 1332-42.

6. Carroll, RE, Match, RM 1974 'Common errors in the management of wrist lacerations' *Journal of Trauma,* vol.14, pp. 553-62.

7. Chan, TK, Ho, CO, Lee, WK, Fung, YK, Law, YF, Tsang, CY 2006, ' Functional outcome of the hand following flexor tendon repair at the no man's land'*, Journal of Orthopaedic Surgery*, vol. 14, no.2, pp. 178-83.

8. Davies, D 1985 'Plastic and reconstructive surgery of the hand', *Br Med J,* vol. 190, pp 1650.

9. Edinburg M, Widgerow AD, Bidduph SL, 1987, 'Early post operative mobilization of flexor tendon injuries using a modification of the Kleinert technique', *J Hand Surg,* Vol.12A, pp. 34-38.

10. Elliot, D, Moiemen, NS, Flemming, AFS, Harris, SB, Foster, AJ 1994 'The rupture rate of acute flexor tendon repairs mobilized by the controlled active motion regimen' *Journal of Hand Surgery*, vol.19-B, pp. 607-612.

11. Grobbelaar, AO, Hudson, DA 1994, 'Flexor tendon injuries in children', *Journal of Hand Surgery* , vol. 19-B, pp.696-698.

12. Hudson DA, de Jager LT 1993. 'The spaghetti wrist, Simultaneous lacerations of the median and ulnar nerves with flexor tendon at the wrist', *Journal of Hand Surgery,* vol.18B, pp.171-173.

13. Kabak, S, Halici, M, Baktir, A, Turk, CY, Avsarogullari, L 2002, 'Results of treatment of the extensive volar wrist lacerations: the spaghetti wrist' *Eur J Emerg Med*. Vol.9, no.1, pp.71-6.

14. Kleinert, HE, Kutz, JE, Atasoy, E, Stormo A 1973, 'Primary repair of flexor tendons' *Orthopaedics Clinic of North America*, vol. 4, pp. 865-876.

15. Kleinert, HE, Verdan, C 1983, 'Report of the commettee on tendon injuries', *Journal of Hand Surgery,* vol. 8, pp. 794-798.

16. Matthews, P, Richards, H 1978, 'Factors in the adherence of flexor tendon after repair' *Journal of Hand Surgery*, vol. 58-B, pp.230-236.

17. Pulvertuft, RG 1960, 'The treatment of profundus division by free tendon graft', *J Bone Joint Surg*, vol. 42-A, pp.1363-71.

18. Rogers, GD, Henshall, AL, Sach, RP, Wallis, KA 1990, 'Simultaneous laceration of the median and ulnar nerves with flexor tendons at the wrist', *Journal of Hand Surgery,* vol.15-A, pp.990-995.

19. Singer M, Maloon S, 1988, 'Flexor tendon injuries: The results of primary repair' *J Hand Surg (Br),* Vol. 13, pp.269-272.

20. Stefanich, RJ, Putnam, MD, Preimer, CA, Sherwin, FS 1992, 'Flexor tendon lacerations in zone v' *Journal of Hand Surgery*, vol. 17-A, pp. 284-291.

21. Widgerow AD, 1990, 'Full house spaghetti wrist injuries, analysis of results' *S Africa, J Surg,* vol. 28: pp. 6-10

Original Article

Result of a Comparative study of wound management by Conventional method and Negative Pressure Wound Therapy

S Anwaruzzaman[1], FA Siddiqui[2], M Ali[3], S Amin[4]

ABSTRACT

Background : Soft tissue infection and sepsis is the most common problem in patients with open trauma wound and sometimes it is life threatening to the patient. Before the development of standard surgical wound management and antisepsis amputations were frequently required procedure to prevent sepsis and death. But at present Negative Pressure Wound Therapy (NPWT) has caused a dramatic result in healing process as well as reduction in the infection rate.

Objective: The aim of this study is to observe the effect of Negative Pressure Wound Therapy on open wound and duration of hospital stay in relation to conventional wound therapy along with reduction of bacterial colonization.

Design: Prospective randomized clinical trial.

Setting: This study was conducted in a Dept. of Orthopedics & Trauma, Comilla Medical College & Hospital from July-2011 to June-2013.

Patients: Fifty patients of open trauma wound without Negative Pressure Wound Therapy were compared with equal number of patients with Negative Pressure Wound Therapy.

Methods: Open trauma wound of the limbs irrespective of age and sex were treated by Conventional Method and Negative Pressure Wound Therapy in other group. Hb% was corrected by Blood Transfusion. Necrotic tissues were debrided and cleaned in both conventional method and before applying NPWT. All patients were followed up until secondary suture or skin grafting or flap coverage. Wound Swab cultures were performed in all patients. New Bacterial colonization , time needed for skin graft or secondary suture number of dressing needed and total hospital stay were compared between two groups.

Results: On this prospective randomized clinical trial 100 patients were studied in two groups as Conventional Method to use of NPWT for the treatment of open trauma wound with 50 patients in each group. There was significant difference between patients of conventional method and patients of Negative Pressure Wound Therapy were observed in number of dressing, significant granulation tissue formation, time for ultimate outcome such as skin graft or secondary suture, new bacterial colonization, total hospital stays, functional outcome, and wound contracture.

Limitations: This study is limited by the study on a small sample size, does not include information on patients comorbidities and data obtained from a single institution.

Conclusion: NPWT was found to accelerate formation of healthy granulation tissue and cost effective and thus to shorten healing time and minimize secondary soft tissue defect coverage procedures in the management of open wound which include acute and chronic wound.

Key words: Open wound, acute wound, chronic wound, conventional wound therapy, NPWT

1. Dr. Syed Anwaruzzaman; Assoc. Professor, Dept. Of Orthopedics & Trauma Comilla Medical College & Hospital.
2. Dr. Faisal Ahmed Siddiqui , Resident. Dept. of Orthopedics.3. Dr. Mohammad Ali, Assist. Registrar , Dept. of Orthopedics, 4. Dr. Md. Sadiqul Amin Assist. Registrar, Dept. of Orthopedics.

Correspondence: Dr. Syed Anwaruzzaman; Assoc. Professor; Cell: *+880-1711-822023:* Email: syedanwaruzzaman@hotmail.com

INTRODUCTION

Negative pressure wound therapy (NPWT) is a therapeutic technique using a vacuum dressing to promote healing of wounds. The therapy involves the controlled application of sub-atmospheric pressure to the local wound environment [1] , using sealed wound dressing connected to a vacuum pump[2,3,12].The use of this technique in wound management increased dramatically over the '1990's and 2004's[4].Wound management represents a considerable burden on health services and requires considerable manpower, frequent specialist consultation, and adjunct therapies. An important example of these adjunct therapies is Negative Pressure Wound Therapy (NPWT). Which was suggested to offer an important option for the advanced management of many wound types [5-7] . Manpower constitutes a great portion of this cost. In their national UK audit, Drew et al [8] suggested that nurses time accounts for 33-41% of the total cost of wound care. On the other hand, chronic wounds can also affect patient's ability to function in their environment causing financial, social and psychological consequences as well as affecting patients' quality of life [9-11].

The conventional treatment methods used for open wounds are skin grafting after the formation of healthy granulation tissue by wet dressing [13]. However the duration of the treatment may be prolonged due to infection or wound condition. NPWT was first described my Argenta and Morykwas [13]. This technique can be used to cover exposed bone or soft tissue defects with our frequent dressing changes and reduces chronic edema and increases local blood supply which enhances the formation of healthy granulation tissue. These clinical benefits derived from the foam interface include edema control and facilitation of closure through application of negative stretching soft tissues, stimulation of angiogenesis and tissue granulation through mechanical stimuli at cellular level. Limitation of destructive proteases within the wound, facilitation of bacterial clearance from the wound and limitation of cross contamination in the hospital environment [14].

Several reports have been issued on the application of NPWT to soft tissue defects of the extremities, abdomen and chest [15, 16]. Specific wounds for which use of NPWT may be beneficial include fasciotomy wounds non healing ulcers, diabetic ulcers venous ulcers. It also enhances wound closure [14].

Almost any type of wound can be treated with NPWT, provided that a seal can be obtained and maintained during therapy. NPWT can be used successfully on the wounds like acute/ trauma wound, diabetic foot ulcers, pressure ulcers, burns, leg ulcers, surgical wound, skin grafts, rotation flaps, and postoperative mediastinitis [17]. NPWT should be stopped if there is known or suspected malignant wound, untreated osteomyelitis, necrotic wound Escher, and fistulas to organs or cavities, exposed organs, severe peripheral vascular disease, dry wounds, active bleeding anticoagulants and difficult hemostasis, proximity to sutured or irradiated vessels or organs [18]. Complication of NPWT are infection, desiccation, pain odor bullae and maceration.

The purpose of this study was to compare the effect of negative pressure wound therapy with conventional wound therapy on open wound.

METHODS

Over the two years period from July-2011 to June-2013, 100 patients with open wound in the department of Orthopedics and Trauma in Comilla Medical College and Hospital were treated, dividing into two groups, with Conventional Method and NPWT method. Patients eligible for this study included those with acute/trauma wound, diabetic foot ulcer, leg ulcer and fasciotomy wound. Exclusion criteria included known or suspected malignant wound, wound with fistula or untreated osteomyelitis, exposure of large vessels on the wound site.

This is a comparative study in which the patients were studied in two groups. In each case relevant history was taken and investigations of blood for CBC, serum Creatinine, pus for C/S, X-ray of affect part were done.

Statistical data analysis.

All the information was collected in a data sheet. All data were analyzed by manually.

And expressed in percentage unless mentioned otherwise.

RESULTS

The patients in both the groups were selected randomly irrespective of their age and sex. In control group mean age is 51.8 and in study group it is 37.5 (age range 10-80 years). Number of dressing was found significantly different in between two groups ($p<0.001$) dressing were more frequent in patients who are diabetic, senile or burn patients whereas in traumatic wounds less dressing required (Fig.1,2,3). After NPWT bacterial colonization was significantly reduced ($p<0.001$)

00 00

Fig.-1: *After surgical toiletting*

Fig.-2: *After 2nd NPWT application*

Fig.-3: *After Skin Graftin*

DISCUSSION

Negative pressure wound therapy is a relatively new concept. It is a concept that enjoys widespread clinical success[20-22]. But there is limited basic science data. Nevertheless clinically it has been very successfully used for complex traumatic wounds. NPWT is postulated to work by a combination of three different mechanisms; increased angiogenesis,[23-27]edema reduction[28,29] and the mechanical stretching of soft tissue leading to tissue genesis.[21,28-31]clinically it is evident that NPWT can produce a tremendous amount of granulation tissue in a very short time when applied to a viable wound bed. It can also produce granulation tissue covering approximately 2cm defects without vascularized tissue in the wound bed[32], relying on ingrowth from adjacent tissue, however it is not successful when applied to larger areas of exposed bone and may actually desiccate and compromise the vascularity of the bone. There is some animal evidence that the NPWT can decrease bacterial counts in wounds[23] but clinical studies have not been published that confirm the findings.

Currently there are few published studies regarding the use of NPWT in orthopedic patients. Herscovici et al published a consecutive nonrandomized study using negative pressure wound therapy for orthopedic trauma patients. They concluded that it was cost effective and remarkably decreased the number of patients requiring flap coverage of their wounds.[33] There have also been case reports published using NPWT as an adjunct to treat infected total knee arthroplasties[34] as well as to obtain wound closure over exposed hardware and tendons.[35-37] Prospective randomized clinical trials are under way to assess the role of NPWT in closed wounds that are at high risk for wound breakdown, such as distal tibia and calcaneus, as well as for treatment of postsurgical hematomas. An additional prospective randomized trial is under way regarding the use of NPWT in patients with severe open fractures although it is clear that the results of these ongoing studies will clarify the precise indication for use of NPWT.

CONCLUSION

The result of present study showed that the clinical utility of NPWT in varieties of wounds is more beneficial than conventional wound management. From this study it was found that there is rapid formation of granulation tissue, edema and discharge reduction, less number of dressing spells, enhanced healing time, reduced hospital stay and no remarkable wound complication. So NPWT reduces time and effort spent by physician and decreases the total treatment cost. Therefore it can be concluded that NPWT has proven a successful adjunct to promote healing of a variety of wounds.

REFERENCES

1. Lillis, Karin (2003). " Effective wound care requires look at total patient picture". Healthcare purchasing News 27 (1):
2. Moody, Yasmeen(19thJuly). "Advances in healing chronic wounds". The Ithaca journal (Ithaca, NY)p.10A
3. Fogg, Erich (27 August, 2009). "Best treatment of non-healing and problematic wounds," Journal of the American Academy of Physician . Assistants 22 (8) ; 46,48, PMID 19725415.
4. Driscoll, P (24th October, 2009). "Negative Pressure Wound Therapy (Gauze and Foam)." Advanced Medical Technologies.

5. P.E.Banwell and L T'eot, "Topical Negative Pressure (TNP); the evolution of a novel wound therapy." Journal of Wound care Vol.12 no. 1 . pp.22-28, 2003.

6. M. J. Morykwas J. Simpson, K Punger, A. Argenta, L. Kremers and J Argenta, "Vacuum-assisted Closure: State of Basic research and . physiologic foundation."

7. Plastic and Reconstructive Surgery vol.117 no. 7 supplement pp. 1215-1265, 2006

8. P. Drew, J. Posnett, and L. Rusling, "The cost of wound care for a local population in England," International Wound Journal, Vol. 4, . . no.2,pp. 149-144,2007.

9. P.J.Franks, L. McCullagh and C.J. Moffatt, " Assessing quality of life in patients with chronic leg ulceration using the medical outcomes short form 36 Questionnaire," Ostomy wound Management, Vol. 49, no.2, pp. 22-26, 2003.

10. A. Person, M.M. Heinen, C.J.M.Van Der Vleuten, M.J. De Rooij, P.C.M.Vand de Kerkhof and T van Achterberg, " Leg Ulcers: A review of their impact on daily life," Journal Of Clinical Nursing , Vol. 13, no.3,pp. 341-354, 2004.

11. M. Augustin, K. Herberger, S.J.Rustenbach, I. Zschocke, and C. Blome," Quality of life evaluation in wound; Validation of the freiburg life quality assessment-wound module, a disease specific instrument," International Wound Journal, Vol. 7, No. 6, PP. 493-501, 2004.

12. Bailey and Love's Short Practice of Surgery (25th edition), Norman S. Williams, Christopher J. K. Bulstrode, P. Ronan O'Connel (page-1123)

13. Argenta Lc, Morykwas MJ: Vacuum assisted closure; a new method for the wound control and treatment; clinical experience. Ann Plastsurg 1997, 38:563-576.

14. Hans-ChristophPape, MD and Lawrence X. Web, MD. The significance of negative pressure wound therapy with reticulated open cell foam in the treatment of orthopedic wounds; and evidence-based review. J OrthopTrauma . Volume 22, Number 10 supplement, November/ December 2008.

15. DeFranzo AJ, Marks MW, Argenta LC, Genecov DG: Vacuum assisted closure for the treatment of degloving injuries, plastic reconstruction surgery 1999, 104:2145-2148.

16. Webb LX: New techniques in wound management vacuum assisted wound closure, J Am AcadOrthopsurg 2002, and 10:303-311.

17. Kate Ballard, BSc, Rgn, tissue viability and clinical trials coordinator, Tissue Unit, Guy's Hospital, London, Vo.97, issue;-35, page no: 51, 30th august, 2001.

18. Song DH WuLC, Lohman RF, Gottlieb LJ, Franczyk M. "Vacuum assisted closure for treatment of sternal wound, the bridge between debridement and definitive closure, PlastReconstrSurg, 2003: 111(1). 92-97.

19. McCallonSk, Knight CA, Valiulus JP, Cunnigham MW, McCulloch JM, Farinas LP: Vacuum assisted closure versus saline moistened gauze in the healing of postoperative diabetic foot wounds, Ostomy wound manage 2000; 46:28-32.

20. Andre N. Pollak, MD,. Use of negative pressure wound therapy with reticulated open cell foam for lower extremity trauma. J Orthop Trauma 2880;22:S142-S145

21. DeFranzo AJ, Argenta LC, Marks MW et al. The use of vacuum assistrd closure theraqpy for the treatment of lower extremity wounds with exposed bone. Plas.Recontr.Surg 2001;108:1184-1191.

22. Lawrence X, Webb Md and Hans ChritophPape, MD. Current thought regarding the mechanism of action of negative pressure wound therapy with reticulated open cell foam. J Orthop Trauma 2008;22:S135-S2137.

23. Saxena V, Hwang CW, Huang S, et al. Vacuum assisted closure: micro deformations of wounds and cell proliferation. Plastrecontrsurg 2004;114:1086-1096.

24. Aronson J Limb lengthening skeletal reconstruction and bone transport with the Ilizarov method. J Bone Surg AM 1997;79:1243-1258.

25. Armstrong DG, L avery LA; Diabetic foot study consortium-Negative pressure wound therapy after partial diabetic foot amputation; a multicentric randomized controlled trial. Lancet,2005;366(9498)1704-1710.

26. Norbury K, Kieswetter K, Vacuum assisted closure therapy attenuated the inflammatory response in a porcine acute wound healing modle. Wounds 2007;19:97-106

27. Brumback RJ, Wound debridement. In Yaremchuk MJ, Burgess AR. Brumback RJ.Lower extremity salvage and reconstruction.Newyork Elsevier science;1989;71-80.

28. Lallis SJ. Comparison of negative dressing and standard dressing in a contaminated open fracture model. Paper presented at Society of Military OrthoipedicSurgeouns (SOMOS) 49th annual meeting; December 10-14, 2007;vail.co.

00 00

Original Article

Evaluation of the Outcome of Steenbeek Foot Abduction Brace after Ponseti Serial Casting for the Management of Congenital Talipes Equino Varus

MS Reza[1], MT Alam[2], QS Alam[3], SG Samdani[4], SI Salam[5], MAG Mollah[6], M Shahiduzzaman[7]

ABSTRACT

Congenital Talipes Equino Varus (CTEV) is the commonest congenital deformity in babies. The Ponseti method for the management of CTEV has recently become popular, with reported excellent outcomes. Bracing with Steenbeek Foot Abduction Brace after Ponseti serial casting is indispensible in maintaining and preventing relapse of corrected CTEV. The purpose of this is to evaluate & analyze the outcomes of Steenbeek Foot Abduction Brace after Ponseti serial casting for the treatment of CTEV.

This prospective observational study was conducted from 1st May 2011 to 31st October 2012. A total number of 49 patients (74 feet) were enrolled in this study as per inclusion and exclusion criteria. Regular follow-up was done for one & a half years and correction of deformity was assessed by Pirani scoring system.

The final outcome of Steenbeek Foot Abduction Brace among 74 feet, 72(97.3%) were good, 2(2.7%) were fair and zero % were poor.

The Steenbeek Foot Abduction Brace for maintaining correction and preventing relapse in Ponseti technique for the treatment of CTEV is effective, safe, and with good compliance.

Keywords: Congenital Talipes Equino Varus (CTEV), Ponseti technique, Steenbeek Foot Abduction Brace (SFAB).

INTRODUCTION

Clubfoot is the commonest congenital deformity in babies which consists of four components: equinus, hindfoot varus, forefoot adductus and cavus[1]. Clubfoot can occur in an otherwise normal child (idiopathic) or as a part of disorders such as myelomeningocele, or arthrogryposis. Idiopathic clubfoot occurs worldwide with an incidence varying from 0.39 to 8 per 1000 live births[2,3]. Male children are affected twice than female children[4] and up to 50% of the cases are bilateral[5].

Pathologically, the ligaments of the posterior aspect of the ankle and of the medial and plantar aspects of the foot are shortened and thickened. The reduction in length and girth of the leg muscles has been observed[6].

The clinical features of clubfoot is the smaller calf muscles and adductus of the forefoot at mid tarsal joint, cavus, varus of the heel and equines of the foot at the ankle joint. The gene or genes responsible for clubfoot remain active from the 12th to 14th week of fetal life to 4 to 6 years of

1. Medical Officer, Pink-II, NITOR, Dhaka.
2. Resident, MS (Ortho), Department of Orthopaedics & Traumatology, Dhaka Medical College & Hospital, Dhaka.
3. Resident, MS (Ortho), Department of Orthopaedics & Traumatology, Dhaka Medical College & Hospital, Dhaka.
4. Registrar, Department of Orthopaedics & Traumatology, Dhaka Medical College & Hospital, Dhaka.
5. Assistant Professor of Paediatric Orthopaedics, Department of Orthopaedics & Traumatology, Dhaka Medical College & Hospital, Dhaka
6. Professor of Orthopaedics, NITOR, Dhaka.
7. Prof & Head, Department of Orthopaedics & Traumatology, Dhaka Medical College & Hospital, Dhaka.

Correspondence: Dr. Md. Selim Reza, Medical Officer, Pink-II, NITOR, Dhaka. Mobile: 01914-33 16 93.

ages. After this age, relapses are very rare, although the calf atrophy will persist throughout life of the patient[7].

Following correction the clubfoot deformity it tends to relapse. Noncompliance and educational level of the parents are significant risk factors for the recurrence of clubfoot deformity after correction with Ponseti method[5].

MATERIALS AND METHODS

This prospective observational study was conducted in the department of Orthopaedics & Traumatology of Dhaka Medical College and Hospital, Dhaka from 1st May 2011 to 31st October 2012 for duration of one & a half years. All congenital clubfoot patients, age less than 24 months of both sexes were included in this study. A total number of 49 patients (74 feet) were enrolled in this study on the basis of purposive sampling (Non randomized) technique according to availability of the patients and strictly considering the inclusion and exclusion criteria. Diagnosis of the congenital talipes equinovarus deformity was made by history and clinical examination.

Treatment was given according to standard Ponseti technique which involves gentle staged correction of the cavus and varus deformities of clubfoot with first three casts. Weekly manipulations were performed and the foot was casted in plaster of Paris at the maximum correction at the end of every manipulation. The cast was removed before the next manipulation and the correction was slowly increased. In many cases full correction was prevented by a tight Achilles tendon and when equinus deformity was >10 degrees, this was corrected by percutaneous tenotomy as an outpatient procedure under local anaesthesia. Once full correction of the clubfoot had been achieved (the foot being returned to the plantigrade position, defined as being able to have the sole of the foot flat on the floor when standing) the patient was given a Steenbeek Foot Abduction Brace to maintain the correction. The brace consists of a bar with high top open-toed shoes attached at the ends of the bar in 70 degrees of external rotation. In children with only one clubfoot, the shoe for the normal foot was fixed on the bar in 40 degrees of external rotation and in bilateral cases both feet were fixed in 70 degrees of external rotation.

To prevent relapses, the brace must be worn full-time for first three months and thereafter at night for 3-4 years. During the daytime the children worn normal shoes. Regular follow-up was done for one & a half years and correction of deformity was assessed by Pirani scoring system. The result was determined 'good' when Pirani score was <o.5, 'fair' when score upto 2.0 and 'poor' when score >2.0[8].

RESULTS AND OBSERVATIONS

Age distribution of the total 49 patients was between 1 month and 21 months, mean was 8.88± 4.969 months, mode was 6, SD was 4.969. Within 49 cases, the male patients were more than female patients which were 35(69%) and 14(31%) respectively.

Pre-bracing Pirani score and after one & a half-year follow-up Post-bracing Pirani score was recorded. The mean were 3.634 ± 0.9978 and 0.236 ± 0.3533 respectively. The difference between Pre-bracing and Post-bracing Pirani score were analyzed and found not statistically significant.

