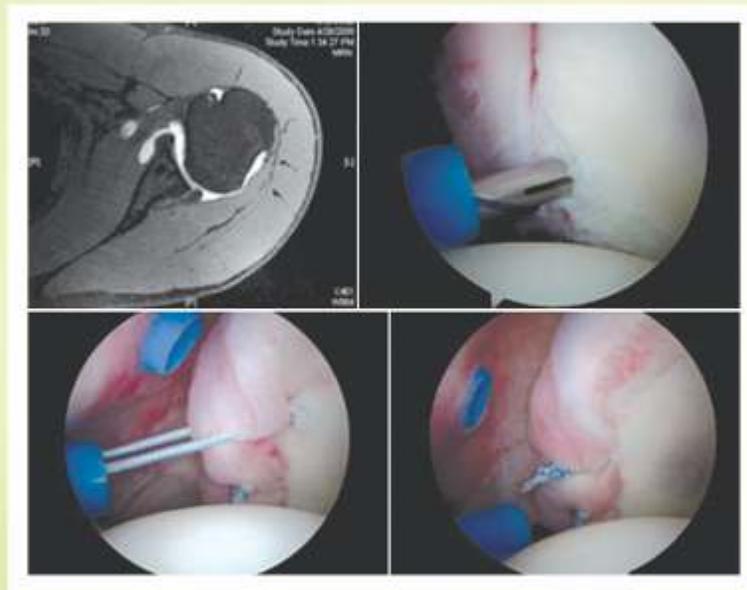


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Edited by
Dr. Edward L. Nazareth
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Editorial

Training the orthopaedic resident : A need for change

Edward Nazareth

Despite the many developments in medical science during the past few decades, the education of the orthopaedist had retained most of its traditional format. The adaptive changes it had experienced may not have been as significant as they could or should have been.¹ Samiento A.

Orthopaedic surgery has grown tremendously over the past few decades in India; joint replacements, complex spine surgeries and microvascular orthopaedic procedures are now available in many of the urban and semi-urban hospitals across the country. Due to various government funded health schemes and insurance facilities many of the modern orthopaedic procedures are now at a reach to majority of the people of this country provided they seek them in time.

The orthopaedic speciality has now been termed as an 'end specialty' in the sense, one need not go further for 'curriculum based training' to have qualification to treat any or all the orthopaedic conditions. Unlike a general surgeon with an M.S. degree who may not be able to practice urology unless he has M.Ch. Urology or do cardiac surgeries without a M.Ch. Cardiology qualification, an M.S. Ortho degree holder can do anything from joint replacement to spine fixation, arthroscopy to tumor excision if he is capable of doing it.

But, the orthopaedic training in our country has not changed since its inception. From a neglected speciality

of treating low energy trauma or correcting the burnt out deformities of osteomyelitis, now it has grown as the most sought of speciality to address high energy trauma, the disabilities due to osteoarthritis, osteoporosis etc. Though orthopaedic practice has been growing with quantum leaps, training the orthopaedic graduates follows the same method used half a century ago!³

More over we have such a heterogeneous curriculum and methods of training, assessing, majority of the orthopaedic postgraduate degree holders today are half baked, if not baked at all! Many of them use this M.S.Ortho as a qualification to get further training either working as an assistant to some one who has already 'established' themselves, and try to grow under his shadow. Few lucky ones get a chance to go further and get trained in one or the other sub-speciality and become 'experts'. The rest go with the flow and earn their livelihood.

It is high time that we design an uniform method of in-service teaching and training so that at the end, the trainee acquires core fundamental knowledge and psychomotor skills to deal with common musculoskeletal clinical problems.² At the end of three years the trainee should have enough knowledge and experience to treat common orthopaedic problems, should be able to handle routine orthopaedic trauma independently and this has to be uniform irrespective of the centre or trainer.