Among the 74 feet, 9(6.7%) developed complications. Among 9 complications pressure sore was 3(33.3%), noncompliance was 2(22.2%), recurrence was 2(22.2%) and infection was 2(22.2%).The compliance among the 74 feet, 67(90.5%) were good, 4(5.4%) were fair and 3(4.1%) were poor. Regarding final outcome among 74 feet, 72(93.7%) were good, 2(2.7%) were fair and zero was poor.

DISCUSSIONS

A total number of 49 patients (74 clubfeet) were enrolled in this study. Among them, male patients were more than female patients which were 35(69%) and 14(31%) respectively. Desai[5] in their study found that boys were more commonly affected than girls and the ratio was 2:1. In my study, the mean age was 8.8 ± 4.97 months with a range of 1 – 21 months. Lourenço[9] reviewed 17 children (24 feet) with congenital idiopathic clubfoot who presented below two years of age and had undergone no previous treatment. Out of 49 patients involvement of right foot was in 16(32.7%) cases followed by bilateral involvement and left foot involvement which was 8(16.3%) cases and 25(51%) cases respectively. Chingulani[10] found 52% bilateral and 48% unilateral club feet. Ponseti[11] found that all of their 16 patients were bilaterally involved.

Pre-bracing Pirani score and after one & a half-year follow-up Post-bracing Pirani score was recorded. The mean were 0.230 ± 0.3433, 0.236 ± 0.3533 respectively. Chingulani[10] found the total mean Pirani score at presentation was 5.0 (4 to 6), at the end of initial treatment were total of 1.5. The complications were recorded and found that 9(6.7%) feet developed complication. Among 9 feet Pressure sore was found in 3(33.4%) feet, infection was found in 2(22.2%), noncompliance was found in 2(22.2%), and recurrence was found in 2(22.2%).Chingulani[10] observed 68% relapse after initial treatment. Janicki[12] reported recurrence requiring additional treatment 31%. Haft[13] reported the deformity recurred in twenty-one patients 41%.

The compliance of brace among the 74 feet, 67(90.5%), 4(5.4%) and 3(4.1%) were recorded as good, fair and poor respectively. Desai[5] and Bor[14] observed significant similarity regarding compliance. The rating of outcomes of bracing after one & a half years follow-up periods among 74 feet, 72(93.3%), 2(2.7%) and zero were good, fair and poor respectively. In my study, high satisfactory result may be due to short follow-up period because recurrence usually appears during pre-school age i.e. at 4 or 5 years. Haft[13] reported 60 % success rate in their study after long follow-up of thirty-five months. According Ippolito[15] results were recorded as excellent 4.26%, good as 38.30%, fair as 23.40% and poor as 34.04%. Jowet[16] showed that the Ponseti method provided excellent results of around 90%.

CONCLUSION

This study permits to conclude that Steenbeek Foot Abduction Brace for maintaining correction and preventing relapse in Ponseti technique for the treatment of CTEV is effective, safe, and with good compliance.

REFERENCES

1. Dobbs M. B., Gurnett C. A. (2009) Update on Clubfoot : Etiology and Treatment. *Clin Orthop and Relat Res*; 467:342-356.
2. Boo N. Y., Ong L. C. (1990) Congenital Talipes in Malaysian Neonates: Incidence, Pattern and Associated factors. *Singapore Med J;* 31:539-542.
3. Dietz F.R. (2002) The Genetics of Idiopathic Clubfoot. *Clin Orthop and Relat Res*; 401:39-48.
4. Siapkara A., Duncun R. (2007) Congenital talipes equinovarus : A review of current management. *J Bone Joint Sur-B*; 89(8):995-1000.
5. Desai L., Oprescu F., DiMeo A., Mocuende J. A. (2010) Bracing in the treatment of children with clubfoot: past, present, and future. *J Bone Joint Surg Am*; 92(5):467-482.
6. Ippolito E., Ponseti I. V. (1980) Congenital Club Foot in the Human fetus: A Histological Study. *J Bone Joint Sur Am*; 62(1):8-22.
7. Ponseti I. V., Laaveg S.J. (1980) Long-Term Results of Treatment of Congenital Club Foot. *J Bone Joint Surg Am*; 62(1):23-31.
8. Singh N. J., Keshkar S., De P., Kumar R. (2011) Management of club foot by Ponseti technique-our experience. *IJPMR*; 22:12-16.
9. Lourenco A. F., Morcuende J. A. (2007) Correction of neglected idiopathic club foot by Ponseti Method. *J Bone Joint Surg Br*; 89(3):378-381.
10. Changulani M., Garg N. K., Rajagopal T. S., Bass A., Nayagam S. N., Sambth J., Bruce C. E. (2006) Treatment of idiopathic clubfoot using the Ponseti method: Initial experience. *J Bone Joint Surg Br*; 88(10):1385-1387.
11. Ponseti I. V., Zhivkov M., Davis N., Sinclair M., Dobbs M. B., Morcuende J. A. (2008) Treatment of complex idiopathic clubfoot. *Cln Orthop Relat Res*; 451:171-176.
12. Janicki J. A., Narayanan U. G., Harvey B. J., Roy A., Weir S., Wright J. G. (2011) A Comparison of Ankle Foot Orthoses with Foot Abduction Orthoses to prevent recurrence following correction of idiopathic clubfoot by the Ponseti method. *J Bone Joint Surg Br*; 93(5):700-704.
13. Haft G. F., Walker C.G., Crawford H. A. (2007) Early clubfoot recurrence after use of the Ponseti method in a New Zealand population. *J Bone Joint Surg Am*; 89(3):487-493.
14. Bor N., Coplan J. A., Herzenberg J. E. (2009) Ponseti treatment for idiopathic clubfoot: Minimum 5-year follow-up. *Cln Orthop Relat Res*; 467(5):1263-1270.
15. Ippolito E., Farsetti P., Caterini R.,Tudisco C. (2003) Long-Term Comparative Results in Patients with Congenital Clubfoot Treated with Two Different Protocols. *J Bone Joint Surg Am*; 85(7):1286-1294.
16. Jowett C. R., Morcuende J. A., Ramachandran M. (2011) Management of congenital talipes equinovarus using the Ponseti method: A systematic review. *J Bone Joint Surg Br*; 93(9):1160-1164.

00 00

Original Article

Comparative Study Between Closed Locking Intramedullary Nailing Versus Open Locking Intramedullary Nailing For Mid Shaft Femoral Fractures in Adult

Manash Chandra Sarker[1], Qamrul Alam Saleh[2], Md. Akshad Al Masur[3], Md. Jahangir Alam[4]

ABSTRACT

Fractures of the shaft of the femur are among the most common fractures encountered in orthopaedic practice. This randomized clinical trial was conducted to compare between closed locking intramedullary nailing versus open locking intramedullary nailing for mid shaft femoral fractures in adult in our country. This study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Sher-E-Bangla Nagar, Dhaka over a period of 24 months. Adult patients with closed fracture of mid shaft of femur were the study population.

A total of 30 patients (30 femoral shaft fractures) aged 18-45 years irrespective of sex were included in the study. Fifteen femoral shaft fractures were treated by closed locking IM nailing(Experimental group) and fifteen were treated by open locking IM nailing(Control group).The mean age of the patients in closed group was 27.87 ± 6.71 years and the mean age of the patients in open group was 27.20 ± 6.89 years. Majority of the patients were male in the both groups. Sixteen (53%) patients were operated on right side and fourteen (47%) patients were operated on left side. The follow-up period in both group ranging from 9 to 14 months.

In final result 93% union found in closed group and 87% union found in open group, mild pain persist 60% cases in open group, 13% cases in closed group, malalignment of fracture union slightly more in closed group. Full range of knee movement found in all cases of closed group and 87% cases in open group.

Closed locking intramedullary nailing for fracture mid shaft of femur is better than open intramedullary nailing .

INTRODUCTION

Fractures of the shaft of the femur are among the most common fractures encountered in orthopaedic practice. Because the femur is the largest bone of the body and one of the principal load-bearing bones in the lower extremity, fractures can cause prolonged morbidity and extensive disability unless treatment is appropriate (Whittle P. A., 2008).

Femoral shaft fracture are challenging problems to treat, as there is usually comminution at the fracture site and associated soft tissue injuries. In addition, there can be difficulty in assessing malrotation at the fracture site. They can be life threatening, because of open wounds, hemorrhagic shock, fat embolism, ARDS or multiple organ failure (Brumback RJ, Lakatos R., 1988) . Further there may be physical impairment due to fracture shortening, malalignment, and prolonged immobilization, due to traction or casting. So the aim of fracture treatment is to obtain union of the fracture, in as near anatomical position, with minimal impairment of function. The type and location of fracture, degree of comminution, age of the patient and

1. Assistant surgeon, Emergency Department, NITOR, Dhaka
2. Professor of Orthopaedic surgery, NITOR, Dhaka
3. RS, 250 Bedded General Hospital, Pabna,
4. Associate Professor, NITOR, Dhaka

Correspondence: Dr. Manash Chandra Sarker, Assistant surgeon, Emergency Department, NITOR, Dhaka

patient's social and economic demands and other factors influence the method of treatment. The technique chosen should cause minimal soft tissue and bone damage.

Several techniques are now available for their treatment such as closed reduction and spica cast immobilization, skeletal traction, femoral cast bracing, external fixation, intramedullary nailing with open or closed technique, Plate fixation (Whittle P. A., 2008). The goal of any internal fixation produce is to increase the stability of fractures, to transfer load across the fracture site, and to maintain anatomic alignment to induce bony union . In 1940, Küntscher stated that closed intramedullary nailing of the femur offer an ideal anatomical, functional, and physiological treatment for fresh femoral fractures. Intramedullary (IM) nailing is an effective method of treating femoral shaft fracture and has become one of the preferred procedures in orthopaedics. Intramedullary fixation of femoral shaft fractures allows early mobilization of the patient (within 24–48 h if the fixation is stable), improved knee and hip range of motion and a marked decrease in the cost of hospitalization**.** Intramedullary nails are load- sharing devices, allowing the bone to transmit compressive forces while maintaining axial alignment (Guodong W. et al., 2008) **.** With closed techniques in particular, non-union is uncommon, there is a low rate of complications, and there is excellent and prompt return of function (Marion C.et al., 1985)**.** Closed intramedullary nailing include the following advantages: which include minimal surgical dissection and indirect fracture reduction without disruption of the fracture hematoma (Zbigniew G. et al., 2011). The disadvantages of the open method compared with closed intramedullary nailing include the following: skin scars must be considered, fracture hematoma, which is important in fracture healing is evacuated, bone shavings created by reaming the medullary canal often are lost, infection rate is increased, rate of union is decreased (Whittle P. A., 2008)

OBJECTIVES

Objective of this study is to compare the outcome of locking intramedullary nailing by closed and open method in treatment of femoral shaft (middle third) fracture regarding any postoperative malalignment (Varus, Valgus, Rotation and shortening of femur) , fracture healing (Union, delayed union and non union), postoperative infection , pain , final range of motion of hip and knee joint between two groups.

MATERIAL & METHODS

This is a Randomized Clinical Trial (RCT) carried out at National Institute of Traumatology & Orthopaedic Rehabilitation (NITOR) in the period of January 2011 to December 2012**,** 30 Adult patients with closed fracture mid shaft of femur regardless of sex were included in the study. Consecutive sampling done according to inclusion and exclusion criteria. Inclusion criteria of this study were Adult patients (>18 years & <45 years) with fracture Mid femoral shaft only and exclusion criteria were age below 18 years & above 45 years, open fracture , pathological fracture, deformity of femur(Previous malunited fracture) . Data were collected, compiled and tabulated according to key variables. Data were analyzed using SPSS.17 with, Fisher exact test, Chi-square, t-independent tests.

Table -I

Classification system of the results of treatment (Thoresen et al.1985)

	Result			
	Excellent	Good	Fair	Poor
Malalignment of femur (degrees)				
Vaurs or valgus	5^0	5^0	10^0	$>10^0$
Antecurvatum or recurvatum	5^0	10^0	15^0	$>15^0$
Internal rotation	5^0	$>10^0$	15^0	$>15^0$
External rotation	10^0	15^0	20^0	20^0
Shortening of femur (cm)	1	2	3	>3
Range of motion of knee (degrees)				
Flexion	$>120^0$	120^0	90^0	$<90^0$
Extension deficit	5^0	10^0	15^0	$>15^0$
Pain or swelling	None	Sporadic, minor	Significant	Severe

Table –II

Designation of results at follow-up (Thoresen et al 1985)

Excellent	Malalignment ($<5^0$ angulation and rotation), shortening of femur <1cm, full range of knee movement, no pain or swelling.
Good	Malalignment ($<10^0$ angulation and rotation), shortening of femur 1-2cm, knee movement upto 120^0, mild pain.
Fair	Malalignment ($<15^0$ angulation and rotation), shortening of femur 2-3cm, knee movement upto 90^0, moderate pain.
Poor	Malalignment ($>15^0$ angulation and rotation), shortening of femur >3cm, knee movement $<90^0$, severe pain.

OBSERVATIONS AND RESULT

In this study, there were 30 patients with age range 18-45 yrs. Mean age was 27.87 ± 6.71 years for the closed group and 27.20 ± 6.89 years for the open group . In closed group 14 cases (93%) were males and 1 case (7%) was females. In open group 14 cases (93%) were males and 1 case (7%) was females . In both groups mode of injury mostly road traffic accident which is 93% in closed group and 80% in open group. Each group has 8 cases (53%) right sided fracture shaft of femur and 7 cases (47%) left sided fracture. In closed group 8 patients (53%) had Winquist type I fractures , 6 patients (40%) had type II and 1 patient(7%) type III fracture. In open group 11 patients (73%) had type I, 3 patients (20%) had type II fractures and 1 patient (7%) had type III fracture. In closed group average time interval between injury and operation were 9 days and in open group were 10 days. In closed group average time required for operation were 101 minutes where as in open group average time required 87 minutes. Dynamisation required 3 cases (20%) in closed group and 5 cases (33%) in open group. There was no superficial or deep infection in this study. No pain observed in 13 cases (87%) in closed group and in open group 6 cases (40%) but mild pain observed only 2 cases (13%) of closed group and 9 cases (60%) of open group. Varus malunion ($<5^0$) found 1 case (7%) in closed group, 3 cases (20%) in open group. Valgus malunion ($<5^0$) found 1 case (7%) in closed group, 2 cases (13%) in open group. Antecurvatum ($<5^0$) found 2 case (13%) and recurvatum ($<5^0$) found 2 cases (13%) in closed group but no antecurvatum/recurvatum found in open group . In closed group $<10^0$ external rotation found 2 cases (13%) and in 1 cases $<5^0$ internal rotation deformity found. 1 cm shortening of limb found 2 cases (13%) in closed group and 4 cases (27%) in open group, 2 cm shortening of limb found 1 case (7%) in closed group and 2 cases (13%) in open group. All patient in closed and open group found full range of hip motion. In closed group all cases (100%) found full range of knee motion ($>120^0$), in open group 13 cases (87%) found $>120^0$ range of knee motion and 2 cases (13%) found $<120^0$ range of motion. In closed group 14 cases (93%) found full union and in open group 13 cases found (87%) found full union, average union rate 18 weeks in closed group and 20 weeks in open group. Delayed union found 1 case (7%) in closed group and 2cases (13%) in open group. In winquist type I fracture excellent result found 7(47%) cases of closed group and 3(20%) cases of open group, good result found 1(7%) case of closed group and 8(53%) cases of open group. In winquist type II fracture excellent result found 5(33%) cases of closed group and 2(13%) cases of open group, good result found 1(7%) case of closed group and 1(7%) cases of open group. In winquist type III fracture excellent result found 1(7%) cases of closed group and 1(7%) cases of open group . Excellent result found 13 cases (87%) in closed group, 6 cases (40%) in open group . Good result found 2 cases (13%) in closed group and 9 cases (60%) in open group.

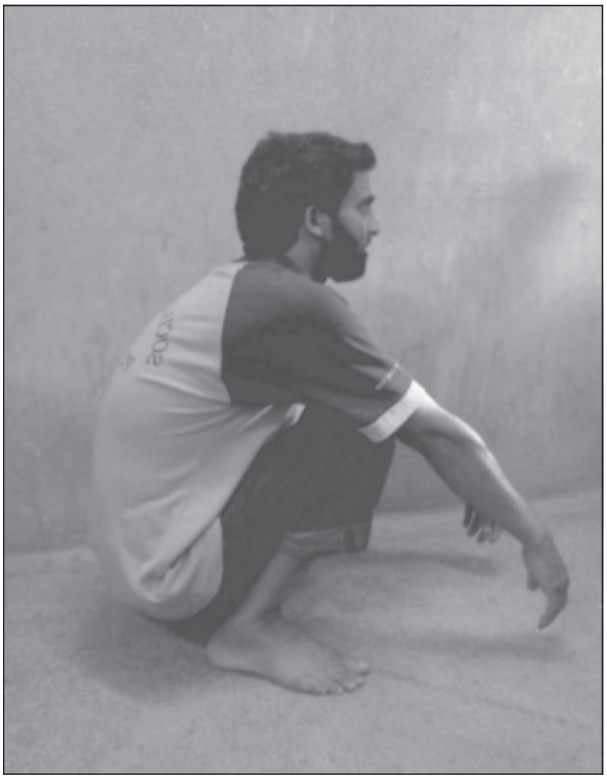
Table-III

Result	Experimental group (Closed) (n=15)		Control group (Open) (n=15)	
	No	Percentage	No	Percentage
Excellent	13	87	6	40
Good	2	13	9	60
Fair	0	0	0	0
Poor	0	0	0	0
Total	15	100	15	100

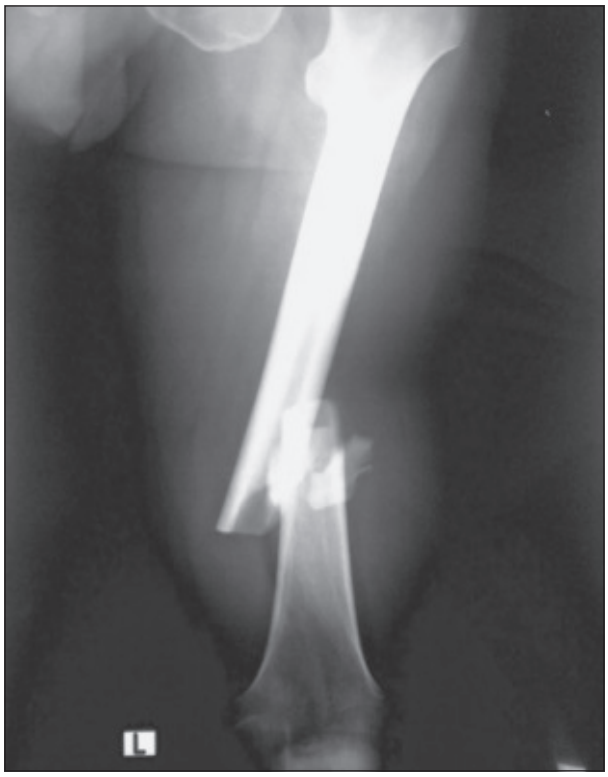
Chi-square test-5.167, P<0.05

Fracture shaft of left femur

Post operative



After 18 weeks of operation



Figures of open nailing

Post operative

After 21 weeks of operation

DISCUSSION

This study was carried out to compare the outcome of closed locking intramedullary nailing versus open intramedullary nailing for closed fracture mid shaft of femur in adult. In this study fracture shaft of the femur was most common in younger people with mean age of 28 years in closed group and 27 years in open group, ranging from 18 to 45 yrs, Winquist et al 1984 in his series reported fracture shaft of femur common in adult with mean age 29.5 years age group. Braten M. et al 1995 observed mean age of 29 years , which are similar with this study . Males were predominantly prone to fracture shaft of the femur due to high incidence found in motor vehicular accidents 93% in each group, in this study males were predominant , Wiss DA et al1986 found male predominance (83.7%) in his 111 patients series which is almost similar with the present study. Motor vehicular accident as the main cause of fracture of femoral shaft i.e. 93 %(14 patients) in closed group and 80%(12 patients) in open group, Winquist et al 1984also had 77% of cases because of motor vehicular accidents. This observation by various authors implies that fracture shaft femur is usually a result of high energy trauma. All patients in this study achieved union, average time for healing of the fracture were 18 weeks for closed group and 20 weeks for open group. Winquist et al had union rate of 99.1%, White et al observed union rate of 99% and average 18 weeks in closed method. Kempf et 1985 al showed 19 weeks of healing time in closed method. Result of closed group regarding healing time similar with previous study where as in open group more time required for healing of fracture . Lauro M.A. et al 2006 reported average healing time for open method was average 20 weeks . In this study, dynamisation done within ten to sixteen weeks in 3 cases (20%) of closed group and 5 cases (33%) of open group . Papakostidis C. et 2011 al performed dynamisation within 10-12 weeks after static IM interlocking nail of fracture shaft of femur which almost similar with the present study . Interval between injury and surgery in this study were 9 days in closed group and 11 days in open group. Hanks et al 1986 reported it as 7.4 days. Delay of operation due to fixed operative day and patients load in this study . In a study Rokkanen P. et 1969 al reported no appreciable difference in the results after early (within one week) compared with those operated upon during the second and third weeks. Average operative time in this study was 101 minutes in closed method and 87 minutes in open methods. Lhowe WD et al in his series reported mean operative time of182 min in 67 patients. Wiss DA et al 1986 had average time for static locking 3 hr 15 min in his111 cases. Less time required in open technique due no need of reduction of fracture in fracture table under C-Arm control . In this study varus malunion found 1 case (7%) in closed group, 3 cases (20%) in open group. Valgus malunion found 1 case (7%) in closed group, 4 cases (27%) in open group. Antecurvatum found 2 case (13%) and recurvatum found 2 cases (13%) in closed group but no antecurvatum/recurvatum found in open

group . William M.R. 2005 reported varus/valgus malunion more in open technique due to lateral positioning of the patient, probably antecurvatum/recurvatum more in supine position in closed method . In closed group 2 cases (13%) found $<10^0$ external and in 1 case (7%) $<5^0$ internal rotation deformity . Excellent knee range of movement seen in all cases of closed technique and 13 cases (87%) of open technique, 2 cases(13%) in open method found good range of knee movement. Helmy N et al 2008 reported full range of movement in 21 patients with closed interlocking for fracture shaft of femur which is similar with this study. Lauro M.A. et al 2006 reported 71% full range and 10% good range of movement after open nailing .1 cm shortening of limb found 2 cases (13%) in closed group and 4 cases (27%) in open group, 2 cm shortening of limb found 1 case (7%) in closed group and 2 cases (13%) in open group. Lauro M.A. et al 2006 reported 1 cm shortening in 14% patients and 2 cm shortening in 10% patients treated with open interlocking nail . Rokkanen P. et al 1969 reported more than 2 cm limb shortening in 3% of fractures treated by closed nailing and 4% in open nailing. In this study more shortening in open nailing due to excision and curettage of fracture end of bone before reduction . In this study no superficial and deep infection found probably due to closed fracture, proper surgical procedure and antibiotics. Wiss et al 1986 reported only 1 superficial infection in 112 patients at the trochanteric incision with no deep infection and no osteomyelitis . In this study 1 case (7%) of closed group and 2 cases (13%) of open group found delayed union and complete union was seen at 23rd weeks. Lauro M.A. et al 2006 reported 14% delayed union in open nailing, which is similar with this study . In this study there was no case of nonunion which better than other series. Rothwell 1982 in his study showed 6 % of non-union . White et al has 1.1 % of nonunion with Brooker-Willis nail. In the closed group- excellent results were observed in 13 (87%), good in 2(13%) cases; where as in the open group excellent results were observed in 6(40%), good in 9(60%) cases. This difference is statistically significant ($P<.05$).

So functional outcome is better in the closed group than open group. This is similar to the study carried out by Rokkanen et al. (1969) – in which closed nailing appeared slightly superior to open nailing. This finding is also supported by the study conducted by Gharehdaghi M. et al. (2007) - they concluded that with closed nailing of femoral shaft fractures, the duration of union was shorter and prevalence on nonunion was lower than in open method .

CONCLUSION AND RECOMMENDATIONS

In the light of the findings of the study, it can be concluded that closed locking intramedullary nailing for mid shaft femoral fracture is superior to open locking intramedullary nailing because the duration of union was shorter, less post operative pain and good range of knee motion . While the prevalence of malalingnment of fractures were higher in closed group . Thus in closed method attention should be paid to malalignment while locking the nail. But in open nailing there is large surgical skin scar, more blood loss, loss of fracture haematoma (which is important in fracture healing) delayed healing and persistent mild pain .

We recognize that this study has several limitations. These include small number of sample size and a short follow-up period. So, further prospective study with larger sample and longer follow-up period is recommended .

REFERENCES

1. Braten M., Terjesen T., Rossvoll I., 1995, 'Femoral shaft fractures treated by intramedullary nailing. A follow-up study focusing on problems related to the method', *Injury*, vol. 26, no. 6, pp379-383 .
2. Brumback R.J., Lakatos R., 1988, 'Intramedullary nailing of femoral shaft fractures', *J. Bone Joint Surg.*, Nov, vol 70Am, no.10, pp 92-94.
3. Gharehdaghi M., Rahimi M., Bahari M., Afzali Z., 2007, 'A prospective study of closed and open reamed intramedullary nailing of 136 femoral shaft fractures in adults', *Journal of Research in Medical Sciences*, Vol. 12, No. 1, pp16-20.
4. Guodong W., Tao P., Xinsheng P., Jun W., 2008, 'A new intramedullary nailing device for the treatment of femoral shaft fractures: A biomechanical study', *Clinical Biomechanics* ,vol. 23, pp 305–312.
5. Helmy N.,Victor T.J., Thomas L,Holman C., Peter J.O., 2008, 'Muscle Function and Functional Outcome Following Standard Antegrade Reamed Intramedullary Nailing of
6. Isolated Femoral Shaft Fractures', *J Orthop Trauma*, Vol. 22, no. 1,pp10-15.
7. Kempf I, Grosse A and Beck G., 1985, 'Closed locked intramedullary nailing — Its application to comminuted fractures of the femur', *J Bones & Joint Surg*, June, vol 67Am, no. 5:pp 709-720.
8. Lhowe D. W., 1988, 'Immediate nailing of open fracture of the femoral shaft', *JBJ Surg*, Vol-70A, pp 812-820.
9. Lauro M.A., Camilo V.T., Fortune D.C., 2006, 'Delayed Open Intramedullary Nailing of Femoral Shaft Fractures', *Techniques in Orthopaedics,* Vol. 21, no. 2,pp88-98.

10. Papakostidis C., Psyllakis L., Vardakas D., Grestas A., Giannoudis P. V., 2011, 'Femoral-shaft fractures and nonunions treated with intramedullary nails: The role of dynamisation' *Injury,* Vol-42, pp1353-1361

11. Rokkanen P., Slatis, Vankka P., 1969, 'Closed or open intramedullary nailing of femoral shaft fractures, A comparison with conservatively treated cases', *The journal of bone and joint surgery,* vol. 51-Br, no. 2, pp 313-322.

12. Rothwell A.G., 1982, ' Closed Kuntscher nailing for comminuted femoral shaft fractures'. *The journal of bone and joint surgery,*vol. 64Br,no. 1, pp12-16.

13. Thoresen B. O., Alho A., Ekeland A., Stromsoe K., Follaras G., Haukeb A., 1985, 'Interlocking intramedullary nailing in femoral shaft fractures, a report of forty-eight cases' *The journal of bone and joint surgery,* vol. 67-Am, no. 9, pp 1313-1320.

14. Winquist, R.A., Hansen Jr., S.T., Clawson, D.K., 1984, 'Closed intramedullary nailing of femoral fractures. A report of five hundred and twenty cases' *J. Bone Joint Surg*. Vol. 66-Am, no 4, p529-539.

15. Wiss D. A., 1990, 'Interlocked nailing for treatment of segmental fractures of the femur' *JBJS*, Vol-June72A, pp724-728.

16. Wiss D.A., Fleming C.H., Matta J.M., 1986, 'Comminuted and rotationally unstable fractures of the femur treated with an interlocking nail', *Clinical Orthopaedics & Related Research* , vol. 212, pp35-47.

17. William M.R., 2005 'Femur: Trauma',in *Orthopaedic knowledge update home study syllabus,* 8th ed , Alexander R.V.,AAOS, p427.

18. White G.M., Healy W.L., Brumback R.J., 1986, 'The treatment of fractures of the femoral shaft with the Brooker -Wills distal locking intramedullary nail', femur' *The journal of bone and joint surgery*, vol. 68Am, no. 6, pp28-34.

19. Whittle P. A., 2008, 'Fractures of the Lower Extremity', in *Campbell's Operative Orthopaedics,* 11th ed. S. T. Canale, J. H. Beaty, Mosby Elsevier, Philadelphia, pp3085-86

20. Zbigniew G., Yaqdan T. Q., John A. H., Ronald W. L., 2011, 'Long-term functional implications of the iatrogenic rotational malalignment of healed diaphyseal femur fractures following intramedullary nailing', *Clinical Biomechanics* ,vol. 26, pp 274–277.

00 00

Case Report

Management of Chronic Osteomyelitis of Femur with Interlocking Intramedullary Nail in a Youngman A Case Report

Alamgir M HM[1], Islam M[2], Islam N,[3] Hasan F[4], Dr Easa[5], Indrojit Kumar Kundu[6]

ABSTRACT:

Chronic osteomyelitis is relatively unusual complication of intramedullary nail fixation of long bone fractures .Depending on the extent of infection,timing of diagnosis and progress of fracture healing ,different treatment options have been developed. There is no hard and fast rule for the treatment of chronic osteomyelitis related to implant.Still now it is a big challenge for orthopaedic surgeons to handle such cases. Some options are very costly and time consuming.We are reporting here such a case of chronic osteomyelitis of femur fracture fixed with interlocking nail in a 23 year youngman.His fracture was a closed one. Appropriate therapy for chronic osteomyelitis complicating a fracture is based on a multimodality approach even if there is no set algorithm to take in charge the two central problems related to it namely eradication of infection and fracture union. The surgical techniques and choice of fracture fixation determined according to age, weight, profession ,intellectual status of patient and the expertise available. Clinical signs and investigation should alert the surgeon to the possibility of an underlying infection and appropriate measures should taken quickly. It is important not to underestimate local skin irritation or signs of inflammation .

Key words: femur, fracture, interlocking nail, infection, external fixator, Ilizarov

INTRODUCTION:

Long bone fractures are severe injuries commonly resulting from high energy trauma due to road traffic collisions. A substantial amount of energy is transferred to limbs leading to damage of soft tissue envelope as well as hard tissue like bone. Intramedullary nail fixation is considered gold standard treatment of femoral shaft fracture[1].The risk of developing infection following intramedullary nailing of closed long bone fracture is thought to be similar to general risk of infection after any orthopaedic procedure but this risk is substantially increased in the setting of open fracture and has been reported to 4 to 7%[2].The incidence of infection following closed long bone fracture approaches 1-2% [3].

Fig.-1: *Showing fracture before operation.*

1. Assistant Professor, Dept. of Ortho-surgery,Shaheed Suhrawardy Medical College Dhaka.
2. Associate Professor, Dept.of Orthosurgery Shaheed Suhrawardy Medical College,Dhaka
3. Resident Surgeon, Dept. of Orthosurgery Sheed Suhrawardy Medical College, Dhaka
4. Assistant Registrar, Dept.of Orthosurgery, Shaheed Suhrawardy Medical College Dhaka
5. Medical Officer, Dept. of Orthosurgery ,Shaheed Suhrawardy Medical College,Dhaka.
6. Medical Officer, Orthopaedic, BSMMU, Dhaka

Correspondence: Dr. MHM Alamgir, Asstt. Prof. Dept. of Orthosurgery Shaheed Suhrawardy Medical College Dhaka , E-mail d.malamgir@yahoo.com

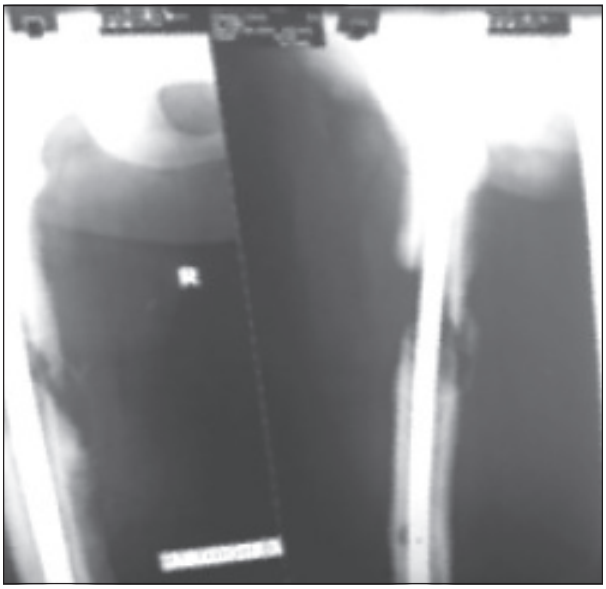


Fig.-2: *Showing infected nonunion after six months of first operation.*

Fig.-3: *Showing the fracture is uniting after application of external fixator.*

CASE REPORT:

In 20.04.2013 a 23year young man admitted in our orthpaedic ward with the complaints persistent pain ,swelling and discharging sinus of right thigh .He had closed fracture of right femoral shaft due motor cycle accident on 12/09/12 and operated on 17/o9/12. The fracture was fixed with open interlocking intramedullary nail in a private setting clinic at district town. Before and during operation his vital parameters were normal. There was no history of loss of consciousness after accident .He gradually developed persistent pain, redness around the incision line and fever .Accordingly he was treated with antibiotics of different kinds but not cured . In this situation he developed severe pain, swelling and ultimately pus started to discharge from lateral aspect of thigh. We investigate him thoroughly. His serial x-rays showed destruction of fracture margins, a little new bone formation at vicinity of fracture and several pieces of sequestra . We stared antimicrobial therapy as per culture –sensitivity and prepared him for operation . We did a surgical toileting and removed dead soft and hard tissues keeping the implant in situ .Wound remains open and gradually healed. But again he developed discharging sinus. At this time we x-rayed the right thigh and showed linear callus approaching towards fracture line.

As there was continuous discharge of pus, we planned for removal of nail and refixation of fracture with uniaxial external fixator. In 13/07/13 we did it maintaining length of femur and wound remains open . Antibiotic continued accordingly .Serial x-ray of right thigh showed progressive union after 3 months. Now he can walk without any walking aid. His knee movement is about 40-180 degree and there is no limb length discrepancy.

DISCUSSION

Long bone fractures are common orthopaedic injuries and occurs in the setting of severe trauma .Since its introduction by Kuntscher intramedullary nail has became choice of treatment for diaphyseal long bone fractures[4,5]. Intramedullary nailing is a technically demanding procedure that requires vigilance and careful planning in order to get optimal outcome. Majors complications following this procedure includes infection, compartment syndrome, venous thrombosis, fat embolism syndrome ,neurovascular damage and nonunion. All these complications could have a significant impact on the ultimate functional outcome of patients[6].The incidence of infection following closed fractures of long bones is approximately 1-2%[3].This incidence is commonly higher, for Gustilo type 1 5%, type ii 10%, type iii 15%[7,8,9].

Previous studies show that intramedullary nailing fixation provides a stable construct and allows fracture to heal even in presence of infection[9].The critical factors influencing the risk of developing infection was the complexity of fractures and not the techniques used[10]. Bachut et al concluded that there is no major advantages to nailing without reaming compared to nailing with reaming for treatment of closed long bone fractures[11].The meticulous clinical evaluation ,detailed diagnostic work-up and a specific treatment strategy are critical factors in

diagnosing the presence of infection after surgical procedure of long bone fractures [12]. Criteria for clinical infection include an open wound with discharging sinus, fever persistent pain and local signs of inflammation. The laboratory investigations include full blood cell count ,c-reative protein, erythrocyte sedimentation rate along with imaging studies can lead to an accurate diagnosis of underlying infection[13].The culture of the infected tissues provides the final diagnosis [13].Kostas G et al proposed an oncologic approach in order to diagnose and manage an infection begins from clinical staging and ending with removal of affected tissues[14].Different strategies for treatment of infected nail have been reported by several authors .Some of them involve retaining nail ,thorough irrigation ,and soft tissues debridement followed by intravenous antibiotics[15].This method considers union of fracture as the most important factor and secondarily deals with infection .Second strategy aims to the eradication of infection as the main objective and involves removal of infected nail ,debridement ,antibiotics and refixation of fracture to achieve union. The main drawback of this method is that soft tissue and bone debridement can lead to sizeable defects requiring reconstruction by additional skills and expertise[16].The methods of treatment depend on stage of infection and progress of fracture union. Infections are classified into three stages[17].

The first stage is defined as bacterial cellulitis occurs in the postoperative period usually within 2-6 weeks, 2nd stage is defined between 2-9 months postoperatively and is associated with delayed wound healing ,wound necrosis, or discharge from the operative site. An impaired fracture healing response might be present . Infection presents in the bone in this stage.The 3rd stage infection (late) is represented with established intramedullary osteomyelitis. The 1st stage can be successfully treated with nail retainment, debridement where necessary and specific antibiotic administration intravenously[18,19]. 2nd stage infections were reported to heal successfully either with nail retainment ,antibiotics and removal of nail with reaming of intramedullary canal after union of fracture [20,21,22] or with nail removal and new antibiotics nail placement[23, 24,]. An alternative option could be an exchange nailing procedure with antibiotic administration although the burden of surgery is greater[25,26,27].Stage iii infections are better managed with debridement ,exchange nailing and antibiotic administration[28,29,22].Finally for stage iii infected non-unions it appears that Ilizarov method is most commonly used with good results when significant bone defects exist[30].

Conclusion; The treatment of infection following intramedullary nailing of long bone fracture remains challenging and the surgeon has to consider the most appropriate treatment option in order to achieve the best clinical results and minimizing the risk of revision surgery. Prompt clinical examination and laboratory screening is mandatory for early diagnosis and treatment to achieve optimum clinical result.

ACKNOWLEDGEMENT

We acknowledged to our patient, his family members and all concerned personnels.

REFERENCES

1. Ikem IC,Ogunlusi JD, Ine HR. Achieving interlocking nails without using an image intensifier;Int'l Ortho 2007;4:487-90.
2. Young S, Lie SA, Hallan G,Zirkle LG.Engesaeter LB,Havelin LI:Risk factors for infection after 46,113 intramedullary nail operations in low and middle income countries.World J Surg 2013;37(2):349-55
3. Duan X, AL-Qwbani M, Zeng Y, Zhang W, Xiang Z; Intramedullary nailing for tibial shaft fractures in adults.Cochrane Database Syst. Rev 2012;1:CD008241.
4. Bong MR, Kumar FJ,Koval KJ,Egol KA;Intramedullary nailing of lower extremity ;biomechanics and biology; J Am Acad Orthop Surg 2007;15 (2):97-106.
5. Hiesterman TG, Shafiq BX, Cole PA.Intramedullary nailing of extra-articular proximal tibia fractures. J Am Acad Orthop Surg 2011;19(11):690-700.
6. Ricci WM, Gallagher B, Haidukewych GJ.Intramedullary nailing of femoral shaft fractures ;current concepts; J Am Acad Orthop Surg 2009;17(5):296-305.
7. Henley MB, Chapman JR. Agel J, Harvey EJ, Whorton AM, Swiontkowski MF. Treatment of type ii iiiA and iiiB open fractures of tibial shaft ;a prospective comparison of undreamed interlocking intramedullary nails and half pin external fixators ;J Orthop Trauma 1998:12:17.
8. Guo JJ, Tang N , Yang HL, Tang TS.A prospective ,randomized trial comparing closed intramedullary nailing with percutaneuos plating in the treatment of distal metaphyseal fractures of tibia. J Bone Joint Surg Br2010:92:(7):984-8.
9. Littenberg B, Weinstein LP, Mc Carren M, et al. Closed fractures of tibial shaft .A meta-analysis of three methods of treatment . J Bone Joint Surg Am 1998;80(2):174-83.
10. Vallier HA, Cureton BA, Patterson BM. Randomised prospective comparison of plate versus intramedullary nail fixation for distal tibia shaft fractures. J Orthop Trauma 2011:25(12):736-41.

11. Blachut PA, O'Brien PJ,Meek RN, Broekhuyse HM. Intralocking intramedullary nailing with and without reaming for the treatment of tibia shaft fractures.A prospective randomized study . J Bone Joint Surg Am1997:79(5):640-6

12. Althanasou NA, Simpson AHR, Wood MK. Histological assessment of the presence or absence of infection in fracture nonunion .Injury 2002:33:151-5.

13. Mathews PC, Berendt AR, McNally MA, Byren I. Diagnosis and management of prosthetic infection.BMJ 2009:2009:338:b1773.

14. Kostas G. Makrisdis, Theodoros Tosounidis and Peter V. Giannoudis,The Open Orthopaedics Journal 2013:7:(Suppl 2:M8)219-226

15. Motsitsi NS. Management of infected nonunion of long bones:the lastdecade (1996-2006).Injury 2008:39(2): 155-60.

16. Eshima I, Feibel RJ, Louie KW, Lowenberg DW. Combined muscle flap and Ilizarov reconstruction for bone and soft tissue defects. Clin Orthop Relat Res.1996:(332):37-51

17. Romano CL, Romano D, Logoluso N, Drago L: Bone and joint infections in adults: a comprehensive classification proposal .Eur Orthop Traumatol 2011:(16):207-17

18. Aderinto J, Kearing JF: Intramedullary nailing of the fractures of tibia in diabetes:J Bone Joint Surg Br2008:90(5):638-42.

19. Kakar S, Torrentta P3rd. Open fracture of tibia treated by immediate intramedullary tibial nail insertion without reaming: a prospective study . J Orthop Trauma 2007:21(3):153-7..

20. Haung CK, Chen WM, Chen TH, Lo WH. Segmental tibial fractures treated with interlocking nails.A retrospective study of 23 cases .Acta Orthop Scand 1997:68 :(6):563-6tarski

21. Nowotarski P, Bru mback RJ: Immediate interlocking nail of fractures of femur cause by low to mid velocity gunshots . J Orthop Trauma 1994:8(2):134-41

22. Court-Brown CM,Keating JF,McQueen MM: Infection after intramedullary nail of fracture tibia:Incciddence and protocol for management .J Bone Joint Surg Br 1992: 74(5):770-4.

23. Vallier HA, Cureton BA, Patterson BA. Randomised prospective comparison of plate versus intramedullary nail fixation for distal tibia shaft fractures. J Orthop Trauma 2011:25(12):736-41.

24. Sekimpi P,Okike K, Zirkle L, Jawa A. Femoral shaft fracture fixation in developing countries an evaluation of surgical implant Generation Network (SIGN) intramedullary nail. J Bone Joint Surg Am 2011; 93(19):1811-8.

25. Roboinson CM, Mclauchlan G, Christie J, McQueen MM,Court-Brown CM. Tibial fractures with bone loss treated by primary reamed intramedullary nailing. J Bone Joint Surg Br1995:77(6):906-13.

26. Rutter JE, de Vries LS, van der Werken C, Intramedullary nailing of open femoral shaft fractures. Injury 1994:25(7):419-22.

27. Nowotarski P,Brumback RJ. Immediate interlocking nailing of femoral fractures caused by low-to mid velocity gunshots.J Orthop Trauma 1994:8(2):134-41

28. Kadar S, Toretta P 3rd. Open fractures of the tibia treated by immediate intramedullary nail insertion without reaming :a prospective study .J Orthop Trauma: 2007: 21(3):153-7

29. Keating JF,Blachut PA, O'Brien PJ, Cort-Brown CM.Reamed nailing of Gustilo grade-iiiB tibial fractures .J Bone Joint Surg Br2000:82(8):1113-6.

30. Megas P, Saridis A, Kouzelis A, Kallivokas A, Mylonas S, Tyllianakis M. The treatment of infected nonunion of the tibia following intramedullary nailig by the Ilizarov method. Injury : 2010:41(3):294-9.

Original Article

Evaluation of Results of Midshaft Fracture of Humerus by Interlocking Nailing- 32 Cases

Md. Golam Sarwar[1], MA Gani Mollah[2], Nur Mohammad[3], Riad Majid[4], Mahfuzur Rahman[5] Dulal Chandra Datta[6]

ABSTRACT

The most fractures of the humeral shaft are inherently unstable, non-operative treatment remains the gold standard[1]. However, the role of surgery, patient selection, type of surgery appropriate is dependent on the patient & the fracture configuration.

In our retrospective study of 32 cases with mid shaft fractures of humerus treated with antegrade locked intramedullary nailing were satisfied with the good results. The mean duration of hospitalization after surgery was 4 days, there were 4 complications-one implant breakage, one infection, one radial nerve palsy required tendon transfer & one impingement syndrome, and the average operation time was 45 minutes. The mean time to consolidation was 16 weeks. There were 2 delayed unions, with a mean time to union were 40 weeks. One patient need subsequent surgery to union of the fracture due to nail breakage & one patient required implant removal because of infection but union achieved thereafter.

The average consolidation rate was over 80%.

Key wards: humeral mid shaft fracture, intra medullary nailing, antegrade, satisfactory result.

INTRODUCTION

Although most fractures of the humeral shaft are inherently unstable, non operative treatment remains the gold standard, but surgical treatment of humeral mid shaft fractures should be considered for multiple reasons.

The relevant anatomy should be clearly understood for operative procedure. The humeral shaft is the area extending from the upper border of the pectoralis major tendon to the supra condylar ridge. The proximal half is almost cylindrical, while distally, the anteroposterior diameter narrows into a prismatic shape. The posterior surface (between the medial and lateral borders) is the largest. The radial sulcus, which contains the radial nerve and, at its midpoint, is the nutrient foramen, crosses the posterior middle third of the humerus.

The large muscles that surround the humerus prevent direct palpation. The arm is divided into anterior and posterior compartments by 2 intermuscular septa: medial and lateral. The anterior compartment contains the biceps brachii, coracobrachialis, and brachialis muscles; the brachial artery and vein; and the median, musculocutaneous, and ulnar nerves. The triceps muscle and the radial nerve are contained in the posterior compartment.[15]

MATERIALS & METHODS

32 patients with fracture mid shaft of humerus were treated with closed antegrade intra medullary interlocking nail fixation were included in this study. The patients were treated in NITOR & other private settings during the period of June 2009 to December 2013.