We have two main processes through which the postgraduates are trained in our country today-one through university affiliated medical colleges which provide three years of training as per the 'guidelines' issued by the Medical Council of India, conduct

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examination and award M.S. Orth degree and the other is through National Board of Examinations which has training programmes in recognized institutions for three years, have examination and the qualified candidates are awarded with DNB degree, now considered at par with M.S. Ortho. In few of the universities two years of training programme for diploma (D.Orth) is also existing though experts feel it has to be abolished.³

The present orthopaedic training in our country has no proper guidelines and there are no set objectives. Uniformity in training is lacking not only in the country but also in every different institutions that come under the same university. The examinations conducted by different universities differ to such an extent, that the 'best' candidate at one centre may not qualify at all in another centre. It is a known fact that the 'strict' examiners at the National Board Examinations are 'lenient' in the university examinations! To maintain high standards, the passing percentage was kept low, even then until recently the National Board degree was considered below par with the university degrees.

What we lack in training?

At present the orthopedic training is available mainly in three types of institutions in our country: i) Government medical college hospitals; ii) Corporate hospitals and iii) Private medical college hospitals. The training in each of these differ from the other and has several lacunae in the training programmes in general; there may be very few exceptions.

Poverty amongst the plenty: In most of the government hospitals majority of the services provided in the orthopaedic department are overburdened-may it be the out-patient clinics, emergency and trauma units, in-patient wards or the elective operation theatres. The orthopaedic residents are the main work force here, their valuable time of training is spent in providing service to the patients. They do not get enough time to evaluate the patients clinically and discuss the treatment options with their mentors¹, who are again busy balancing between their 'presence' in the government medical college

hospitals and 'availability' at the private hospitals in the same or neighbouring city. I had met many of these 'mentors' who even own a private hospital in the same city! Though there is vast clinical material in the medical college hospitals, there are no people to use these properly and efficiently to train the postgraduate trainees. There is plenty and more clinical material of different type, but the sub-specialties are not available in many of the major government medical college hospitals. In some hospitals the sub-specialty units are headed by the people who have no training in that specialty. Recently I visited one such hospital in a major city, where the spine unit was headed by a senior professor, who was able to get the posting through political power, but was able to perform only one type of spine surgery- that was removal of the disc by laminectomy!

In many of the government hospitals a junior postgraduate learns from his senior postgraduate who repeats what his senior had done...and the tradition continues. The postgraduate trainees hardly interact with their so called 'mentors' unless they also do 'duty' in their mentors' private hospitals! There are no clinical classes, no seminars, no journal discussions. In one of the reputed government medical college, the trainees informed me that the third year residents routinely attend as many as possible 'postgraduate teaching programmes' conducted by different institutions so that they learn how to present the cases in the examinations!

Profession is a business: I was not able to make out why a DNB trainee of a spine unit of a reputed corporate hospital was finding it hard to present a patient with spinal tuberculosis at a postgraduate teaching programme, until he confessed with me during tea-break that it was his first case presentation in three years of training! The DNB trainees in many of the corporate hospitals are looked after well and are also made to work beyond their capacity. But many of these trainees lack the basic skills to examine and to make decisions.

Some of these institutions are equipped with state of art operation theatres, most modern gadgets but have few resource persons to give conceptual teaching. These

places have few patients capable of paying for surgery with hardly any opportunity for hands-on training for the trainees⁵. The trainees duty is to maintain the records, attend the rounds of the seniors, do the dressings and plan the discharge. They have no opportunity to follow-up the patients, since attendance to the attending surgeons' out-patient clinic is not permitted¹.

In these centers, the trainees are enrolled with certain orthopaedic surgeons who mainly excel in a particular subspecialty of orthopaedics². A trainee trained in spine surgery unit may not know how to reduce Colles' fracture and apply plaster cast, because he would not have had a single chance not only to do but even to assist and see some one reducing the fracture. In many of the corporate hospitals the patients are treated as commodities and not human beings! A trainee from a spine unit of a corporate hospital was telling me how each and every disc that is protruded in MRI is removed irrespective whether it was the cause of symptoms. Another one of my student was sharing the experiences of passing K wire to any fracture of the distal radius in the hand unit of a similar hospital. This corporate culture is based on the difference of the financial benefits the 'mentors', the orthopaedic surgeons, receive from the surgical versus non-surgical care given to a particular patient. This is at what Sarmiento expressed his anguish when he wrote 'The seminal and uncontroversial reality is that Medicine is rapidly ceasing to be a profession, and becoming a business. The values of medicine are being replaced with those of the business community'⁴.

And the postgraduate trainees that are trained in such institutions may become a generation of unsafe orthopedists without a general orthopaedic background.² The trainees knowingly or unknowingly follow their mentors, whom they might accept as their professional role models⁴. The main reason for the unprofessional and unethical deviations of some of the orthopedists during and after their training is the poor example set by their teachers⁵.

Training for sale : I was stunned when one of the trainee in an university postgraduate examination answered that he had neither assisted nor seen a 3.5 mm dynamic compression plate being used in his institution during three years of his training. He was trained in a medical college owned by a private management. His trainers were on records, but appeared only during inspection by Medical Council of India at which time truck loads of 'patients' are also brought from the nearby villages by paying double their daily wages. The department was virtually headed by an assistant professor whose main duty was to supervise the record building! The interns and the postgraduates were made to write out-patient, in-patient case records of the imaginary patients and even the surgery notes! On records the department had enough patients for admitting four postgraduate candidates annually! This may be the worst scenario of a private medical college; but many of the private medical colleges significantly lack both the clinical material and teachers. Many of such institutions are relying on 'retired government professors' who would be available in the department only on University or Medical Council inspection and rest of the time are busy in their established private practice in the towns where they were serving as professors earlier.

Majority of the postgraduate admissions in such institutions are auctioned privately and the highest bidder amongst the candidates are selected. Many of them have taken several attempts to pass MBBS and would not be eligible to get a postgraduate seat by other competitive examinations. Somehow they complete their training and are able to get the degree!

Exceptionally we do have more exemplary institutions in the private sector also. They have corporate units and general wards side by side looked after by the same department catering patients from all economic group. Some of these have best subspecialties, expert trainers, good teachers but unfortunately these type of institutions are very few.

How to address these issues?⁶

To achieve standards in training the postgraduates, we need to have a uniform need-based curriculum applicable throughout the nation. Each medical teaching institution, whether government or private should have certain minimum standards of imparting education. The trainees should have a roadmap in the form of educational objectives which can help them reach their destinations. The current orthopedic training program, based on an opportunistic learning pattern or "apprenticeship" model, needs to be replaced by a "structured" training system.⁷ A competency based or outcome-based education is a structured program in which decisions about the curriculum are driven by the outcomes which the students display by the end of the course.

The current guidelines for three years of postgraduate orthopedic education needs to be defined by developing a structured curriculum. In all developed nations like UK, US, Singapore, the duration of orthopedic training has been increased to 6 years which includes basic surgical training.^{8,9} At present the trainee, by the end of 3 years only qualifies in basic orthopedics which seems grossly inadequate and this insufficiency can badly reflect on the poor patients. We have to define the minimum achievable competence for each course as well as minimum eligibilities to be generalist and subspecialty experts³.

The specific guidelines for minimum distribution of experience in the training program be made mandatory. Untill the duration of the training is increased, the conceptual frame work for three years should be laid down so as to define the scope of orthopedic training including the stages, and the milestones that must be achieved by the trainee. A common foundation course for postgraduate is needed to provide an introduction to the principles of planning, interpersonal skills, medical ethics and legal responsibilities, epidemiology and statistics. The students should also get familiarized with research methodology and literature search techniques.

At present we have examinations at the end of three years where one long case and three short cases decide the competency of the trainee. Some of the clinical tests that decides the results are best to be preserved in the museums. Instead of this a continuous assessment of clinical competence should be done throughout the program. Present system of answering four papers of three hours each has to be replaced by objective type of examinations ideally conducted online by the competent boards or university. Two sessions of online evaluation may take away the trainer related bias and can truly assess the knowledge of the trainee. A minimum knowledge has to be the criteria to take clinical examinations.

The clinical examinations should assess the technical competence and the ability to formulate a treatment plan for a given clinical problem. This may also be evaluated by the performance in operation theatre or in the manual skill laboratory. The mindset of the examiners must reconcile clearly and loudly that the orthopedic trainee would be examined essentially for fundamentals of core orthopedics. There should be a match between what a trainee is expected to know and what is asked².