All 32 patients were selected by the following criteria: closed mid shaft fracture of humerus, open fracture (Gustillo-1) within 72 hours, transverse / short oblique fracture, no comminuted fractures involved in this study, child below the age of 18 years, male & female both sexes were included.

Exclusion criteria were proximal & distal humeral fractures, open fractures Gustillo-2 or above, comminuted fractures,

1. Assistant Professor, Department of Orthopaedics, NITOR, Dhaka
2. Professor, Department of Orthopaedics, NITOR, Dhaka
3. Associate Professor, Department of Orthopaedics, BICH, General Hospital, Dhaka
4. Assistant Registrar, NITOR, Dhaka
5. Medical Officer, Department of Orthopaedic Surgery, BSMMU, Dhaka
6. Assistant Professor, NITOR, Dhaka

Correspondence: Dr. Md. Golam Sarwar, Assistant Professor, Department of Orthopaedics, NITOR, Dhaka

fractures with acute nerve injury, patients below the age of 18 yrs, old patients with frozen shoulder or impingement syndrome, debilitating & bed ridden patients.

The average age at the time of surgery were 8 hours, ranges 18-64 hrs, among them 24 cases were due to road traffic accident & 6 were fall from height, 2 cases were caused by others. The right humerus were 22 & left were 10, average age were 28.8, ranges from 18-60, operations time were 45 minutes, average hospital stay were 4 days.

Pre-operative radiographs were assessed for fracture pattern, degree of commination & site of fracture. All of the cases were evaluated by using the AO classification. According to the AO classification they were A-87.5%, B-12.5%, C-00.0% &<10% were open (3 cases were open, account for 9.3%).

There were bimodal age distribution with peak third decade in men Z& large peak in sixth decade in women.

DISCUSSION

Most closed fractures of the humeral shaft can be treated successfully with closed methods; union rates of more than 90% are often reported.[7,16,17] Multiple closed techniques are available, including the employment of traction, as well as the use of the hanging arm cast, co-aptation splint, abduction shoulder spica cast, or functional brace.[7,16] All of these techniques have been used successfully, but closed humeral shaft fractures are usually treated with a hanging arm cast or a co-aptation splint for 1-3 weeks, after which they are placed in a functional brace.[7,8,9,17]

Rockwood recommends using hanging arm casts initially for oblique or spiral fractures with shortening,[7] when a hanging arm cast is employed, it should be replaced, once reduction is adequate, with another treatment method or should be monitored very closely to look for fracture distraction and nonunion.[17] In some cases, a functional arm brace also can be applied as the initial treatment.

Sarmiento and colleagues first used the functional brace in 1977.[18] The fracture is kept in position through soft-tissue compression, and the brace is tightened as the swelling decreases. A functional brace should not be used when massive soft-tissue injury or bone loss has occurred, when an acceptable fracture alignment cannot be maintained, or if the patient is unreliable or uncooperative.[19]

The main problem remains in nonoperative treatments (e.g., functional bracing, hanging arm casts, co-aptation splinting) to work most effectively, the patient should remain upright, either standing or sitting, and should avoid leaning on the elbow for support. This allows gravitational force to assist in fracture reduction. The patient should begin ROM exercises of the fingers, wrist, elbow, and shoulder as soon as these can be tolerated.

Acceptable alignment of humeral shaft fractures is considered to be 3 cm of shortening, 30° of varus/valgus angulation, and 20° of anterior/posterior angulation.[8,20] Varus/valgus angulation is tolerated better proximally, and more angulation may be tolerated better in patients with obesity. Patients with large, pendulous breasts who are treated nonsurgically are at increased risk of varus angulation. No set values for acceptable malrotation exist, but compensatory shoulder motion allows for considerable tolerance of rotational deformity.[8]

Patients with humeral shaft fractures present with arm pain, deformity, and swelling. The arm is shortened, with motion and crepitus on manipulation. A careful neurovascular evaluation of the limb must be documented, because the incidence of radial nerve injuries is approximately 16%.[9] If indicated, Doppler pulse and compartment pressures should be checked.[8,10,11]

The surgical treatment of humeral shaft fractures should be considered for multiple reasons. One indication for surgery is an inability to maintain the fracture in adequate alignment using closed methods. Factors that can account for this inability include the following:

Fracture pattern - Displaced, comminuted, or segmental (segmental fractures are at risk of nonunion at 1 fracture site or at both of them)[12].

Prolonged recumbency or an inability to maintain a semisitting or reclined position, as in a patient with multiple traumatic injuries

Noncompliance: Ipsilateral fracture of the ulna and/or radius is another indication for surgery, requiring stabilization of the humeral and forearm fractures to allow early range of motion (ROM).[8,9,13] If the patient has bilateral humeral fractures, 1 or both should be fixed to allow patient self-care.[7] Operative indications also include open fractures, existing or impending pathologic fractures, and fractures associated with a vascular injury that requires repair.]

Spinal cord or brachial plexus injuries are indications for surgery.[13] Surgery is also indicated for fractures of the humeral shaft that are associated with displaced intra-articular fracture extension.[14]

Open reduction and internal fixation (ORIF) with direct fracture exposure often yields near anatomic alignment.

The rates of nonunion and hardware failure requiring revision range from 0-7%.[12,21] The ROM of the elbow and shoulder predictably returns after plate fixation; when complete motion is not obtained, it is often the case that other associated skeletal or neurologic injuries exist.[13] Evidence also suggests that immediate weight bearing on an upper extremity that has been treated with ORIF has little or no deleterious effect.[22] The most common complications associated with plating procedures are iatrogenic nerve palsy (0-5%, with most cases being a transient problem that requires no further intervention) and infection (0-6%).[12,21,23]

Fig.-1 (A): Pre-operative x-ray

Fig.-1(B): Immediately post-operative x-ray

Fig.-1(C): After 3 month

Fig.-2(A): Pre-operative x-ray

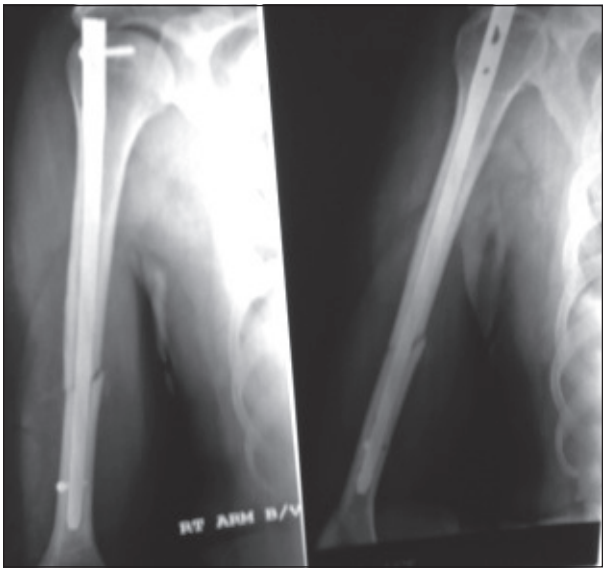


Fig.-2(B): Immediately post-operative x-ray

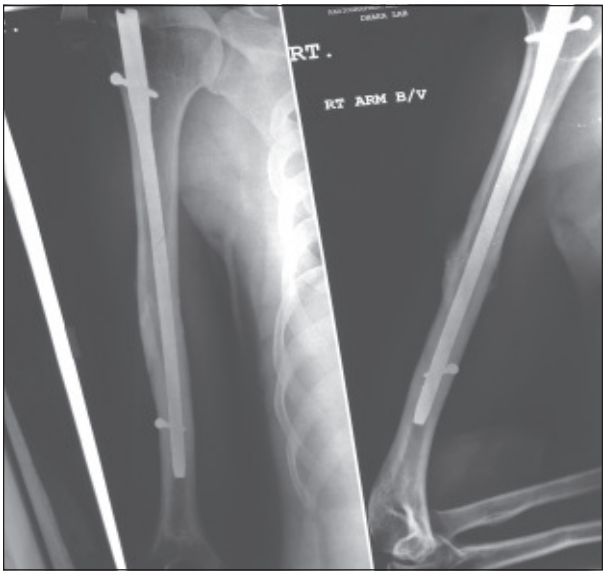


Fig.-2(C): After 3 month

The 2 approaches that are used for fracture exposure and plate application are the posterior approach and the anterolateral approach. Either approach is adequate for fractures in the midthird and distal third, but fractures in the proximal third often require the anterolateral approach.[7,8,13,17]

Some surgeons prefer not to plate humeral shaft fractures because of the difficulties of dealing with fracture exposure, the technical aspects of plating, and complex fracture patterns, as well as because of concerns about radial nerve injury.[13,26]

Intramedullary (IM) fixation has gained popularity over the last several years. Initial reports revealed that there was a higher nonunion rate following such fixation than there was with conservative treatment or with ORIF with plates and screws. However, several reports have demonstrated that with newer implants and improved techniques, locked IM nailing can achieve a success rate as high as that of the other methods.[1,23,27,28-36] In these studies, the incidence of nonunion is approximately 6%, the incidence of infection is 2%, and the incidence of radial nerve palsies is 3%. IM nailing can be used to stabilize fractures that are 2 cm below the surgical neck to 3 cm proximal to the olecranon fossa.[8] Results comparing ORIF with locked IM nailing have failed to demonstrate any difference in blood loss or operating room time.[13,23]

IM nails have certain potential advantages over plates and screws. The IM nail is closer to the normal mechanical axis and can act as a load-sharing device if there is cortical contact. The nails are subjected to lower bending forces, making failure by fatigue less likely to occur.[8] IM nails can be placed without direct fracture exposure and with much less soft-tissue dissection. Additionally, cortical osteopenia caused by stress shielding (as seen with plates and screws) is less likely.

Standard locked intramedullary humeral nails can also be inserted either antegrade or retrograde. The antegrade approach typically involves a starting point at the proximal humerus; this point can be through the rotator cuff, where the tissue is less vascular, or just lateral to the articular surface, where the blood flow is higher.

The procedure can be started with a small incision made with the aid of fluoroscopy or with a larger incision, where the cuff is identified and purposefully incised. No evidence has indicated that either method is superior.[37,38,39] The nail can be placed with or without reaming (no evidence suggests that either method is superior with regard to healing time and complication rate) and then be locked proximally and distally.[13] Care must be exercised when placing the proximal locking screws because the axillary nerve lies 5-6 cm distal to the edge of the acromion.[26] The distal locking screw can often be placed lateromedial or anteroposterior. The lateromedial technique puts the radial nerve at risk, and the anteroposterior method places the musculocutaneous nerve at risk. An alternative and possibly safer method involves placing the screw posteroanteriorly.[9]

Retrograde insertion requires a distal triceps splitting approach and a hole placed 2.5 cm proximal to the olecranon fossa, measuring 1 cm in width and 2 cm in length.[13] The starting hole must be beveled along the path of the nail

insertion.[9] The nail can be locked proximally, either lateromedially (placing the axillary nerve at risk) or anteroposteriorly (placing the biceps tendon at risk).

The use of flexible nails (often Ender nails with a 3.5-mm diameter) has become limited to isolated cases of transverse or short oblique fractures with a canal larger than 7 mm. These nails can be inserted either retrograde (more common, triceps splitting with an entry portal just above the olecranon fossa) or antegrade. These nails can be locked at the end with wire or 3.5-mm cortical screws to prevent migration, but no method of statically locking these nails exists. Therefore, bending and angulation can still occur in spiral or comminuted fractures.

The outcome of humeral fractures treated with flexible IM nailing (Ender nails) reveals that antegrade insertion is associated with shoulder dysfunction (pain and decreased ROM) in 5-10% of patients and that hardware removal is not entirely effective in relieving symptoms.[40,41,42] A starting point outside the rotator cuff may help to decrease these numbers. Reports on the use of Rush rod fixation have demonstrated unacceptably high rates of nonunion, delayed union, and shoulder pain.[43] With retrograde nailing, union rates vary from 91-98%, and infection (which is mostly associated with open fractures) varies from 0-2%. With the use of multiple nails, hardware failure is reported to be rare, and the rate of iatrogenic radial nerve injury, which is usually temporary, is placed at 3%.[13]

Locked IM nailing in an antegrade fashion has resulted in loss of shoulder motion in 6-37% of cases.[37,39] It has also been reported that retrograde nailing is not associated with shoulder pain and that the return of elbow motion is not a problem unless other associated injuries are located in the fractured extremity.[13] A concern also exists that, once the retrograde nail has been placed, the starting hole just distal to this may act as a stress riser.[26] Biomechanical studies have shown that, for midshaft fractures, retrograde and antegrade nailing showed similar initial stability, bending, and torsional stiffness. In proximal fractures (10 cm distal to the greater tuberosity tip), the antegrade nails have demonstrated significantly more initial stability and higher bending and torsional stiffness, as has been true for distal fractures with retrograde nailing.[44]

Nonunions in humeral fractures after treatment with plate and screws typically respond well to replating with the addition of bone graft. This is not the case when nonunions follow treatment with humeral nails. If a humeral nonunion treated with an IM nail is treated with exchange nailing, the success rate can be as low as 40-60%.[39,45] However, if the nail is removed and ORIF with bone grafting is performed, the union rate is again very high. However, this is a more technically difficult scenario.[26]

Modified techniques for minimally invasive plating have been reported.[46,47] Although minimally invasive plate osteosynthesis (MIPO) is a difficult procedure, satisfactory outcomes have been achieved by skilled surgeons with an understanding of neurovascular anatomy.[47]

Traditionally, the external fixation of humeral shaft fractures has been limited to open fractures. The open wound should be treated in an appropriate manner and, for Gustilo grade I or II wounds, be followed by ORIF or unreamed IM nailing. For grade III wounds, external fixation is the treatment of choice. Debridements are performed every 48 hours until the wound is clean. Then, at the final debridement, bone grafting may be used if needed.[17] A high complication rate has been associated with the treatment of humeral shaft fractures with an external fixator.[48]

The patient's position for surgery is determined by the method chosen for fixation. Antegrade nailing of the humerus is performed with the arm draped free and the patient in either a beach chair or a supine position. For the placement of distal locking screws, the c-arm can be rotated 180° so that the top can be used as a table to support the arm. Retrograde nailing is performed with the patient in the prone position and the arm supported on a radiolucent arm board.

Results and complications

The average follow up was 2 years, ranges from 2 months to 24 months. All the fractures were healed in our study group, but before union one patient was a fall on the slippery ground & break her nail, (we remove the nail and refixed by Locking DCP with bone graft) one patient had infection,(we removed the nail, do adequate curettage & debridement, healed eventually) one had radial nerve palsy need tendon transfer & one had impingement syndrome.

FUTURE PLAN & SUGGESTION

The best operative treatment modality has still not been fully determined. An association between fractures treated with antegrade IM nailing and a higher number of shoulder complications were usual, but cases involving newer nails, such as the Synthes flexible humeral nail (with a starting point lateral to cuff insertion),have a better result yet.

REFERENCES

1. Lin J, Hou SM, Hang YS, et al. Treatment of humeral shaft fractures by retrograde locked nailing.

ClinOrthopRelat Res. Sep 1997;(342):147-55. [Medline].

2. Persad IJ, Kommu S. U cast or functional bracing following fractures of the shaft of humerus. Emerg Med J. May 2007;24(5):361. [Medline].

3. Ekholm R, Adami J, Tidermark J, Hansson K, Törnkvist H, Ponzer S. Fractures of the shaft of the humerus. An epidemiological study of 401 fractures. J Bone Joint Surg Br. Nov 2006;88(11):1469-73. [Medline].

4. Connolly S, McKee MD, Zdero R, Waddell JP, Schemitsch EH. Immediate Plate Osteosynthesis of Open Fractures of the Humeral Shaft.J Trauma. Jan 8 2010;[Medline].

5. Heineman DJ, Poolman RW, Nork Sean SE, Ponsen KJ, Bhandari M. Plate fixation or intramedullary fixation of humeral shaft fractures. ActaOrthop. Apr 2010;81(2):218-25. [Medline].

6. Pretell J, Rodriguez J, Blanco D, Zafra A, Resines C. Treatment of pathological humeral shaft fractures with intramedullary nailing. A retrospective study.IntOrthop. Apr 2010;34(4):559-63. [Medline].

7. Zuckerman JD, Koval KJ. Fractures of the shaft of the humerus. In: Rockwood CA, Green DP, Bucholz RW, et al, eds. Rockwood and Greens' Fractures in Adults. 4th ed. Philadelphia, Pa: Lippincott-Raven; 1996:1025-53.

8. Beaty JH. Humeral shaft fractures. In: Orthopaedic Knowledge Update. Rosemont, Ill: American Academy of Orthopaedic Surgeons; 1999:278-86.

9. Hartsock LA. Humeral shaft fractures. In: Levine AM, eds. Orthopaedic Knowledge Update, Trauma. Rosemont, Ill: American Academy of Orthopaedic Surgeons; 1999: 23-32.

10. Garcia A Jr, Maeck BH. Radial nerve injuries in fractures of the shaft of the humerus. Am J Surg. May 1960;99:625-7. [Medline].

11. Shao YC, Harwood P, Grotz MR, Limb D, Giannoudis PV. Radial nerve palsy associated with fractures of the shaft of the humerus: a systematic review. J Bone Joint Surg Br. Dec 2005;87(12):1647-52. [Medline].

12. Foster RJ, Dixon GL Jr, Bach AW, et al. Internal fixation of fractures and non-unions of the humeral shaft. Indications and results in a multi-center study. J Bone Joint Surg Am. Jul 1985;67(6):857-64. [Medline].

13. Gregory PR, Sanders RW. Compression plating versus intramedullary fixation of humeral shaft fractures. J Am AcadOrthop Surg. Jul 1997;5(4):215-23. [Medline].

14. Schatzker J. Fractures of the humerus. In: Schatzker J, Tile M, eds. The Rationale of Operative Fracture Care. New York, NY: Springer-Verlag; 1987:61-70.

15. Williams PL, Warwick R, Dyson M, et al, eds. Gray's Anatomy. 37th ed. New York, NY: Churchill Livingstone; 1989:406-10.

16. Crenshaw AH. Shaft of humerus. In: Canale ST, ed. Campbell's Operative Orthopaedics. 9th ed. St Louis, Mo: Mosby; 1998:2296-309.

17. Ward EF, Savoie FH, Hughes JL. Fractures of the diaphysealhumerus. In: Browner BD, Jupiter JB, Levine AM, et al, eds. Skeletal Trauma: Fractures, Dislocations, Ligamentous Injuries. 2nd ed. Philadelphia, Pa: WB Saunders; 1998:1523-47.

18. Sarmiento A, Kinman PB, Galvin EG, et al. Functional bracing of fractures of the shaft of the humerus. J Bone Joint Surg Am. Jul 1977;59(5):596-601. [Medline].

19. Naver L, Aalberg JR. Humeral shaft fractures treated with a ready-made fracture brace. Arch Orthop Trauma Surg. 1986;106(1):20-2. [Medline].

20. Klenerman L. Fractures of the shaft of the humerus. J Bone Joint Surg Br. Feb 1966;48(1):105-11. [Medline].[Full Text].

21. Heim D, Herkert F, Hess P, et al. Surgical treatment of humeral shaft fractures—the Basel experience. J Trauma. Aug 1993;35(2):226-32. [Medline].

22. Tingstad EM, Wolinsky PR, Shyr Y, et al. Effect of immediate weightbearing on plated fractures of the humeral shaft. J Trauma. Aug 2000;49(2):278-80. [Medline].

23. Rodriguez-Merchan EC. Compression plating versus hackethal nailing in closed humeral shaft fractures failing nonoperative reduction. J Orthop Trauma. Jun 1995;9(3):194-7. [Medline].

24. Hoppenfeld S, deBoer P. The humerus. In: Hannon BC, ed. Surgical Exposures in Orthopaedics: The Anatomic Approach. 2nd ed. Philadelphia, Pa: JB Lippincott; 1984:52-65.

25. Gerwin M, Hotchkiss RN, Weiland AJ. Alternative operative exposures of the posterior aspect of the humeral diaphysis with reference to the radial nerve. J Bone Joint Surg Am. Nov 1996;78(11):1690-5. [Medline].

26. Farragos AF, Schemitsch EH, McKee MD. Complications of intramedullary nailing for fractures of the humeral shaft: a review. J Orthop Trauma. May 1999;13(4):258-67. [Medline].

27. Sims SH, Smith SE. Intramedullary nailing of humeral shaft fractures. J South Orthop Assoc. Spring 1995;4(1):24-31. [Medline].

28. Achecar F, Whittle AP. Unreamedvs reamed interlocking nailing of humeral shaft fractures. Orthop Trans. 1997;21:1166.

29. Brumback RJ. The rationales of interlocking nailing of the femur, tibia, and humerus.ClinOrthopRelat Res. Mar 1996;(324):292-320. [Medline].

30. Crates J, Whittle AP. Antegrade interlocking nailing of acute humeral shaft fractures. ClinOrthopRelat Res. May 1998;(350):40-50. [Medline].

31. Ingman AM, Waters DA. Locked intramedullary nailing of humeral shaft fractures. Implant design, surgical technique, and clinical results. J Bone Joint Surg Br. Jan 1994;76(1):23-9. [Medline].[Full Text].

32. Redmond BJ, Biermann JS, Blasier RB. Interlocking intramedullary nailing of pathological fractures of the shaft of the humerus. J Bone Joint Surg Am. Jun 1996;78(6):891-6. [Medline].

33. Rommens PM, Verbruggen J, Broos PL. Retrograde locked nailing of humeral shaft fractures. A review of 39 patients. J Bone Joint Surg Br. Jan 1995;77(1):84-9. [Medline].[Full Text].

34. Shazar N, Brumback RJ, Vanco B. Treatment of humeral fractures by closed reduction and retrograde intramedullary Ender nails. Orthopedics. Jun 1998;21(6):641-6. [Medline].

35. Tomé J, Carsi B, García-Fernández C, et al. Treatment of pathologic fractures of the humerus with Seidel nailing. ClinOrthopRelat Res. May 1998;(350):51-5. [Medline].

36. Mückley T, Diefenbeck M, Sorkin AT, et al. Results of the T2 humeral nailing system with special focus on compression interlocking. Injury. Dec 27 2007;[Medline].

37. Riemer BL, Foglesong ME, Burke CJ 3rd. Complications of Seidel intramedullary nailing of narrow diameter humeral diaphyseal fractures. Orthopedics. Jan 1994;17(1):19-29. [Medline].

38. Riemer BL, Butterfield SL, D'Ambrosia R, et al. Seidel intramedullary nailing of humeral diaphyseal fractures: a preliminary report. Orthopedics. Mar 1991;14(3):239-46. [Medline].

39. Robinson CM, Bell KM, Court-Brown CM, et al. Locked nailing of humeral shaftfractures. Experience in Edinburgh over a two-year period. J Bone Joint Surg Br. Jul 1992;74(4):558-62. [Medline].[Full Text].

40. Brumback RJ, Bosse MJ, Poka A, et al. Intramedullary stabilization of humeral shaft fractures in patients with multiple trauma. J Bone Joint Surg Am. Sep 1986;68(7):960-70. [Medline].

41. Hall RF Jr, PankovichAM. Ender nailing of acute fractures of the humerus.A study of closed fixation by intramedullary nails without reaming. J Bone Joint Surg Am. Apr 1987;69(4):558-67. [Medline].

42. O'Donnell TM, McKenna JV, Kenny P, et al. Concomitant injuries to the ipsilateral shoulder in patients with a fracture of the diaphysis of the humerus. J Bone Joint Surg Br. Jan 2008;90(1):61-5. [Medline].

43. Stern PJ, Mattingly DA, Pomeroy DL, et al. Intramedullary fixation of humeral shaft fractures. J Bone Joint Surg Am. Jun 1984;66(5):639-46. [Medline].

44. Lin J, Inoue N, Valdevit A, et al. Biomechanical comparison of antegrade and retrograde nailing of humeral shaft fracture. ClinOrthopRelat Res. Jun 1998;(351):203-13. [Medline].

45. McKee MD, Miranda MA, Riemer BL, et al. Management of humeral nonunion after the failure of locking intramedullary nails. J Orthop Trauma. 1996;10(7):492-9. [Medline].

46. Tan JC, Kagda FH, Murphy D, Thambiah JS, Khong KS. Minimally invasive helical plating for shaft of humerus fractures: technique and outcome. Open Orthop J. 2012;6:184-8. [Medline].[Full Text].

47. Shin SJ, Sohn HS, Do NH. Minimally invasive plate osteosynthesis of humeral shaft fractures: a technique to aid fracture reduction and minimize complications. J Orthop Trauma. Oct 2012;26(10):585-9. [Medline].

48. Mostafavi HR, Tornetta P 3rd. Open fractures of the humerus treated with external fixation. ClinOrthopRelat Res. Apr 1997;(337):187-97. [Medline].

00 00

Original Article

Innovation of a Low Cost Effective Negative Pressure Wound Therapy (NPWT) Unit and Its Application Technique

S Anwaruzzaman[1], Faisal Ahmed Siddiqui[2], Mohammad Ali[3], Md. Sadiqul Amin[3]

Abstract

The commercial NPWT systems like KCI-wound VAC system (kinetic concepts, Inc., San Antonio, TX) for providing negative pressure wound therapy for wounds is expensive and may not be available for patients in our country. We have examined the feasibility of using simple low cost components to provide comparable negative pressure therapy at a low cost. An aquarium pump modified to create negative pressure (>o.012 MPA). Povidone iodine impregnated Gauze piece, Open cell polyurethane foam (1cm thick), NG Feeding Tube, Packaging tape, Sterile soft cotton roll. All that is used in this system is relatively inexpensive and costs around Five Dollar. We have used this system in one hundred patients and it is comparable to the commercial system and have not seen any remarkable complications. This simple low cost system can be employed safely to provide Negative Pressure Wound Therapy to open wound and thereby making the bed suitable for secondary closure, skin grafting or flap coverage& remarkably short hospital stay in all other institutions of our country.

Key words: Negative Pressure Wound Therapy, Wound, Skin Graft, Vacuum Assisted Closure.

INTRODUCTION

The advantages of negative pressure therapy appear to include better control of wound secretions, reduction of wound edema, and promotion of granulation tissue, improved patient comfort and more rapid healing. The application of continuous negative pressure to promote wound healing was first described in the Russian Medical Literature for patients with infected breast wound. Their original reports described the topical application of a suction cup type apparatus to the wound surface to create negative pressures of 80 mmHg. [1-2]. in these early reports surgical gauze was used to create an interface between the wound surface and the vacuum source,

Kinetic concepts, Inc., (KCI; San Antonio, TX) markets a modular negative pressure system (Wound VAC) that is based on the system developed by Argenta and Morykwas[6] and Morykwas et al [7] by using foam sponges connected to suction tubing and a vacuum pump containing small canister.

Other commercial vendors market similar systems. The foam sponges used in the commercial system provide a good, possibly optimal, interface between the wound and the vacuum source because of the even distribution of suction exerted by the porous foams and their ability to capture secretions.

In a poor country like Bangladesh we have to give our full effort to provide the best modality of treatment with our small resources. In this concern we have developed an apparatus of creating negative pressure in wound by using simple low cost components that is easy to construct and apply, and based on our experience in 100 cases, appears to provide excellent effects on wound healing. We use this system whenever negative-pressure therapy is indicated and the commercial available apparatus (e.g. KCI-wound VAC system; kinetic concepts, Inc., San Antonio, TX) is not available or affordable in our country.

1. Associate Professr. Professor, Dept. Of Orthopedics & Trauma Comilla Medical College & Hospital.
2. Medical Officer. Of Orthopedics & Trauma Comilla Medical College & Hospital.
3. Indoor Medical Officer. Of Orthopedics & Trauma Comilla Medical College & Hospital.

Correspondence: Dr. Syed Anwaruzzaman; E-mail syedanwaruzz aman@hotmail.com

A. Making of NPWT (Negative Pressure Wound Therapy) unit

MATERIALS REQUIRED

One aquarium pump, Screw Driver, Glue, portion of Infusion set, Drill machine (Fig. 1). At first the aquarium pump is disassembled by screw driver. Then the suction unit of the pump is isolated (Fig.2). there is an opening for the air entry for the suction unit which needs to be sealed by glue.(Fig.4) . After the air inlet is sealed and glue is set the machine is reassembled (Fig. 5). Then a hole is made with drill machine in the side of the pump for making a controlled inlet from the wound (Fig.6). A portion of infusion set attached to the inlet and made airtight by glue. Now the machine is ready for use for Negative Pressure Wound Therapy.

Fig.-1: *required materials: One aquarium pump, Screw Driver, Glue, A portion of Infusion set, Drill machine.*

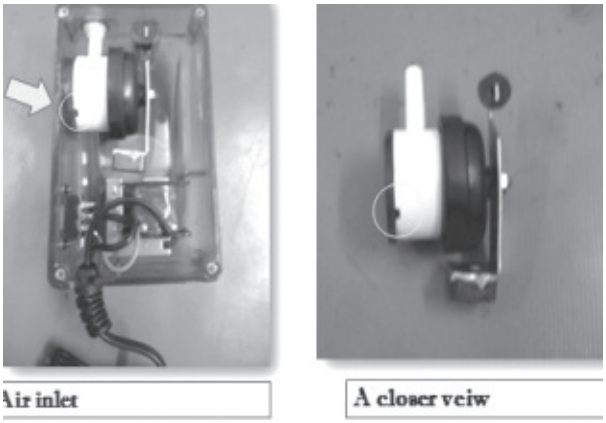


Fig.-2: *Identify the pump's air inlet and outlet.*

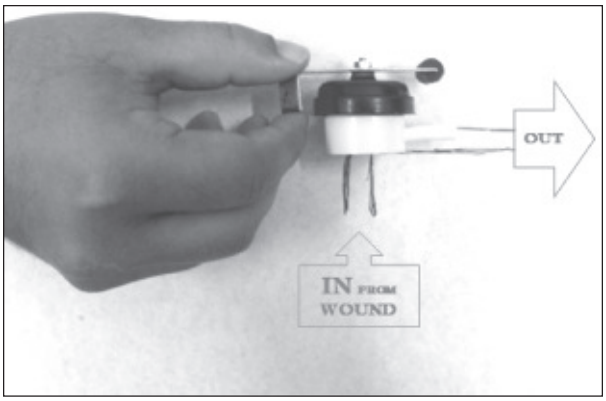


Fig.-3: *Planning the inlet from the wound and outlet for drain collection*

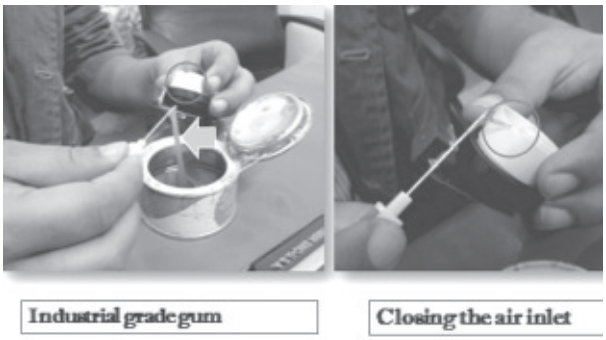


Fig.-4: *Sealing off the air inlet*

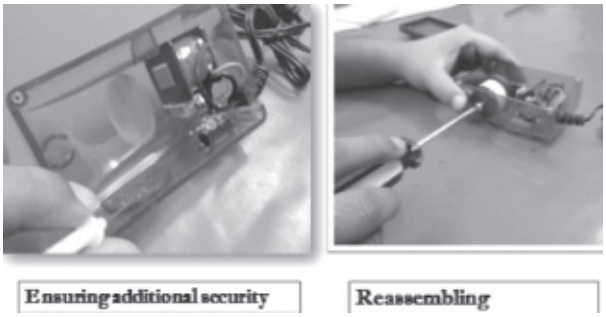


Fig.-5: *Re-assembling the apparatus.*

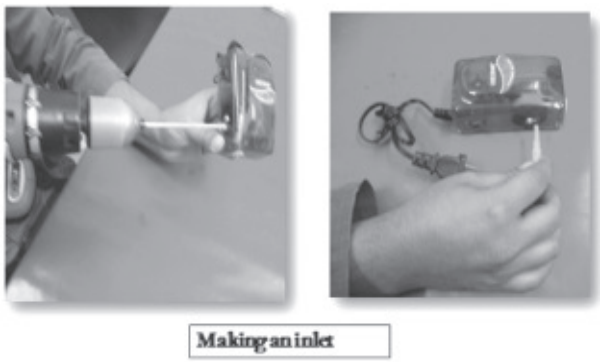


Fig.-6: *Making the drill hole for attaching the inlet from the wound.*

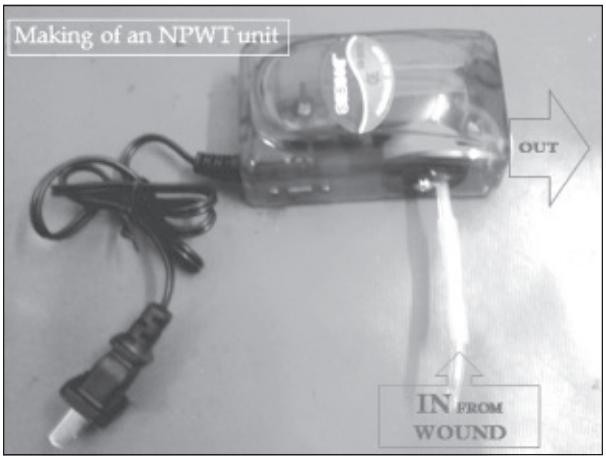


Fig.-7: *NPWT machine ready to use.*

B. Application technique of NPWT to a wound

After anesthesia surrounding skin was shaved prior to debridement. The wound surface area is measured. (Fig. 8)

Then wound is thoroughly debrided and cleaned with copious Normal Saline. Then the wound made dry and first layer of open cell polyurethane foam (thickness 1cm) was cut according to wound surface area (fig.9). And second layer of open cell polyurethane foam was cut larger than first layer by 2 cm.(Fig.10) Now the wound bed is covered with povidone iodine ointment impregnated gauge piece according to exact shape of the wound over which first layer of foam piece applied(Fig.11). Then a fenestrated drain tube was kept in the mid line of the foam and second foam piece was applied. Precaution was taken that the drain tube keeps it midline placement (Fig12,13. Now Adhesive surgical tape was applied over foam and skin so that the foam and drain tubes are in a fixed position. After that a sterile soft roll was wrapped around the wound/limb (fig.14). Finally the bed made airtight by wrapping another layer of packaging tape over the wrapped cotton layer and skin (fig.15). At the end the drain tube was connected to our innovated NPWT machine input and output is connected with a drain bag (Fig16,17, 18). The machine was plugged in and turned ON till the next dressing (after72 hour).

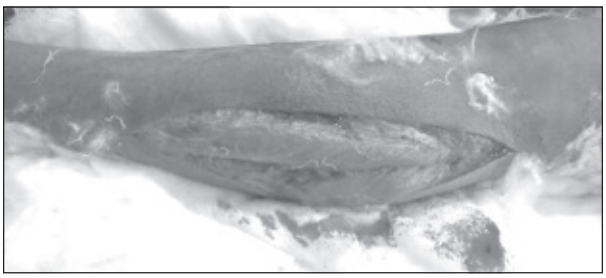


Fig.- 8: *After anesthesia surrounding skin was shaved prior to debridement. The wound surface area is measured.*

Fig.-9: *Then wound is thoroughly debrided and cleaned with copious Normal Saline. Then the wound made dry*

And first layer of open cell polyurethane foam (thickness 1cm) was cut according to wound surface area.

Fig.-10 *Second layer of open cell polyurethane foam was cut larger than first layer by 2 cm.*

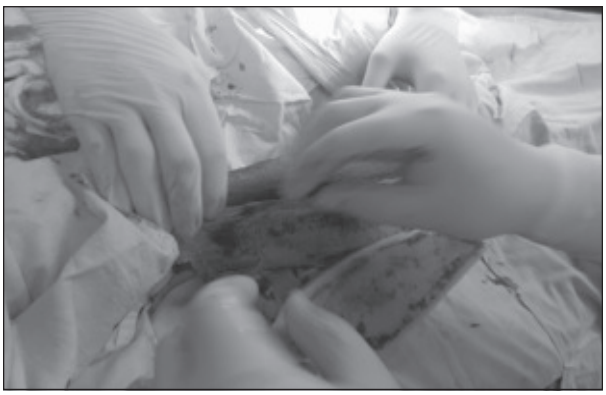


Fig.-11: *now the wound bed is covered with povidone iodine ointment impregnated gauge piece according to exact shape of the wound over which first layer of foam piece applied*

Fig.-12: *Then a fenestrated drain tube was kept in the mid line of the foam.*

Fig.-13: *Second foam piece was applied. Precaution was taken that the drain tube keeps it midline placement*

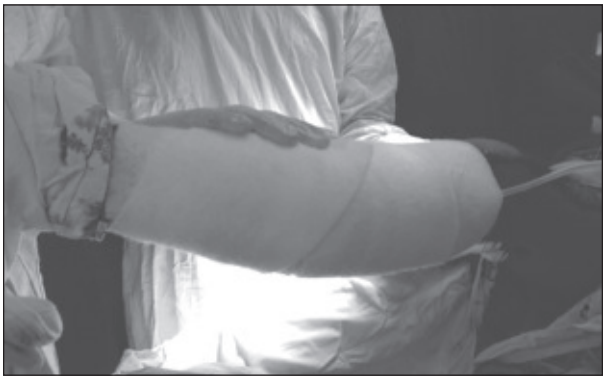


Fig.-14: *whole wound was covered with soft roll for equal pressure distribution.*

Fig.-15: *Adhesive tape applied over foam and skin*

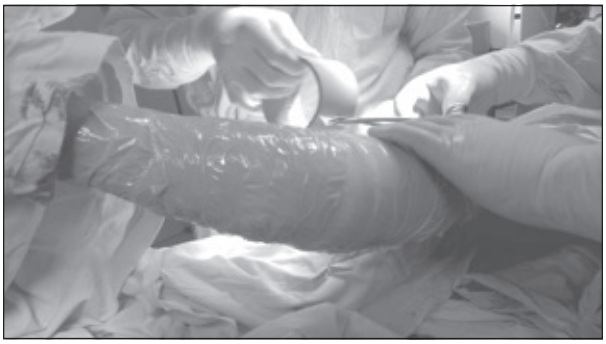


Fig.-16: *Finally the bed made airtight by wrapping another layer of packaging tape over the wrapped cotton layer and skin*

Fig.-17: *At the end the drain tube was connected to our innovated NPWT machine input and output is connected with a drain bag*

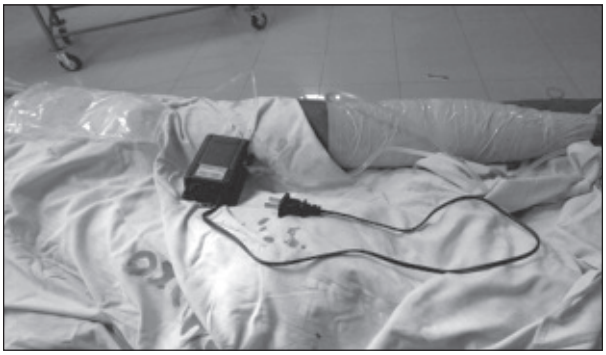


Fig.-18: *Completed application of NPWT unit and the machine is ready for plug in.*

After 72 hour Machine was turned off and unplugged. The wound was opened for aeration for 30mins. Then the patient is taken to Operation Theatre to assess the reduction of the discharge and edema, reduction of wound size by measuring the surface area, granulation tissue. Then the wound washed with Normal Saline and surrounding skin made dry and second dressing applied aseptically in previous manner.

This whole procedure was repeated at every 72 hours until the wound was ready for Skin grafting or secondary suture or flap coverage (usually after third application)

DISCUSSION

We have used the simple low cost components for management of leg ulcers, open fracture wounds, Diabetic foot wound, degloving injuries, Dehisced extremity incision, and fasciotomy wound in 100 patients in the past 2 years. We have found that our innovated apparatus is not similar to the commercial apparatus but serving our purpose efficiently. The overall cost is less than $5 to prepare one NPWT apparatus by using an aquarium pump available locally.

This estimate does not take into account for the charges of electricity we used which is also low. The application of the vacuum should be used to test the system in the operation room or at bedside and rapid compression of the foam raft when vacuum is applied reliably indicates that no significant leak is present. Although we have not observed any problem with Hemostasis with this method (e.g. Discontinuing therapy because of bleeding), there is some concern that large wounds those oozing at the time of application could bleed excessively as unlike commercial system it does not have a volume cut off level. Because of this limitation we urge caution in using this method in pediatrics departments in which drain volume should be monitored carefully and vary large wounds or those likely to bleed excessively. Other limitation of our innovated NPWT unit includes the inability to modify the pressure cycle as for example intermittent suction and to treat patient on an outpatient basis. Despite these limitations our system is invaluable for patient who would benefit greatly from negative pressure wound therapy but who are unable to obtain access to commercial systems as a result of funding, cost considerations or unavailability. A recent clinical trial indicated that negative pressure therapy is more cost effective than Traditional gauze dressing [16]. Unfortunately in our country commercial technology is not always available a result of cost affordability issues. The components required in this low cost NPWT system are available in most community hospitals and are easy to assemble and apply to manage in patient wound problems and based on our experiences it provides results closer to more complex and expensive commercial system.

CONCLUSION

We have developed our own NPWT (Negative Pressure Wound Therapy) unit from simple locally available low cost components which is more affordable by patients and easier to use in any hospital setting of our health service. Our NPWT Unit works effectively to serve the purpose by reducing hassles of repeated wound dressing, markedly reducing dressing cost and hospital stay. Finally, we cannot claim our NPWT machine is perfect or equal to commercial machine but it is serving our purpose effectively.

REFERENCES

1. Lillis, Karin (2003). "Effective wound care requires look at total patient picture". Healthcare purchasing News 27 (1):
2. Moody, Yasmeen(19thjuly). "Advances in healing chronic wounds". The ithaca journal (Ithaca, NY)p.10A
3. Fogg, Erich (27 August, 2009). "Best treatment of non-healing and problematic wounds," Journal of the American Academy of Physician Assistants 22 (8) ; 46,48, PMID 19725415.
4. Driscoll, P (24th October, 2009). "Negative Pressure Wound Therapy (Gauze and Foam)." Advanced Medical Technologies.
5. P.E.Banwell and L T'eot, "Topical Negative Pressure (TNP); the evolution of a novel wound therapy." Journal of Wound care Vol.12 no. 1 pp.22-28, 2003.
6. M. J. Morykwas J. Simpson, K Punger, A. Argenta, L. Kremers and J Argenta, "Vacuum-assisted Closure: State of Basic research and physiologic foundation."
7. Plastic and Reconstructive Surgery vol.117 no. 7 supplement pp 1215-1265, 2006
8. P. Drew, J. Posnett, and L. Rusling, "The cost of wound care for a local population in England," Internation Wound Journal, Vol. 4, no.2,pp. 149-144,2007.
9. P.J.Franks, L. McCullagh and C.J. Moffatt, " Assessing quality of life in patients with chronIc leg ulceration using the medical outcomes short form 36 Questionnaire," Ostomy wound Management, Vol. 49, no.2, pp. 22-26, 2003.
10. A. Persoon, M.M. Heinen, C.J.M.Van Der Vleuten, M.J. De Rooij, P.C.M.Vand de Kerkhof and T van Achterberg, "Leg Ulcers: A review of their impact on daily life," JournalOf Clinical Nusing , Vol. 13, no.3,pp. 341-354, 2004.
11. M. Augustin, K. Herberger, S.J.Rustenbach, I. Zschocke, and C. Blome," Quality of life evaluation in wound; Validation of the freiburg life quality assessment-wound module, a disease specific instrument," International Wound Journal, Vol. 7, No. 6, PP. 493-501, 2004.
12. Bailey and Love's Short Practice of Surgery (25th edition), Norman S. Williams, Christopher J. K. Bulstrode, P. Ronan O'Connel (page-1123)
13. Argenta Lc, Morykwas MJ: Vacuum assisted closure; anew method for the wound control and treatment; clinical experience.Ann Plastsurg 1997, 38:563-576.

14. Hans-ChristophPape, MD and Lawrence X. Web, MD. The significance of negative pressure wound therapy with reticulated open cell foam in the treatment of orthopedic wounds; and evidence-based review. J OrthopTrauma . Volume 22, Number 10 supplement, November/ December 2008.

15. DeFranzo AJ, Marks MW, Argenta LC, Genecov DG: Vacuum assisted closure for the treatment of degloving injuries, plastic reconstruction surgery 1999, 104:2145-2148.

16. Webb LX: New techniques in wound management vacuum assisted wound closure, J Am AcadOrthopsurg 2002, and 10:303-311.

17. Kate Ballard, BSc, Rgn, tissue viability and clinical trials coordinator, Tissue Unit, Guy's Hospital, London, Vo.97, issue;-35, page no: 51, 30th august, 2001.

18. Song DH WuLC, Lohman RF, Gottlieb LJ, Franczyk M. "Vacuum assisted closure for treatment of sternal wound, the bridge between debridement and definitive closure, PlastReconstrSurg, 2003: 111(1). 92-97.

19. McCallonSk, Knight CA, Valiulus JP, Cunnigham MW, McCulloch JM, Farinas LP: Vacuum assisted closure versus saline moistened gauze in the healing of postoperative diabetic foot wounds, Ostomy wound manage 2000; 46:28-32.

20. Scherer LA, Shiver S, Chamg M, Meredith JW, Owings JT. The vacuum assisted closure device: a method of securing skin grafts and improving graft survival. Arch Surg 2002; 137:930-934.

21. Webb LX: New techniques in wound management vacuum assisted wound closure, J Am AcadOrthopSurg 2002,10:303-311.

22. Wongworat MD, Schnall SB, Holtom PD, Moon C, Schiller F. Negative Pressure dressing as an alternative technique for the treatment of infected wounds. ClinOrthopRelat Res 2003; 414:45-48.

40. Morykwas MJ, Argenta Lc, Shelton Brown El, McGuirt W.: Vacuum assisted closure; a new method for the wound control and treatment:animal studies and basic foundation.Ann Plastsurg 1997, 38:553-562

24. Fabian TS, Kaufman HJ, Lett ED, et al. The evaluation of sub-atmospheric pressure and hyperbaric oxygen in ischemic full-thickness wound healing. Am Surg 2000; 66:1136-1143

25. Genecov DG, Schneider AM, Morykwas MJ, Parker D, White WWL, Argenta LC, A controlled sub-atmospheric pressure dressing increases the rate of skin graft donor site re- epithelization. Ann Plast Surg. 1998; 40:219-225.