The quality of work done by the teachers should be monitored as well.³ The teachers should be given enough training and some minimum standards are required for them as well. Research papers, presentations and academic work should fetch more credentials. Examinership should be given to those who have better credentials than by simple virtue of age or experience. Train the trainers program should be implemented as a routine by the universities so that the incompetencies and autocracy among the educators are removed.^{1, 10}

It is high time that the Indian Orthopaedic Association takes up this issue with the Medical Council of India. There was a suggestion to form a national orthopedic residency committee (ORC), which should be empowered to monitor and suggest any changes¹¹. We should have a uniform residency system of training with a structured national curriculum, ensuring a specific core

competency system within the given framework². It should also be emphasized that postgraduate trainees are not used only as resident duty doctors in the institution.

It is the responsibility of the government to provide adequate infrastructure for medical education in the universities and state medical colleges. The government will have to provide funding to these academic centers for creation of new knowledge and training competent doctors who will improve the healthcare service of the nation.

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Rotator cuff tear

Vivek Pandey

INTRODUCTION

Patients with rotator cuff tear, partial or complete, are more common than believed as most of them remain asymptomatic for a long time.^{1,2} Ignorance about the rotator cuff pathology, over diagnosis of frozen shoulder and overlap of cervical symptoms leads to mismanagement of the original problem of rotator cuff disease. Although the exact pathogenesis is controversial, a combination of intrinsic factor proposed by Codman and extrinsic factors theorized by Neer is likely responsible for most rotator cuff tears.³⁻⁵ Better understanding of pathology, clinical symptoms and signs has led to improved diagnosis of rotator cuff tear. Though MRI remains gold standard for the diagnosis of rotator cuff tears, emergence of ultrasound has revolutionized the diagnostic capability.⁶ Conservative treatment offers satisfactory results in partial or small tears.⁷ For symptomatic full thickness tear, mini-open rotator cuff repair is still commonly performed and results are comparable to arthroscopic repair but all-arthroscopic repair of rotator cuff tear is now fast becoming a gold standard for rotator cuff repair as it is easy to tackle various other co-existing pathologies in the joint like biceps, labrum and cartilage.⁸⁻¹² Strong & biological repair techniques, better suture anchors and gradual rehabilitation of post-cuff repair has led to good to excellent outcome after repair. Role of biological agents

like platelet rich plasma and stem cells in postoperative healing is still under evaluation.¹³⁻¹⁶

RELEVANT ANATOMY

Though formed by confluence of joint capsule, tendons and Coraco-humeral ligament, primarily rotator cuff consists of four tendons; Subscapularis (SC), Supraspinatus (SS), Infraspinatus (IS) and Teres Minor (TM). All these tendons arise from scapula and insert upon lesser and greater tuberosity of Humerus and assist in rotation and abduction of shoulder. Interesting fact about SS is that anterior 7 mm of SS tendon is stronger as compared to remaining mid-posterior part of tendon leading to formation of a stress riser zone between anterior edge and remaining mid-posterior fibres. More than 90% of degenerative tears start and propagate from this junction. Histologically, SS and IS is made up of "five" interlocked distinct layers. Differential anatomy between various layers initiate stress riser and can cause intrasubstance tears. Robust collagen on bursal side makes it more resistant to tensile stress. Hence, articular side is more prone for tears than bursal side.¹⁷⁻¹⁹ Vascular supply to the cuff is by suprascapular, subscapular, anterior & posterior circumflex humeral vessels.²⁰⁻²² The famous "critical or hypovascular zone" in supraspinatus tendon proximal to its insertion is controversial in existence.^{23, 24} The subacromial space which is approximately 8-12 mm wide in superior-inferior direction is bounded superiorly by lower end of acromion

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and distal clavicle and inferiorly by humeral head. Anteriorly, this space is bounded by Coracoacromial (CA) ligament which is attached on to the anterolateral edge of acromion and Coracoid process inferiorly forming Coracoacromial arch. As rotator cuff tendons traverse this space and arch, any chronic contact of arch with the cuff can lead to damage to the cuff especially with hooked acromion or calcified CA ligament.^{5, 25-28}

FUNCTION OF ROTATOR CUFF

The main function of Rotator cuff is to keep head of the Humerus centered into the glenoid fossa permitting a single center of rotation while allowing efficient abduction or elevation of the arm.^{29, 30} Supraspinatus acts as initiator of abductor and continues to assist deltoid in further abduction. Infraspinatus provides 90% of external rotation strength and Subscapularis major internal rotator.³¹ Supraspinatus and Deltoid form a force couple in coronal plane while Subscapularis and Infraspinatus-Teres Minor in transverse plane. The balanced force couple in both planes ensures that the head remains centered and glenohumeral function is maintained.³² In case of IS and SC tears in combination with SS tear, the head migrates proximally due to imbalance in force couple severely compromising function.^{33, 34}

ETIOLOGY OF CUFF TEAR

The etiology of rotator cuff tear can be divided into two types.