26. Morykwas MJ, Flaer BJ, Pearce DJ, Argenta LC.Effects of varying levels of sub-atmospheric pressure on the rate of granulation tissue formation in experimental wounds in swine. Ann Plast surg;2001;47:547-551.

27. Morykwas MJ, Howell H, Bleyer AJ, Molnar JA, Argenta LC. The effect of externally applied of sub-atmospheric pressure on serum myoglobin levels after prolonged crush/ ischemia injury. J Trauma 2002;53:537-540.

28. Banwell PE, Teot L. Tropical Negative Pressure (TNP); the evolution of a novel wound therapy. J Wound Care 2003;12;22-28.

29. Morykwas MJ. External application of sub atmospheric pressure and healing; mechanism of action. Wound healing society Newsletter 1998;8:4-5.

30. Harvey EJ, Grjic L, Early JS, Benirschke SK, Sangeorzan BJ, Morbidity associated with ORIF of intra articular calcaneus fractures using lateral approach. Foot Ankle Int 2001.

31. Morykwas MJ, Argenta LC, Non-surgical modalities to enhance healing and care of soft tissue wounds. J South OrthopAssoc 1997;6:279-288

32. Attinger C, Cooper P. Soft tissue reconstruction for calcaneal fractures or osteomyelitis. OrthopClin North AM 2001;2:135-170

33. Herscovici D Jr. Sanders RW, ScadutoJM, Infante A, Dipasquale T. Vacuum assisted closure (VAC Therapy) for the management of patients with high energy soft tissue injuries. J Orthop Trauma 2003; 17:683-688

34. Fox MP, Fazal MA, Ware He, Vacuum assisted closure a new method for control of wound problems in total knee arthroplasty. J Bone Joint Surg Br 2000;83-B:19

35. de la Torre Jl, Martin SA, Oberheu AM, Vasconez LO. Healing of a wound with an exposed Herrington rod: a case study. Ostomy Wound Manage 2002;48:18-19

36. Heugel J,RMPards KS, Christie SS, PulitoJRmZegzula DH, Kamalyan NA. Treatment of the exposed Achilles' tendon using negative pressure wound therapy; a case report. J Burn Care Rehabil 2002;23:167-171

37. Yuan-Innes MJ, Temple CL, Lacey MS. Vacuum assisted wound closure; a new approach to spinal wounds with exposed hardware. Spine 2001;26:E30-E33

00 00

Original Article

Comparison of The Outcome Between Cemented and Noncemented Bipolar Hemiarthroplasty of The Hip In Femoral Neck Fractures of the Elderly

Arun Kumar Sarker, Partha Sarathi Shome, Sumon Mallick, Shankar Kumar Roy, Istiaque ul Fattah, Dipankar Nath Talukdar, Kamrul Ahsan, Nuruddin Ahmed

ABSTRACT

Displaced intracapsular femoral neck fractures in the elderly are treated by hemiarthroplasty, with or without cement. The majority of studies suggested a lower revision rate, less thigh pain and better mobility in-patients in whom the prosthesis was cemented. Bipolar cemented hemiarthroplasty may be associated with increased operative time and blood loss. There appears to be no difference in general complication, or mortality rates after 3 months, between the two groups. Both arthroplasties may be used with good results after displaced femoral neck fractures. A prospective comparative study was conducted in the Department of Orthopaedic Surgery, Sylhet MAG Osmani Medical College Hospital, Sylhet, Bangladesh during the period from July 2008 to June 2010 with 30 patients taking 15 in each group. In cemented group, satisfactory result was found in 14 (93.3%) cases and unsatisfactory result in 1 (6.7%) case; where as satisfactory result was found in 7 (47.7%) cases and unsatisfactory result in 8 (52.3%) case in non-cemented group. The final outcome of this study showed the cemented group experienced better final out come (p=0.014). We conclude, this study tends to support the use of cemented hemiarthroplasty for displaced intracapsular femoral neck fractures of the eldely.

INTRODUCTION:

Fracture of the neck of femur is the second most common fracture in the elderly with an annual incidence of 86 per 100,000 in the UK (Ramisetty *et al*. 2005). Femoral neck fracture is notoriously known as an Orthopaedic enigma, since a permanent solution for its treatment still eludes the Orthopaedic Surgeon. Needless to say, It is termed as an 'Unsolved Problem'. The wise saying, *" We come to the world under the brim of pelvis and go out of the world through the fracture neck of femur."*

The management of this fracture has been changing from time to time. However the number of procedures available and practiced show that no one is universally applicable and surgeon has to select one which would be ideal in a given situation.

Operative treatment is the treatment of choice for the majority of the displaced femoral neck fractures (Agarwal 2006). However, the debate as to whether the femoral head should be retained or replaced continues (Parker 2000; Min *et al*. 2006; Patel *et al*. 2006). The choice depends on

1. Jr. Consultant cum R S (Ortho. & Traumatology) Dinajpur Medical College Hospital, Dinajpur.
2. Former Professor & Head, Dept. of Orthopaedics, Sylhet Osmani Medical College, Sylhet.
3. Assistant Professor, JRRMC, Sylhet.
4. Assistant Professor, Sylhet Osmani Medical College, Sylhet.
5. Associate Professor, Sylhet Osmani Medical College, Sylhet.
6. Associate Professor, Sylhet Osmani Medical College, Sylhet.
7. Professor(C.C.) & Head , Dept. of Orthopaedics, Dinajpur Medical College, Sylhet.
8. Assistant Professor, Sylhet Osmani Medical College, Sylhet.

Correspondence: Dr. Arun Kumar Sarker, Jr. Consultant cum R S (Ortho. & Traumatology) Dinajpur Medical College Hospital, Dinajpur. E-mail: drarunsarker@gmail.com

many factors including the health and age of the patient, ambulatory demands of the patients, oseoporotic status, the degree of displacement of the fractures and the available resources (Hay and Gottschalk 2005).

Introduction of single piece unipolar metal prosthesis in 1950's, to replace the femoral head has undoubtedly played an important role in the treatment of these fractures. However, acetabular erosion and loosening of stem giving rise to pain are significant long term complications of one piece hemiarthroplasties (Maini *et al*. 2006, Rai *et al*. 2008).

To abate these problems bipolar prosthesis was designed which consists of polished femoral head prosthesis with a locking internal ultra high molecular weight polyethylene bearing reducing friction between the outer head and acetabulum (Rai *et al*. 2008).

Khan *et al*. (2002) supported the use of cemented hemiarthroplasty in the elderly as revision was fewer in the cemented group. In contrast, most cementless series have significant osteolytic changes and high failure rates after only 7 years (Kim and Kim 1990). Charnley showed that cement increases the load bearing capacity of a prosthesis 200 fold (Turek ,1984).

Though many centers throughout the world are practicing the cemented hemiarthroplasty, but fewer efforts were observed previously in our country to evaluate the outcome of cemented hemiarthroplasty in comparison to non-cemented hemiarthroplasty of the hip to end the therapeutic dilemma in our orthopaedic arena regarding the treatment of femoral neck fractures of the elderly.

MATERIALS AND METHODS

This was a prospective comparative study conducted in the Department of Orthopaedic Surgery, Sylhet MAG Osmani Medical College Hospital, Sylhet, Bangladesh during the period from July 2008 to June 2010. For this purpose 30 patients with femoral neck fracture were selected by simple random sampling according to inclusion and exclusion criteria and divided them into cemented group and non-cemented group, each consisted of 15. Inclusion criteria were of age group between 60 years to 90 years, irrespective of sex, Garden Grade III and IV,, ambulant patients (All patients had independent walking capability with or without a walking aid before fracture) and absence of severe cognitive dysfunction. Exclusion criteria were pathological fracture neck femur (Metastatic bone tumors) and Polytrauma patients. After explaining the purpose of the study informed written consent was taken and data were collected using a structured questionnaire. All patients were assessed before operation from history, physical examination and necessary investigations and declared fit by the anaesthetists. Study samples were divided randomly into cemented and non-cemented group by sealed enveloped lottery method.

After proper antibiotic prophylaxis (Cefuroxime 1.5 gm followed by two additional doses during the fist 24 hours) bipolar prosthesis (INOR Orthopaedics, Stainless steel UHMWPE) were inserted via Moore's posterior approach using the recommended surgical technique using first generation cementing(DePuy, CMW for cemented arthroplasty only) technique (syringe or digital application). Hip abduction was maintained by placing pillows between the legs of the patients (Singh and Deshmukh 2006). The patient undergoing hemiarthroplasty was informed about mobilisation technique and was allowed to sit on a high chair immediately after surgery and to move a fixed distance using an walker. Then gradual weaning from walker crutches should proceed as tolerated depending upon the patient's psychological, physical and social situation. During hospital stay, daily neurovascular examination should be continued with particular attention to the patient's calves. Surgical dressing over the hip was changed on post-operative day 3, unless soilage or wound drainage necessitates early removal (Kenneth and Michael 2005). As criteria for discharge were met the patient and family should be approached regarding specific instructions and follow up plans with written dates and time -schedule. The Harris Hip Score assessed hip function in four dimensions: pain, function, absence of deformity and range of motion (ROM) (Blomfeldt 2006).

RESULTS

Thirty hemiarthroplasties were performed for displaced intracapsular femoral neck fractures in the elderly (>60 years). Fifteen patients (6 males and 9 females; 8 Garden type IV and 7 Garden type III) underwent cemented bipolar hemiarthroplasty and 15 patients (3 males and 12 females; 12 Garden type IV and 3 Garden type III) underwent uncemented bipolar hemiarthroplasty. The outcome of the study was as follows:

Table-I showed the frequency distribution of patients according to cause of injury. Most of the case in cemented group was due to fall 14 (93.3%) and in 1 (6.7%) patient the cause of injury was due to assault. In non-cemented group the most common cause of injury was also due to fall 14 (93.3%) and in 1 (6.7%) patient the cause of injury was due to road traffic accident. The causes of injury in both group was identical (p=0368). Table 2 showed the distribution of

different outcome variables. The mean pain score in cemented group was 39.47 ± 4.17 and that of non-cemented group was 31.60 ± 10.20 (p=0.010); the mean gait score in cemented group was 23.73 ± 4.15 and that of non-cemented group was 17.53 ± 4.81 (p=0.001); the mean activity score in cemented group was 9.67 ± 0.25 and that of non-cemented group was 7.40 ± 2.41 (p=0.017); the mean function score in cemented group was 35.40 ± 5.97 and that of non-cemented group was 29.93 ± 6.91 (p=0.001); the mean deformity score in cemented group was 4.00 ± 0.0 and that of non-cemented group was 3.73 ± 1.03 (p=0.326); the mean ROM in cemented group was 4.2 ± 0.56 and that of non-cemented group was 3.53 ± 1.23 (p=0.049); and the mean Harris Hip score in cemented group was 80.80 ± 9.50 and that of non-cemented group was 63.13 ± 17.41 (p=0.002). The over all difference between the groups was significant with the cemented group experienced better out come (p=0.002). Figure 1. showed the distribution of the patients on outcome of the study. In cemented group, excellent outcome was found in 9 (60.0%) cases, good in 5 (33.3%), fair in 1 (6.7%) cases but no poor outcome; whereas in non-cemented group, excellent outcome was found in 3 (20.0%) cases, good in 4 (26.6%), fair in 7 (46.7%) cases and poor outcome in 1 (6.7%) case There was statistically significant difference between the outcome of the study in cemented group and non-cemented group (p=0.035). Figure 2. showed the distribution of the patients on final outcome of the study. In cemented group, satisfactory(excellent & good) result was found in 14 (93.3%) cases and unsatisfactory(fair & poor) result in 1 (6.7%) case; Where as satisfactory result was found in 7 (47.7%) cases and unsatisfactory result in 8 (52.3%) case in non-cemented group, There was statistically significant difference between the final outcome of study in cemented group and non-cemented group where the cemented group experienced better final out come (p=0.014). Fisher's Exact test was employed to analyze the data.

Table-I

Distribution of the patients on the cause of injury (n=30)

Cause of injury	Cemented group (n=15)		Non-cemented group (n=15)		p* value
	Frequency	Percentage	Frequency	Percentage	
Fall	14	93.3	14	93.3	0.368
RTA	0	0.0	1	6.7	
Assault	1	6.7	0	0.0	
Total	15	100.0	15	100.0	

χ^2 (Chi- square) test was employed to analyze the data.

RTA= road traffic accident

Table-II

Distribution of different outcome variables (n=30)

Outcome vaiables	Cemented group (n=15)	Non-cemented group (n=15) (n=15)	p* value
Pain	39.47 ± 4.17	31.60 ± 10.20	0.010
Gait	23.73 ± 4.15	17.53 ± 4.81	0.001
Activity	9.67 ± 0.25	7.40 ± 2.41	0.017
Function	35.40 ± 5.97	29.93 ± 6.91	0.001
Deformity	4.00 ± 0.0	3.73 ± 1.03	0.326
Range of motion	4.2 ± 0.56	3.53 ± 1.23	0.049
Harris score	80.80 ± 9.50	63.13 ± 17.41	0.002

*Student 't' test was employed to analyze the data

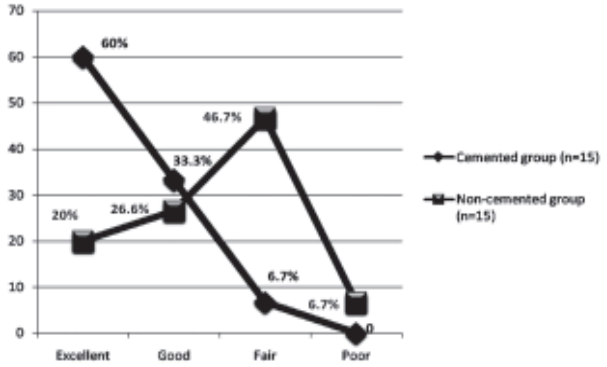


Fig-1: *Distribution of the patients on outcome of the study (n=30)*

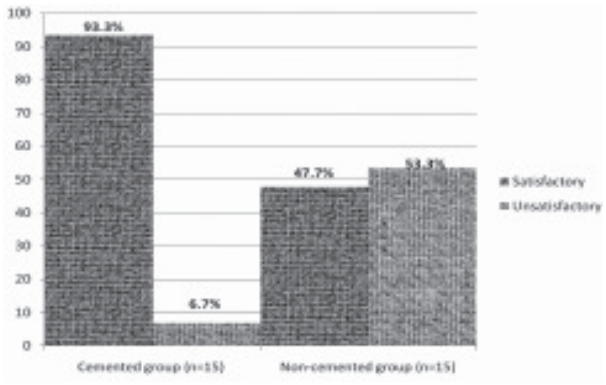


Fig-2: *Distribution of the patients on final outcome of the study (n=30)*

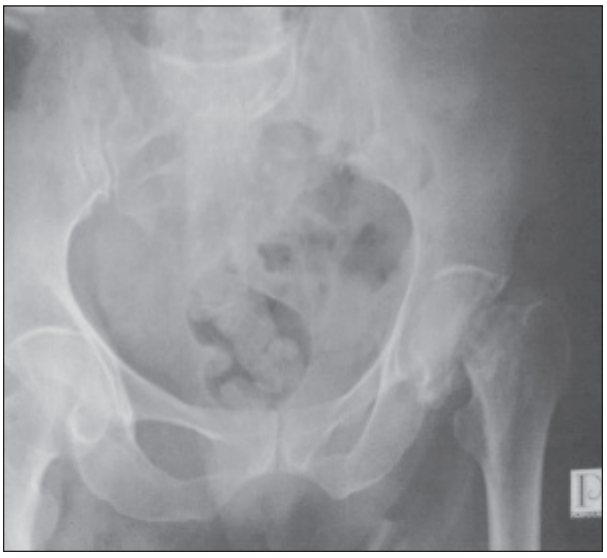


Fig-1: *Pre-operative X-ray.*

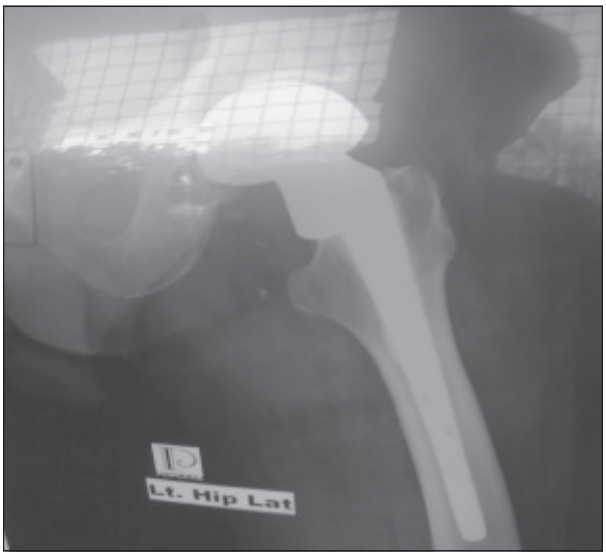


Fig-2. *Post-operative X-ray.*

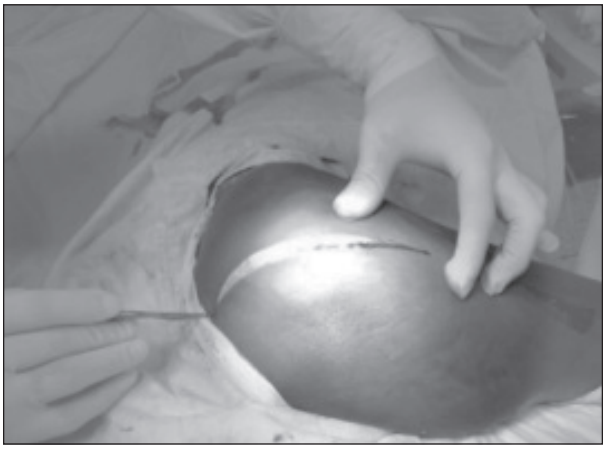


Fig-3 : *Incision (Moore approach)*

Fig-4 : *Wound closed leaving a Romovac suction drain.*

Fig-5. *Walking with WALKER*

Fig-6: *Independent Painless Walking*

DISCUSSION:

The present study showed that most of the case in cemented group was due to fall 14 (93.3%) and in 1 (6.7%) patient the cause of injury was due to assault. In non-cemented group the most common cause of injury was also due to fall 14 (93.3%) and in 1 (6.7%) patient the cause of injury was due to road traffic accident (p=0368). This result was similar to the study of Frihagen *et al*. that among their haemiarthroplasty patients cause of injury was fall from standing height or lower in 99.0% of cases.

Harris Hip Score was ranging from 56 to 91 with the mean score of 80.80 ± 9.50 in the cemented group and the mean score of 63.13 ± 17.42 (Mean ± SD) in the non-cemented group in the current study. The over all difference between the groups was significant with the cemented group experienced better out come (p=0.002). Frihagen *et al*. found that among their haemiarthroplasty patients Harris Hip Score was 83.6 ± 13. 59 (mean ± SD). Outcome was measured by different scores where more the score better the performance. In the present study, mean pain score in cemented group was 39.47 ± 4.17 and that of non-cemented group was 31.60 ± 10.20 (p=0.010); the mean function score in cemented group was 35.40 ± 5.97 and that of non-cemented group was 29.93 ± 6.91 (p=0.001); the mean ROM in cemented group was 4.2 ± 0.56 and that of non-cemented group was 3.53 ± 1.23 (p=0.049); and the mean Harris score in cemented group was 80.80 ± 9.50 and that of non-cemented group was 63.13 ± 17.41 (p=0.002). In this regard Dorr compared a cemented bipolar hemiarthroplasty with an uncemented bipolar hemiarthroplasty in 50 patients. Mean pain score for the cemented prosthesis was statistically signiûcant in favour of the cemented prosthesis. Mean mobility score was also reported to be statistically signiûcant in favour of the cemented prosthesis. (Dorr 1986 reviewed by Parker and Gurusamy 2009). In another study Perker *et al*. found that the degree of residual pain was less in those treated with a cemented prosthesis ($p < 0.0001$) three months after surgery. Regaining mobility was better in those treated with a cemented implant ($p = 0.005$) at six months after operation.

In cemented group, satisfactory result was found in 14 (93.3%) cases and unsatisfactory result in 1 (6.7%) case; where as satisfactory result was found in 7 (47.7%) cases and unsatisfactory result in 8 (52.3%) case in non-cemented group. The final outcome of this study showed the cemented group experienced better final out come (p=0.014).

Bipolar hemiarthroplasty was found to be a good option for displaced intracapsular femoral neck fractures, and overall outcome was better in the cemented group in terms of pain (p=0.010), gait (p=0.017), activity score (p=0.017), function score (p=0.001), range of motion (p=0.049), Haris Hip score (p=0.002), out come (p=0.035) and final outcome (p=0.014).

CONCLUSION

The final out come showed a statistically significant difference between the cemented group and non-cemented group. The cemented group experienced better out come than noncemented group (p=0.014) irrespective of the cause of injury.

REFERENCES:

1. Ramisetty, N.M., Pynsent, P.B. and Abudu, A. 2005. Fracture of the femoral neck, the risk of serious underlying pathology. *Injury, Int. J. Care Injured*, 36, 622-626.
2. Agarwal, A. 2006. Osteosynthesis and primary valgus intertrochanteric osteotomy in displaced intracapsular fracture neck of femur with osteoporosis in adults. Injury 2006, 37, 666-667.
3. Parker, M.J. and Gurusammy, K.S. 2009. Arthroplasties (with and without bone cement) for proximal femoral fractures in adults. *The Cochraine Library*, Issue 1, John Willey & Sons. Ltd.
4. Parker, M.J., Pryor, G. and Gurusamy, K. 2010a. Cemented versus uncemented hemiarthroplasty for intracapsular hip fractures: a randomised controlled trial in 400 patients. *J Bone Joint Surg [Br]*, 92, 116-122.
5. Parker, M.J. Pryor, G. and Gurusamy, K. 2010b. Hemiarthroplasty versus internal ûxation for displaced intracapsular hip fractures: A long-term follow-up of a randomised trial. *Injury, Int. J. Care Injured*, 41, 370–373.
6. Hay, M. and Gottschalk, F. 2005. Cemented versus uncemented hip replacement for fracture of the hip. *Disability and Rehabilitation*, 27 (18-19), 1151-1155.
7. Rai, A.K. Agarwal, R., Singh, S. and Ratan, R. 2008. The BHU bicentric bipolar prosthesis in fracture neck femur in active elderly.*Journal of Trauma Management and Outcomes* [online], 2, 7, Available from: http://www.traumamanagement.org/content/2/1/7. Accessed on 20 April 2010.
8. Khan R.J.K., MacDowell, A., Grossman, P. and Keene, G.S. 2002. Cemented or uncemented hemiarthroplasty for displaced intracapsular fractures of the hip-a systematic review. *Injury*, 33, 13-17.
9. Kim, J.W., Nam, K.W., Yoo, J.J. and Kim, H.J. 2007. The role of preoperative bone scan for determining the treatment method for femoral neck fracture. *Int Orthop*, 31(1), 61-64.
10. Turek, S.L. 1984. *Orthopaedics*. 4th edn. Vol: 2. Lippincott-Raven: Philadelphia.
11. Blomfeldt. R., Törnkvist, H., Eriksson, K., Söderqvist, A., Ponzer, S. and Tidermark, J. 2007. A randomised controlled trial comparing bipolar hemiarthroplasty with total hip replacement for displaced intracapsular fractures of the femoral neck in elderly patients. *J Bone Joint Surg [Br],* 89(2), 160-165.
12. Frihagen, F., Nordsletten, L. and Madsen, J.E. 2010. Hemiarthroplasty or internal fixation for intracapsular displaced femoral neck fractures: randomised controlled trial. *British Medical Journal*, 1-8 [Online First]. Retrieved from: bmj.com. Aceessed on 10 Feb 2010.
13. Koval K.J. and Cooley, M.R. 2005. Clinical pathway after hip fracture. *Disability and Rehabilitation*, 27 (18-19), 1053-1060.
14. Maini, P.S., Talwar, N,, Nijhawan, V.K. and Dhawan, M. 2006. Results of cemented bipolar hemiarthroplasty for fracture of the femoral neck - 10 year study. *Indian J Orthop*, 40, 154-156.
15. Patel, K.K., Ashford, R.U., Frasquet-Garcia, A., et al. 2006. Muller straight stem total hip arthroplasty for fractured neck of femur. *Injury*, 37, 727-33.

ReviewArticle

Anesthesia Considerations in Total Hip Replacement

Nasir Uddin Ahmed[1], Golam Sarwar[2], Moazzem Hossain[3]

ABSTRACT

Hip replacement surgery is a common & effective procedure for the relief of pain and loss of function. The number of procedure is increasing and great interest is shown for the manner of outcome improvement following hip replacement surgery. Last decade (2001-2010) is declared as the Bone & Joint Decade and has been characterized by many innovations in hip replacement surgery including minimally invasive technique but also by improvement in anesthetic technique. However there is no consensus about most appropriate anesthetic and analgesic techniques to use. Total hip replacement surgery is a procedure characterized by great perioperative disturbances including cardiovascular complications, possible significant perioperative blood loss ,possible bone-cement syndrome, high incidence of thrombo-embolic complications and high level of postoperative pain. Anesthetic consideration is the total perioperative anesthesia care. Most important factors determining outcome of patients include preoperative assessment and planning in order to minimize potential anesthetic problems, optimize co-morbidities & provide the most appropriate anesthetic on the patient. In this article total hip replacement procedure and preoperative assessment are discussed. Advantages & problems of regional anesthesia are outlined. All the problems of intraoperative course and how to avoid these are presented. Possible postoperative pain management are also presented. The importance of thromboprophylaxis is outlined and recent guidelines for thromboprophylaxis are given including recommendations for new antithrombotic drugs. Our recommendation is to always prepare a patient for this procedure, careful preanesthetic assessment, close optimal anesthetic technique, provide thromoprophylaxis and postoperative pain therapy according to accepted guidelines.

Key wards: Regional anesthesia, Hip replacement, Thromboprophylaxis, Pain therapy.

INTRODUCTION

Total hip replacement surgery is performed to relieve pain, restore function & improve quality of life. The main indications for total hip replacement in patients are degenerative joint diseases commonly osteoarthritis. Other conditions rheumatoid arthritis, infection, congenital dislocation & avascular necrosis of the femoral head. Avascular necrosis (also osteonecrosis, bone infarction, aseptic necrosis, ischemic bone necrosis and AVN) is a disease where there is cellular death (necrosis) of bone components due to interruption of the blood supply. Without blood, the bone tissue dies and the bone collapses. If avascular necrosis involves the bones of a joint, it often leads to destruction of the joint articular surfaces(see osteochondritis dissecans). There are many theories about what causes avascular necrosis. Proposed risks factors include, chemotherapy, alcoholism, excessive steroid use, post trauma, caisson disease(decompression sickness), vascular compression, hypertension, vasculitis, arterial embolism and thrombosis, damage from radiation, bisphosphonates (particularly the mandible), sickle cell anaemia, Gauchers Disease, and deep diving[1,2]. In some cases it is idiopathic. Rheumatoid arthritis and lupus are also common causes of AVN. The haemopoitic cells are most sensitive to anoxia and are the first to die after reduction or removal of the blood supply, usually within 12 hours. Experimental evidence suggests that bone cells (osteocytes, osteoclasts, osteoblast etc.) die within 12-48 hours, and that bone marrow fat cells die within 5 days. AVN usually affects peoples between 30 and 60 years of age; about 10,000 to 20,000 peoples develop AVN of the head of the femer in the U.S each year. Avascular necrosis is specially common in the hip joint. The most common is being the total hip replacement for AVN of formal head.

1. Assistant Professor, Department of Anesthesia & ICU, NITOR, Dhaka
2. Assistant Professor, NITOR, Dha;a
3. CA, NITOR, Dhaka

Correspondence: Dr. Nasir Uddin Ahmed, Assistant Professor, Department of Anesthesia & ICU, NITOR, E-mail: masudaislamkhan@yahoo.com

Total hip replacement involves;

* Dislocation and removal of the femoral head.
* Reaming of the acetabulam and insertion of a prosthetic plastic or ceramic cup.
* Reaming of the femer with insertion of a prosthetic femoral component (metal or ceramic head, metal stem) into the femoral shaft with or without cement.

Problems complicating the anesthesia for Total hip replacement:

1. Blood loss.
2. Thrombo-embolism.
3. Cement reactions; hypoxia, hypotension and cardiovascular collapses including cardiac arrest.

Preoperative assessment;

Patients age ranges from 30 to 60 years. Elderly patients are commonly associated with hypertension, ischemic heart disease, chronic obstructive pulmonary disease and renal impairment. Other problem like rheumatoid arthritis. Therefore careful preoperative evaluation is essential to identify risks factors and ensure that the patient is as fit as possible for surgery. Cardiac, renal function may be impaired due to age, hypertension, use of NSAID.

History of taking drugs like Aspirin, Clopidegrol, Warferin, Beta blocker, ACE inhibitor.

Investigations are advised;

* Full blood count.
* Serum creatinine, urea & electrolytes, random blood sugar.
* Blood grouping & cross matching.
* Coagulation tests.
* ECG.
* Echocardiography.
* Chest X- Ray.

Choice of anesthesia: Total hip replacement can be performed under general anesthesia, spinal or epidural anesthesia or combination of techniques used. In the majority of centre general anesthesia is primarily used but more recently the use of epidural & spinal anesthesia has increased because of significant advantages over general anesthesia.

Advantages of regional anesthesia;

* Reduced blood loss during surgery reducing the need for blood transfusion.
* Decreased bleeding at the operation site, improved cement bonding and shorter surgical time.
* Reduced incidence of DVT and PE.
* Avoids the effects of general anesthesia on pulmonary function.
* Provides good early postoperative analgesia.
* Lower cost.

Problems with regional anesthesia;

* Lack of technical expertise in performing the blocks.
* Lack of ability to sedate patients in the lateral decubitus position for long periods of time.

The reduced blood loss seen with spinal anesthesia as compared with general anesthesia is due to the reduction in arterial and venous pressure resulting from sympathetic blockade which gives rise to less arterial and notably less venous oozing of blood from surgical area.

Hypotensive anesthesia;

Typically, hypotensive anesthesia has been achieved using general anesthesia with a variety of vasodilating agents[10]. The problem with inducing hypotensive general anesthesia is that it causes a reduction in cardiac output and the technique is not recommended for patients with underlying medical co-morbidities or advanced age. More recently, at the hospital for special surgery, a technique of combining epidural anesthesia with intra-operative hypotension has been developed[11]. These technique enables mean arterial pressure to be reduced by 50% with preservation of cardiac output. Extensive epidural anesthesia is established and circulatory stability maintained with low dose intravenous epinephrine infusion (1 to10micro gm). The epinephrine infusion preserve cardiac output and heart rate appear to increase blood flow to skeletal muscle. Intra-operative blood loss for primary THR using epidural anesthesia is usually between 150 and 250ml. this compares favourably with blood losses in the ranges 500-1500ml recorded in other centres using general anesthesia with normotension.

Monitoring;

* Blood pressure usually noninvasively.
* Heart rate and oxygen saturation by pulse oximetry.
* ECG monitoring.
* Blood loss.
* Urine output.

Temperature;

* Try to keep patient warm.
* Use forced air warm.
* Use warm intravenous fluid.

Blood pressure;

Maintain adequate level, ensure adequate volume filling prior to cementing.

Antibiotic prophylaxis is required.

Position; lateral position mostly.

Spinal anesthesia;

* Check contraindication to spinal anesthesia.
* Preload with I.V fluid before spinal performed.
* Close monitoring blood pressure.
* For single shot spinal use 0.5% bupivacaine heavy 2.5 to 3.5ml with fentanyl 12.5microgm(0.5ml).
* Sedation is often desirable due to the length of the operation, intra-operative noice and patient request.
* I.V midazolam or propofol infusion is usually used for sedation.
* Oxygen given by face mask throughout the period.
* For long cases and management of postoperative analgesia, combined spinal and epidural with catheter technique is performed.

General anesthesia;

* Pre-oxygenation.
* Induction of anesthesia with thiopentone sodium or propofol.
* Endotrachial intubation and ventilation maintained by NMBA.
* For analgesia, fentanyl is used.
* Hypotensive anesthesia is induced using vasodilator like GTN or beta blocker like labetalol.
* Reverse from anesthesia, use neostigmine and atropine as usual.

Postoperative management;

* Oxygen is given by facemask for 24hrs and may continue up to72hrs in those at high risk MI patient.
* Position; Patient should be supine, leg abducted using pillow to prevent dislocation of the prosthesis.

Analgesia; patients are generally mobilized within 24hrs and simple intramuscular or oral opioids with regular paracetamol and NSAID usually sufficient.

The benefits of epidural analgesia may be limited to the early postoperative periods up to 6hrs and longer time use may delay mobilization.

* Fluid balance; blood loss may be double in the 1st 24hrs and poorly tolerated in elderly patients. Therefore careful fluid balance maintenance is essential.

Complications;

1. Blood loss; average loss 300-500ml.(reduced by cento-neuroaxial technique.
2. Venous thrombo emboli; deep venous thrombosis is the most common complications occurs in at least 1% of patients even prophylactic measure have taken.

Risk factors include; * H/O DVT or PE.
* Positive family history.
* Prolong immobilization.

STRATEGIES' TO MINIMIZE THE RISK INCLUDE;

i. Regional anesthesia.
ii. Intermittent leg compression device.
iii. Graduated compression stockings.

There is strong evidence for the effectiveness of low dose heparin, LMWH, warfarin or the selective factor Xa inhibitor in reducing DVT.

Recent evidence based guidelines advice that all patients should be offered mechanical prophylaxis plus LMWH.

If using central neuro-axial block ensure that the final preoperative dose is timed appropriately. Bleeding and compression neuroprexia is a potential complication in patients who are anticoagulated or with clotting abnormalities.

Recommendations allow a 12hrs interval between LMWH and epidural/ spinal injection. This also applies to removal of an epidural catheter.

3. Cement reaction; use of cement to fix the prosthesis in place may lead to bone cement implantation syndrome. Methylmethacrylate is an acrylic polymer that has been used extensively in orthopedic surgery for 30 years. Its use is associated with the potential for hypoxia, hypotension and even cardiovascular collapse including cardiac arrest. The most likely cause is fat embolism resulting from raised intramedullary pressure due to the cement expanding as it hardens. Direct toxic effects of the cement are also possible. Problem typically occur soon after cement insertion but may not occur until the end of the operation when the hip is relocated and emboli are dislodged from a previously obstructed femoral vein.

Prevention and treatment;

* Increased inspired oxygen conc. prior to cementing.
* Measure blood pressure frequently at this time.
* Ensure adequate blood volume prior to cementing.
* Stop N_2O (when G/A is given).
* Alfa agonist-methoxamine/adrenaline to treat hypotension.

Suction applied to the bone cement by the surgeon to evacuate air and fat during cement insertion dramatically reduce the incidence of complications.

DVT; a number of reports [12,13,14,15] have described lower rates of DVT following THA when either spinal or epidural anesthesia was used. More recently lower DVT rates were observed by psoas compartment block[16].

The use of LMWH is gaining popularity in Europe[20]. If these agents are given preoperatively, this probably precludes using regional anesthesia because of ever present risk of epidural haematoma for the anesthetic community who recognizes the advantages of epidural anesthesia.

PE; intra-operative hypotension & peri-operative hypoxia are known complication of THA[18]. These have been attributed to methylmethacrylate monomer or fat and bone marrow emboli. Recently echocardiography monitoring has demonstrated significant embolization during THA[19]. The emboli occur during reaming and during insertion of both cemented and noncemented prosthesis, but appears more dramatic when cemented prosthesis are inserted.

Present anesthetic considerations in total hip surgery in different hospitals of Bangladesh is progressing. Total hip replacement surgery performed primarily under general anesthesia (hypotensive anesthesia) in the year 2000-2004. After that spinal anesthesia is being provided. But more recently the use of either epidural & spinal anesthesia or combined epidural-spinal technique has increased because of significant advantages over general anesthesia.

Summery; THR is one of the most successful orthopedic procedure, performed to-day. It can relieve hip pain, restore function and improve the quality of life. Good anesthetic support is an essential element for THR procedure. Anesthetic consideration for THR include background knowledge about the procedure, expertise in the regional blocks(spinal, epidural), management of haemodynamic derangement, close monitoring and postoperative analgesia. A close working relationship between all member of the operating team is necessary for the success of the program. Advancement of the nuro-axial block with catheter technique curtails the percentage of morbidity,mortality and concomitant reduction in the cost.

REFERENCES AND RECOMMENDED READING

1. Ohzone K, Saito M, Takaoka, et al. Natural history of non traumatic avascular necrosis of the femoral head. J Bone Joint Surg Br. Jan 1991;73(1):68-72.
2. Mont, MA, Pacheso IH, Hungerford Ds. Non Traumatic osteonecrosis of the femoral head. Part1. Demographics; Pathogenesis, diagnosis and staging Vol 38. Bombay Hospital Journal;1996.
3. Mauermann WJ, Shilling AM, ZuoZ. A comparison analysis of neuroaxial block versus general anesthesia for elective Total hip replacement; a meta analysis. Anesthesia and analgesia 2006;103;10,8-25.
4. Dulin N. Anesthesia for Hip replacement. Update in Anesthesia 2004;18 www.world anesthesia.org.
5. Worms R, Griffiths R. Orthopedic Surgery. Oxford Hand Book of Anesthesia 2nd edition. AllmanKG, Wilson IH oxford University press 2006.
6. Dashfield A. Acute pain. Oxford Handbook of Anesthesia 2nd edition, Allman KG,Wilson IH, Oxford University press 2006.
7. National Institute for Health and Clinical Excellence. Reducing the risk of venous thromboemolism in patients undergoing surgery.2007 www.nice.org. HK/CGO46.
8. Prospect (procedure specific postop pain management). Total Hip Arthoplasty www Twyman R, Kirwan T, Fennelly M:Blood loss reduced during hip arthoplasty lumber plexus block. J Bone Joint Surg(Br) 1990,72: 770-771.
9. PostopPain. Org 2005.
10. Van Ee R, Van Oene JC: Effect of ketancerin on intraoperative blood loss during THA in elderly patients under G/A. Br. J. Anesth 1991,66:496-499.
11. Sharrock NE, Mineo R, Urquhart B: Haemodynamic response to low dose epinephrine infusion during hypotensive epidural anesthesia for total hip arthoplasty.Reg Anesth 1990,15:295-299.
12. Modig J, Karistrom G, Sahistedt :Thromboembolism after THR, role of epidural and general anesthesia. Anesth Analg 1983,62:174-180.
13. Modig J, Mariduu E, Sahlstedt B: Thromboemolism following THR; Prospective investigations of 94 patients with emphasis on the efficacy of lumber epidural anesthesia in prophylaxis. Reg, Anesth 1986,11:72-79.
14. Prins MH, Hirsh J: A comparison of G/A and R/A as a risk factor for DVT following hip surgery, a critical review. Thromb Haemost 1990;64:497-500.
15. Thorburn J, Louden JR, Vallan R; Spinal and General anesthesia in THR; frequency of DVT. Br. J Anesth 1980;52: 1117-1120.
16. Hoek JA, Henny CP, Knipscheer HC, Tencwe H, Nurmohamed MT, Ten-Cate JW: The effect of different anesthetic techniques on the incidence of thrombosis following THR. Thromb Haemost 1991, 65: 122-125.
17. Sharock NE, Ranawatcs, Urquhart B: Factors influencing DVT following THA under hypotensive anesthesia. Reg.Anesth 1991,15:33.
18. Al-Shaikh B: Effect of inspired oxygen Conc. On the incidence of desaturation in patients undergoing THR. Br.J. Anesth1991,68:580-582.
19. Ereth MH, Lennon RL, Rose SH, Lewallen DG: Haemodynamic changes in patients undergoing total hip arthoplasty : cemented vs noncemented. Anesthesiology 1990,73:A110.
20. Planes A, Vochelle N, Fagola M, Bellaud M, Feret J, Saizard C, Planes M: Effecacy and safety of a perioperative enoxaparin regimen in total hip replacement under various anesthesia. Am J Surg 1991,161:525-531.

00 00

Original Article

Dorsolumbar Spinal Tuberculosis And Its Surgical Management

Abdur Rob[1], AKM Zahiruddin[2], Md Mahabbatullah[3], Shakawat Hossain[4], Badrul Alam[5], Riad Majid[6]

INTRODUCTION

The treatment of tuberculosis of the spine (Pott's disease) is essentially conservative and a vast majority of patients can be successfully managed on antituberculous therapy (ATT) alone.

Surgery is indicated in a few specific cases whe re deformity of spine, pain, or neurological compromise is becoming a serious issue. In cases where surgery is indicated the benefits are almost immediate and excellent. (Syed Ather Enam and Ahmed Ali Shah)

Evidences of spinal tuberculosis have been found in Egyptian mummies and the disease is one of the oldest diseases afflicting humans. The demography, diagnosis, medical and surgical treatment, as advocated currently, have been reviewed with a brief discussion of the literature. Early diagnosis and comprehensive treatment are needed to control this public health problem.

Tuberculosis of the spine is one of the oldest diseases afflicting humans. Evidences of spinal tuberculosis have been found in Egyptian mummies dating back to 3400 BC. The descriptions in Rigveda, Atharvaveda and Charak Samhita are the oldest known texts in the world literature relating to this disease. The association of paraplegia and kyphotic deformity of the spine was first noticed by Sir Percival Pott.

If the patients are diagnosed early, they can be treated medically. Although clinical and radiological findings are clear in tuberculosis of the spine, making an early and definite diagnosis is not yet easy, because disease progression is slow and insidious. Due to this difficulty in the early diagnosis of the disease, several patients have received treatments like non-steroid anti-inflammatory drugs, physical therapy, a corset, etc., prior to correct diagnosis.

If there are not any complications and if the lesion is limited to the vertebrae, triple-drug anti-tuberculous chemotherapy can treat tuberculosis. However, with proper indications, surgical procedures are superior in the prevention of neurological deterioration, maintenance of stability, early recovery and early mobilization.

Tuberculosis (TB) is one of th e leading causes of infectious disease-related deaths in under-developed countries and it has had a resurgence in developed countries as well. The most common site of bony dissemination of this disease is in the spine. It may be present in about 1% of TB cases.

Those who present with spinal TB may have pulmonary TB in one-third to two-thirds of cases. The most important route of dissemination of TB to the spine is hematogenous.

In 1779, Percival Pott published the first description of the spinal tuberculosis (SP) named as Pott's disease. Any organ system may be affected by *M. tuberculosis*, pulmonary tuberculosis (TB) is the most clinical manifestation including 80% of all the cases.] Bone and joint TB account approximately 15% to 38% of extrapulmonary form of the disease and 1% to 5% of all the cases of TB. Spinal TB is the most frequent of the musculoscheletical form of the disease and can affect any segment of the lower thoracic and the lumbar vertebrae. Usually spinal TB has an insidious clinical evolution with a mild clinical symptoms and a diagnosis delay. The optimal treatment of spinal TB remains controversial particularly in the topics related with the duration of the antituberculous treatment and the necessity of surgical treatment. (marcelo and maria)

Demography of Spinal Tuberculosis :

In the Indian population, spinal tuberculosis is predominantly a disease of the young, the usual age of

1. Assistant Professor, Department of Orthopaedic Surgery, NITOR, Dhaka
2. Assistant Professor, Department of Orthopaedic Surgery, NITOR, Dhaka
3. Assistant Professor, Department of Orthopaedic Surgery, NITOR, Dhaka
4. CA, Department of Orthopaedic Surgery, NITOR, Dhaka
5. CA, Department of Orthopaedic Surgery, NITOR, Dhaka
4. Assistant Registrar, Department of Orthopaedic Surgery, NITOR, Dhaka

presentation being the first three decades of life. Reports from developed countries indicate a much older patient population, the median age at diagnosis being sixty-one years11. In most series, the disease has been found to affect males and females in equal proportions.

Role of Imaging in Decision to Operate:

Radiology remains essential in Pott's disease evaluation, providing precious information for the diagnosis and prognosis of spinal tuberculosis.

Plain radiographs may show involvement of adjacent vertebrae with erosion of end-plates. There may be significant kyphosis and a paraspinal shadow, occasionally with involvement of posterior elements. An atypical form of tuberculosis without disc involvement is increasing in frequency and may mimic other bacterial, fungal, inflammatory and neoplastic diseases.

MRI is preferred over CT for it shows soft tissues, including the spinal cord and its distortion by the epidural collection. It may also show asymptomatic 'skip' lesions away from the main disease. CT is useful for appreciation of bony destruct ion and for needle aspiration or biopsy.

Magnetic resonance imaging (MRI) and computerised tomography (CT) have facilitated the preoperative diagnosis of tuberculosis of the spine, but the histopathological diagnosis is still essential. CT-controlled biopsy and abscess drainage also aid in making the diagnosis. Due to these technical advances, cases with severe deformity and complications (gibbosity, paraplegia) are seen less frequently today

Classification of tuberculous paraplegia/tetraplegia:

Table

From *J Cranioverb junction spine*.2010 july-dec;1(2) 74-85

Stage	Clinical Feature
1.Negligible	Patient unware of neural deficit,Physician detects planter extensor /or ankle clonus
2.Mild	Patient is unware of deficit but manages to walk with support
3.Moderate	Non ambulatory because of paralysis(in extension),sensory deficit <50%
4.Severe	III+flexor spasm/paralysis in flexion/flaccid/ sensory deficit >50%

CONSERVATIVE MANAGEMENT

In the absence of major neurological involvement and deformity, the patient is treated conservatively with a standard 4-drug regimen. A brace or a collar is also advised if the disease involves the cervical or lumbar regions, or the thoracolumbar junction. Rifampicin, isoniazid (INH), pyrazinamide and ethambutol are given for the first three months followed by rifampicin, INH and pyrazinamide for the next three months. Rifampicin and INH are then given for the remaining period. In the pediatric age group, streptomycin (for two months) replaces ethambutol to avoid optic neuropathy. In short, 9 to 12 months of treatment is safer and appropriate.

SURGICAL APPROACH AND THE NEED FOR INSTRUMENTATION

As noted, treatment of spine TB is preferably non-surgical unless problems of deformity, significant neurologic deficit, pseudo-arthrosis, pain or failure of chemotherapy is an issue. When a decision is made for surgical intervention, the next question is through what approach and to what extent. Surgical approach may be anterior or posterior. Surgical intervention may be limited to debridement, or radical resection with autografting and instrumentation.