1. Traumatic tear:

There is a history of significant trauma to upper limb. E.g. road traffic accident (typically fall from bike) or fall with arm in forward flexion or adducted arm with shoulder tip hitting the floor. Patient is unable to lift arm after the trauma.

2. Non-traumatic or degenerative tear:

It is more frequent and worrying cause of rotator cuff tendon tear. Tendon is weakened by extrinsic or intrinsic pathology leading to gradual failure of tendon with or without superimposed acute injury.

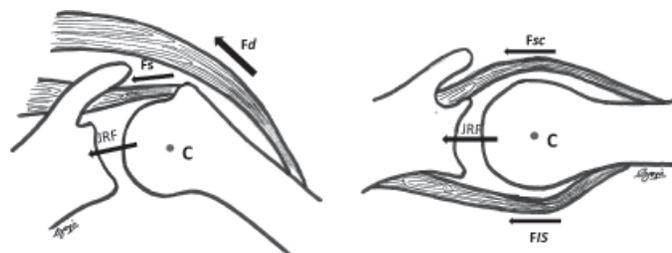


Figure 1: Force couple balance in coronal and axial plane. Abbreviations; JRF- Joint reaction force, C- center of rotation, Fs- supraspinatus force, Fsc- force in subscapularis, Fis- infraspinatus force, Fd- deltoid force.

a) Extrinsic theory of tendon failure: Neer's classic work advocated extrinsic causes for rotator cuff tendon failure. During forward elevation of the shoulder, anterior part of the cuff abuts against Coracoacromial ligament (CAL), anterior acromion and occasionally Acromio-clavicular (AC) joint.^{4, 35} This theory was consistent with finding of anterior part of supraspinatus as most frequent area of tendonitis and rupture. Nicholson further stated that higher incidence of rotator cuff tears was present in patients with Bigliani type III acromion (Hook type). However, extrinsic theory of tendon failure has been challenged by many authors as this theory cannot explain the tears happening in Infraspinatus or articular side tear.³⁶

b) Intrinsic theory of tendon failure: Codman questioned extrinsic theory as he found that most tendon tears start on deep surface and intrinsic damage initiated "deep peeling of tendon" which he termed as rim rent lesion of supraspinatus.³⁷ Currently, intrinsic theory is based upon "degenerative-microtrauma" model. It proposed that age related degeneration compounded with repeated microtrauma leads to partial tear that then converts into full thickness tear. This altered degenerated-microtrauma environment is further influenced by inflammatory mediators which alters tendon gene expression and histopathology.^{38, 39} Oxidative stress in local environment induces "tenocyte apoptosis" which further damages the tendon.⁴⁰⁻⁴² Repetitive load on a degenerated, structurally altered tendon leads to partial and then into full thickness tear. Also, rates of tendon tear increase with age with high incidence in sixth to tenth decade.^{5, 43, 44}

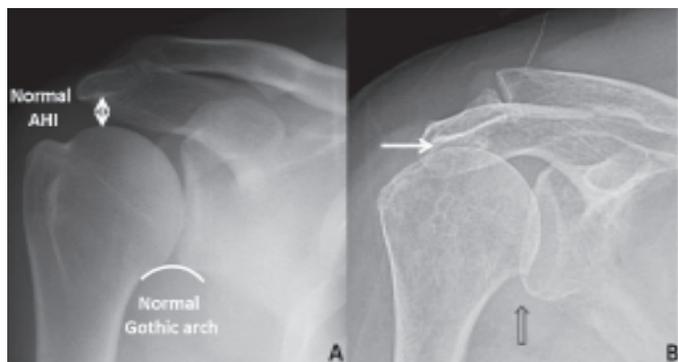


Figure 2: Radiograph revealing normal and reduced acromiohumeral interval. Abbreviation: AHI-acromiohumeral interval. White arrow indicating reduced AHI and another one shows broken arch.