Indications for surgical intervention in spinal tuberculosis:

Absolute indications:

Watts has listed the absolute indications for surgery in tuberculosis of the spine as:

- Marked neurologic deficit related to severe kyphosis, retro pulsed bone or retro pulsed disc.
- Large cervical abscesses in a patient in whom respiratory obstruction has developed.
- Progression of neurologic deficit despite adequate chemotherapy.
- Progression of kyphosis or instability despite adequate =chemotherapy.

Relative indications:

- Inability to obtain material for culture by other means.
- Neurologic deficits in patients for whom prolonged bed rest may give =rise to other problems.
- Persistent pain or spasticity.
- Pain related to spinal instability where spontaneous fusion has not occurred.With regard to spinal tuberculosis and its management, the following are some of the points noted in recent (and not so recent) literature.

FOLLOW UP

Progress of the disease and response to treatment is followed fortnightly for the first 2 to 3 months and then on

a monthly basis once improvement h as set i n. Improvement in pain and fever is a welcome sign. This is usually followed by neurological recovery and reduction of previously raised ESR. Imaging studies may demonstrate reduction in disease burden and the beginning of a healing process by as early as 2 to 3 months. A plain lateral and AP x-ray of the affected spine is advised to monitor the progress every month for the first 3 months and then every other month for as long as ATT is being used. After that x-rays should be repeated with flexion and extension views every 3 to 6 months for 2 years.

Duration of Anti-TB Medication after Surgery:

The British Medical Research Council has published several reports on the efficacy and duration of chemotherapy for spine TB patients who have undergone surgery. One of the initial reports was based on data from Hong Kong. In this report, 114 patients with a mean follow-up of more than 14 years were assigned to one of three regimen combinations (6, 9 or 18 months) after radical debridement and anterior arthrodesis. A 6-month course of rifampicin and INH with streptomycin for the first 3 months was as effective as the rest, with no difference in deformity between various groups and any recurrence or reactivation during follow-up. In three other randomized controlled trials carried out in Hong Kong, Madras and Korea, the conclusion was same, i.e., 6 or 9 months of rifampicin and INH, with streptomycin in first 6 months, was as good as longer therapy.

Patients and Methods:

twelve patients with confirmed spinal tuberculosis (7 males:5females, with mean age 29 years, range 18–47 years) were treated surgically between Jan 2009 to Dec 2010. All these patients were prospectively analyzed. Who were operated by posterolateral (extracavitory or extra pleural) debridement, decompression and reconstruction with cage and posterior instrumentation.

The indications of surgery in both the groups were neurological deficit not responding to antituberculous chemotherapy for 4–6 weeks or significant kyphosis (>40° of segmental kyphosis) or instability (anteroposterior or lateral translation; >40° of segmental kyphosis).

RESULTS

The mean duration between surgery and onset of symptoms was 3 months (range 3-5 months. The distribution of lesions was almost similar in both the groups The mean surgical time was 3 and half hours (range 3 to 4 and half hours) . Average blood loss was 900 ml (500–1000 ml). Mean follow-up period was 18 months (range 12–24 months).

Four patients were classified as Frankel type C, 4 as Frankel type D, and 4 as Frankel grade E before surgery. After surgery, out of 4 patients with Frankel C, 8 patients improved to Frankel D, 8 patients improved to Frankel E at final follow-up. All patient with Frankel E had no completion at final follow-up.

Fig.-1: *Pre operative MRI*

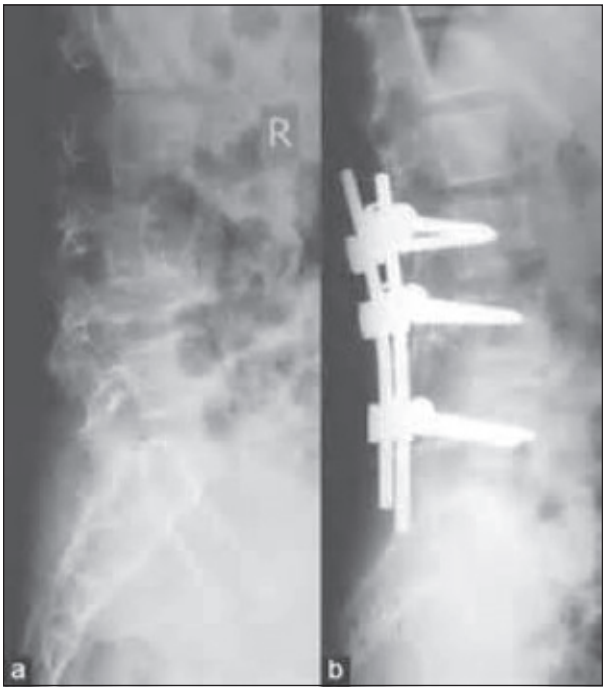


Fig.-2: *After stabilization, decompression and fusion*

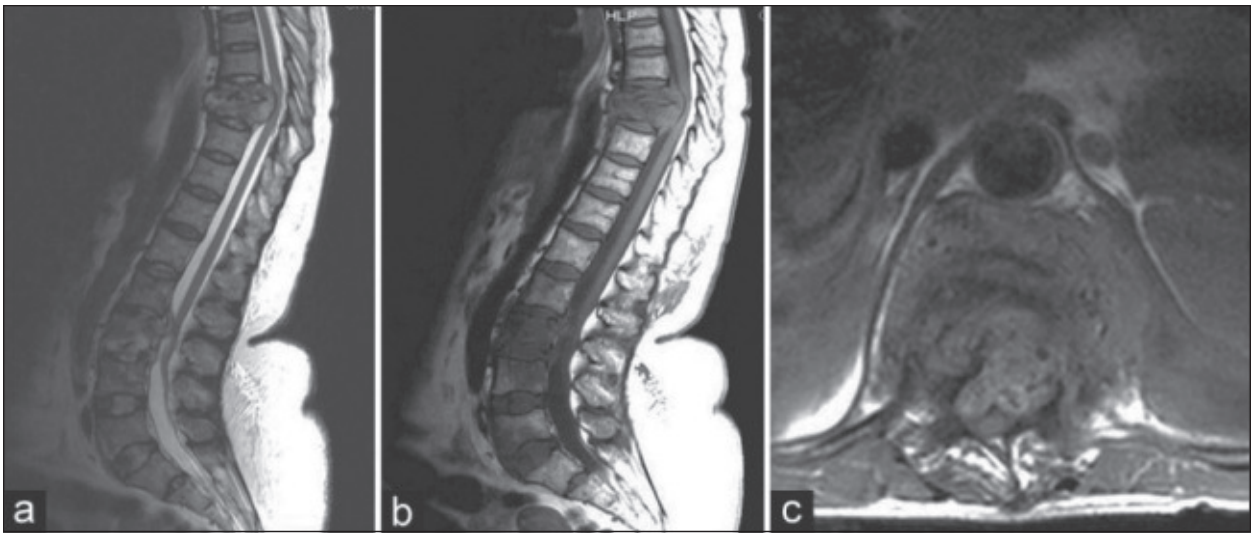


Fig.-3: *pre operative MRI*

DISCURSION

Diagnostic delay is a common problem in spinal tuberculosis. It is necessary to obtain a detailed patient history and clinical and radiological investigations to prevent this problem. MRI findings have led us to detect the lesion localisation, involvement of discs and vertebral bodies, abscess formations and their compressive effects on the spinal cord. Nevertheless, spinal tuberculosis progresses slowly and insidiously, and early diagnosis before abscess formation and disc degeneration is difficult. For this reason, a detailed patient history is very important in these cases. In the early stages, single-level disc degeneration can be detected by MRI. Nevertheless, disc degeneration shows a unique degenerative process, and so the probability of diagnosing the condition as an infection is very low. In either case, painful symptoms of patients can be resolved with medical treatment. If there is a tuberculosis history (in the patient or a family member), night sweats and weight loss focusing on the lesion, detailed MRI investigations are necessary for early diagnosis and medical therapy. CT-controlled biopsy from the destroyed area in the centre of the vertebral body is the gold standard technique for the early histopathological diagnosis of these patients

If there is a cold abscess, antibiotic-analgesic therapy, bed rest or bracing cannot prevent the extensive destruction of vertebral bone and disc material. After cold abscess and two-level disc degeneration, immediate drainage, microbiological and histopathological examination of the abscess along with medical therapy can protect the patient from vertebral collapse and prevent any delay in the diagnosis. The localisation of abscesses is very important. They can be observed in two locations, namely paraspinal and epidural. Epidural abcesses may cause more serious neurological problems because they can compress the cord. We observed that they are more pronounced in the thoracic region than in the lumbar region. Abscess drainage via the psoas muscle diminishes the compressive effects of pathology in the thoracolumbar and lumbar region. Therefore, patients with epidural abscesses have therapeutical priority.

Nevertheless, many spinal tuberculosis cases are diagnosed after the progressive degenerative processes. These cases can only be treated surgically. There are several surgical techniques: abscess drainage, anterior strut grafting, anterior instrumentation, posterior instrumentation, combined anterior and posterior stabilisation and video-assisted minimally invasive thoracoscopic spinal operations. If there is no vertebral collapse, grafting is not necessary. But in the case of vertebral collapse and kyphosis, it is necessary to curette and graft the affected bone. If there is instability and severe kyphosis, (sagittal index e”20°), instrumentation and fusion should be performed. There are some good results from other studies using anterior instrumentation, but conventionally we performed posterior instrumentation. If bone quality is sufficient and the infection status allows anterior fusion, it can be performed. However, the best surgical method for each particular case has yet to be decided.

Surgical treatment is by far the superior treatment. In summary, abscess drainage and debridement enhance drug treatment; biopsy specimens can be taken efficiently for histopathological diagnosis; local instability and disc

degeneration are treated by fusion, which prevents pain and the development of deformity; decompression is provided in cases with neurological problems; if there is any deformity, it can be corrected; surgical treatment leads to rapid recovery and early mobilisation.

The earlier the surgical treatment begins, the faster the healing process. The risk of paraplegia by losing time should be kept in mind. We believe that this new classification can be used as a practical guide in the treatment of spinal tuberculosis.

Although *M. tuberculosis* is an uncommon pathogen in western countries, it is still common in the developing world. TB of the spine accounts for 50% of skeletal TB and 1% to 5% of all TB cases.(marcelo and maria).

In our observation the mean duration between surgery and onset of symptoms was 3 months (range 3-5 months. The distribution of lesions was almost similar in both the groups The mean surgical time was 3 and half hours (range 3 to 4 and half hours) . Average blood loss was 900 ml (500–1000 ml). Mean follow-up period was 18 months (range 12–24 months).

Four patients were classified as Frankel type C, 4 as Frankel type D, and 4 as Frankel grade E before surgery. After surgery, out of 4 patients with Frankel C, 8 patients improved to Frankel D, 8 patients improved to Frankel E at final follow-up. All patient with Frankel E had no completion at final follow-up.

CONCLUSION

If patients have milder forms of spinal TB and are diagnosed earlier, conservative management consisting of anti-tuberculous medication and orthosis is the treatment of choice. In those cases where conservative management has failed, and the patient is dev eloping kyphotic deformity and/or neurological deficits, surgical treatment is superior. In cases with significant pain due to pseudo-arthrosis, surgery should be considered even if the underlying TB infection has healed. In surgical treatment, since the pathology is usually anterior, an anterior approach with wide debridement, autologous bone grafting and instrumentation is appropriate in most of the cases.

REFERENCES

1. Anil Jain,Ish Kumar and Puneet Misra Kyphosisin Spinal tuberculosis-Prevention and correction .Indian j orthop apr-jun;44(2):127-138.
2. B Jadav and M Pruvakor Primary posterior fixation for tuberculosis spine The Internet journal of orthopedic surgery vol 10 num 1.
3. O Karaeminogullan, U Adynily and Ozturk Tuberculosis of the lumbar spine :Outcomes after combined treatment of two drug therapy and surgery Orthopedics Jan 2007 vol 30 issue 1.
4. Maecello, Maria ,Norberto, Claudio and Leonerdo Spondilodiscitis due to Mycobacterium tuberculosis in HIV and non HIV infected patients:Eleven years experience in a referent hospital of infectious disease in Argentina Ortho Article 2012 vol5(5):450-452.
5. Bhavuk Garg,Pankaz kanwal and arvind Jaswal Anterior versus posrterior procedure for surgical treatment of thoracolumbar tuberculosis:a retrospective analysis Indian j orthop. 2012;46(4).
6. vinod agarwal, P Patgaonkar and S P Nagaiya Tuberculosis of spine Journal of Cranioverbral Junction spine

00 00

Original Article

Removal of Dead and Infected Bone in Chronic Osteomyelitis is the Prime Factor to Control Infection – Early Removal Decreases Morbidity

AHM Rezaul Haque,[1] Debashis Biswas[2] Shakeel Akter[2], Takbirul Islam[3], Debashish Ghosh[3]

ABSTRACTS

We studied prospectively a consecutive series of 16 patients with chronic osteomyelitis. All patients had a surgical intervention before coming to the hospital. All patients had open wound. After doing culture & sensitivity and antibiotics accordingly patient didnot improved satisfactorily but after removal of dead and infected bone patient improved dramatically and only one patient developed recurrence. There is always controversy about the removal of sequestrum. We preferred to remove the dead and infected bone when there is line of demarcation between living and dead bone.

INTRODUCTION

The management of chronic osteomyelitis continues to pose a major challenge for orthopaedic surgeons. Chronic Osteomyelitis of children is most commonly of haematogenous origin but in adult it is commonly occur after trauma in relation with either open # or to internal fixation.

Because of the avascular nature of sequestrum, osteomyelitis is difficult to treat and can be associated with high morbidity and possible mortality for the patient. Treatment is aimed at resolution of infection and maximization of patient function.

The treatment of chronic osteomyelitis significantly advanced with the use of muscle flaps and vascularized bone transfer to manage large open defect after debridement.

FURTHER ADVANCEMENT HAVE INCLUDED –

1. Antibiotic beads to manage dead space in staged reconstruction.
2. The use of ext. fixator in the illizarov technique of SK reconstruction.
3. There advancement has led to increased success in the management of Chronic Osteomyelitis with success rates > 90% in the literature[2].

Principle of treatment is eradication of infection by thorough debridement and appropriate antibiotic coverage.The main part of debridement is sequestrectomy. There is debate about the timing of sequestrectomy.Here we have removed the sequestrum when there is line of demarcation between living and dead bone. The extent of bone removal was decided during operation. We follow paprika technique. Early sequestrectomy causes improvement of local wound, control of infection and general condition of patient.

PATIENT & METHOD

There were 10 men and 6 women with a mean age at presentation of 20 (2- 52) years. The diagnosis of chronic osteomyelitis was made on the basis of clinical presentation and imaging. The aetiology of chronic osteomyelitis was post traumatic in 6 patients, post traumatic post-operative in 1 patient and haematogenous in 4 patients.

Depending on the anatomical location of disease the extent of osteomyelitis, the patients' age and comorbidity and their preference of treatment option a decision was made about surgical intervention.

1. Dept. of Orthopaedics, Uttara Adhunik Medical College, Uttara, Dhaka.
2. Associate Professor, Uttara Adhunik Medical College, Uttara, Dhaka.
3. Assistant Registrar, Uttara Adhunik Medical College, Uttara, Dhaka.
Correspondence: Dr. AHM Rezaul Haque, Assistant Professor, Department of Orthopaedics, Uttara Adhunik Medical College, Uttara, Dhaka.

Radiographs were done before operation for determining the line of demarcation. The actual extent of bone resection was determined at the time of surgery.

Debridement is aimed at removing all infected or necrotic bone and soft tissues. All sinus tracts, scar tissues and wound edges were excised and the adjacent soft tissues were resected back to the tissue the bleed briskly. In general, scalpel was used.

Bone was exposed to in extra periosteal. Periosteal stripping avoided. Involucrum was kept in situ. Precise bone debridement was performed until the paprika sign. For endosteal infection debrided with curate and reamer. In some situations, debridement of intramedullary canal done by means of a trough in the bone.

In patient with extensive or circumferential involvement of cortical bone, extensive resection of the involved area was done. Infected perioseum was removed. In these situations, stabilization done.

Tissue obtained at the time of debridement was sent for culture and pathology. In some cases serial debridement is done. After closing the wound, closed irrigation and suction system, temporary antibiotic laden polymethyl methacrylate beads, given in some cases. Bony defect can be corrected by fibula graft and illizarov external fixator.

After surgery, broad spectrum antibiotics were administered I/V to all patients, this was modified after the result C/S.

All patients were followed up regularly, with a mean length of follow up of 20 months. Recurrence of infection was diagnosed by local signs and symptom of infection, sinus formation or drainage, a raised level of C reactive protein or E S R or of systemic symptom such as fever for which no other cause could be found.

Fig.-1: *Preoperative X Ray*

RESULTS

The clinical details and the outcome of treatment for all patients are given in table. Despite accurate microbiological diagnosis from intralesional biopsy and of antibiotic therapy all patients had a recurrence of infection.There were only one case of recurrence in patients after removal of infected bone after one year. In some patients, 2/3 times operations had to be performed.

Mean age at first surgical intervention was 20 yrs (2 – 52), 75%[12] of the patients with chronic osteomyelitis came

Fig.-2: *Post operative xRay*

Fig.-3: *Bones to be removed during operation*

Fig.-5: *X Ray film before removal*

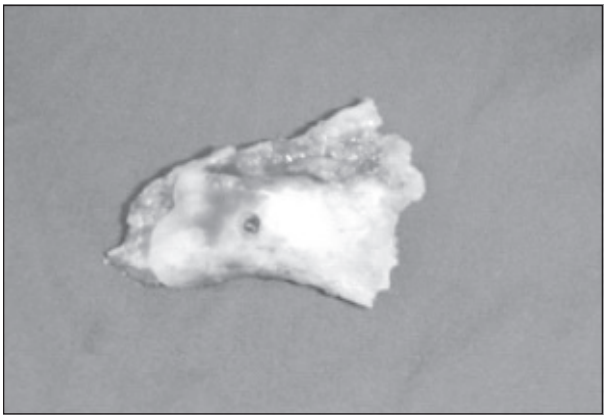


Fig.-4: *Segmental Bones remove*

from the rural community while 25%[4] came from urban or common. Other bones involved are humerous and ulna.

The duration of osteomyelitis was determined as the time from the first onset of symptom to the time of surgical intervention.

Other determinant factor which might affect the likelihood of recurrence of infection are aetiology, site of infection, host comorbidity, duration of infection and causative organism.

It is showing that most of the chronic osteomyelitis of femur is of post traumatic. After accident, proper surgical toileting is not done in remote area. First surgical toileting and wound care is the most important factor to prevent development of chronic osteomyelitis after open fracture.

Table-I

Pt/ Sl	Age	Aetiology	Site	Duration	Stabilisation	Follow up	Recurrence	complication
1	20	PT & PO	femur	6months	Nail, Ext. fixator, illizarov*	4years	No	Knee stiffness
2	2	H	tibia	3months	LLBS	1year	No	Fibula Migration
3	24	PT	femur	1year	Illizarov	1year	No	Limb Shortening
4	12	H	tibia	6months	LLBS	1year	No	Nil
5	40	PT & PO	tibia	8months	Illizarov*	1year	No	Skin
6	10	PT & PO	femur	3years	Nail	1year	No	Ugly scar
7	12	PT	Ulna	4years	Graft and nail	6months	No	Nil
8	40	PT	Humerous	1year	Ext. Fixator	1year	No	Nil
9	3	H	Tibia	6months	LLBS	1year	No	Fibula migration
10	18	PT & PO	Femur	10months	Ext. Fixator	2years	Once	Nil
11	25	PT	Tibia	1year	Illizarov	3years	No	Nil
12	9	H	Humerous	6months	LABS	2years	No	Nil
13	19	PT	Tibia	1year	ORIF*	2year	No	Nil
14	52	PT	Femur	2year	ORIF*	1year	No	Nil
15	24	PT & PO	R&U	6months	Nail/Ext.	1year	No	Nil
16	16	PO	Femur	2year	IM Nail*	1year	No	Nil

PT- Post traumatic; PO- Post Operative; H- Haematogenous

*Final Fixation

DISCUSSION

It is essential to remove all necrotic and infected bone when treating osteomyelitis. Many techniques have been used to determine whether bone is alive or dead. The technique most commonly used is the presence of bone at the time of surgery and the presence of punctuate bleeding. We used this technique to assess whether or not the bone was viable.

In post -traumatic osteomyelitis where repeated surgical clearance done chance of involucrum formation is negligible. Repeated surgical clearance causes increased local tissue scarring, decreased local vascularity, decreases chance of neovascularisation so there by healing and union. Waiting for separation of sequestrum makes the surgery late.

Prolonged use of antibiotic causes antibiotic causes antibiotic resistance, renal impairment, increases morbidity and increased financial loss.

The duration of the infective process also adversely affected the prognosis. It has been suggested that prolonged infection causes increased sclerosis and scarring of the soft tissue envelope, making the infection more resistant to treatment[6].

The local or systemic immune response of some patient may be suboptimal which may lead to higher recurrence ratio[7]. It is very difficult to remove all dead and necrotic material in a single sitting. After removing the main bulk of infective foci body's immune system can remove small infective foci. This was seen in haematogenous osteomyelitis.

It is showing that most of the chronic osteomyelitis of femur is of post traumatic. After accident, proper surgical toileting is not done in remote area. First surgical toileting and wound care is the most important factor to prevent development of chronic osteomyelitis.

CONCLUSION

Chronic osteomyelitis is a condition associated with potentially high morbidity and has historically been very difficult to cure. Treatment is geared toward resolution of infection, while maintaining optimal function of the patients' extremity.

Although a variety of treatment options are available, no set guideline or algorithm is available for treating patients with chronic osteomyelitis. The main factor to control of infection is removal of dead infected bone. As early as the dead and infected bone can be removed as early as infection can be controlled, so the morbidity decreases and gives near normal function of extremity.

Cierny and others stress that treatment should be individualized to the patient. Management should take into account the anatomic aspects of the patients' infection, morbid medical condition and patients perception of the expected outcome. This will allow the optimum outcome in the management of these patients.

REFERENCES

1. Mathes SJ, Alpert BS, Chang N. Use of muscle flap in chronic osteomyelitis: experimental and clinical correlation. Plast Reconstr. Surg. 1982;69: 815-829

2. Patazakis MJ, Mazur K, Wilkins J, Sherman R, Holtom P. Septopal beads and autogenous bone grafting for bone defects in patients with chronic osteomyelitis. Clin Orthop 1993; 295: 112-118

3. Cierny G, Mader JT, Penninck JJ. A clinical staging system for adult osteomyelitis. Contemp Orthop 1985; 10: 17-37

4. Mader JT, Cripps MW, Calhoun JH. Adult post-traumatic osteomyelitis of the tibia. Clin Orthop 1999; 360: 14-21

5. Daoud A, Saighi- Bouaouina A. treatment of sequestra, pseudarthroses, and defects in the long bones of children who have chronic hematogenous osteomyelitis. J Bone Joint Surg. [AM] 1989; 71: 1448-1468

6. West WF, Kelly PJ, Martin WJ. Chronic osteomyelitis: factors affecting the results of treatment in 186 patients. JAMA 1970; 213: 1837-42

7. Kelly PJ. Infected non-union of the femur and tibia. Clin Orthop North Am 1985; 15:1481-90