c) Cuff vascularity: Traditionally, 10-15 mm proximal to site of SS insertion is thought to be the site of critical ischaemia.⁴⁵ But, theory remains controversial as many authors have later challenged it.²⁰ Despite this, perhaps role of hypovascularity still remains in discussion especially in a dynamic setting. According to Rothman et al, an adducted shoulder where SS is compressed against head of Humerus causes cuff hypoperfusion.²¹ This fact is utilized in postoperative rehabilitation of cuff in healing phase wherein shoulder is immobilized in slight abduction. This probably ensures better perfusion of cuff.

d) Other factors or mechanism: Cuff disease or tears are certainly more common in people who are indulged in strenuous overhead activity like carpenter, painter, and manual laborers. This further strengthens theory of tensile overload leading to cuff failure. Walsh et al proposed another interesting mechanism termed as internal impingement.⁴⁶ The causes for intrinsic cuff failure can also range from fatigue due to overuse to underlying shoulder instability or superior labral pathology, injuries which have been associated with internal impingement and articular side failure.⁴⁶⁻⁴⁹

PATHOLOGY AND NATURAL COURSE OF TEAR

According to Codran, degenerative cuff tears initiates in the anterior fibres of supraspinatus as "peel off lesion"

7 mm behind the biceps pulley or SS tendon.⁵¹ This peel off lesion starts behind strong SS tendon which is very resistant to tensile loads, which is the stress riser junction. Gradually, the peel off lesion extends onto the bursal surface and finally appears as a Rim rent (pin hole) lesion in anterior SS. This gradual enlargement of peel off lesion to full thickness pin hole may take several months to years. Full thickness tears do not heal and progress slowly unless compounded by an acute traumatic event.^{44, 50-53} Anterior strong tendon resist anterior migration of tear so tear keeps progressing posteriorly forming deep U or later L shape tear due to capsular pull. Later, the strong SS tendon subluxes anteriorly towards coracoid exposing biceps pulley. The long head of biceps tendon (BL) hypertrophies or later rupture causing SC tear. Finally; capsule further contracts, SS retracts till glenoid, IS torn or subluxes below the head and subscapularis tears further. This exposes the head and is called as classic "bald head tear" with disrupted coronal and transverse force couples pushing the head upwards. It initiates arthritic changes in glenohumeral joint later, causing rotator cuff arthropathy which is the end stage of cuff tear spectrum. In the natural course of few months to years, full thickness tears do not heal spontaneously.⁴⁴ Majority of the full thickness cuff tears (36-50%) do progress in size.^{44, 54-56} Larger tears (>1-1.5 cm) have greater rate of progression along with higher incidence of muscle atrophy and fatty infiltration.⁵⁶ When the size of a cuff remains constant, patient may remain clinically asymptomatic or may complain of mild pain with intact active elevation. Onset of pain or worsening pain, with or without accompanying weakness in active arm elevation usually signals increasing size of cuff tear. However, partial thickness cuff tears can heal (10%) or become smaller (10%) but 53% propagate and 28% become full thickness tears.⁵⁷ Functionally, Small degenerative tears of SS are well tolerated functionally as long as rotator cable is maintained and anterior fibre of SS tendon is intact.^{32, 58} However, full thickness tear involving complete SS tendon affects abduction and humeral rotational capability and later with disrupted force couples, head migrates upwards.⁵⁹

CLASSIFICATION

are many classifications recommended for full thickness rotator cuff tear for better understanding of natural history, its treatment and outcome. In this review, some important classification involving full thickness tear would be discussed.

1. DeOrto and Cofield classification⁶⁰. Based upon Tear size in antero-posterior direction
 - i) Small: < 1cm
 - ii) Medium: 1-3cm
 - iii) Large: 3-5 cm
 - iv) Massive: > 5cm
2. Ellman and Gartsman classification⁶¹: Based upon tear shape
 - i) Crescent shape: Wide antero-posterior with minimal retraction
 - ii) Reverse L and L shape tear: tendon tears from head and extends medially through rotator interval or through the interval between SS and IS.
 - iii) Trapezoidal tear:
 - iv) Massive tears: larger and irreparable
3. Patte's classification⁶²: Based upon tear retraction in frontal plane
 - i) Stage 1: Proximal stump close to bony insertion
 - ii) Stage 2: Proximal stump at the level of head of Humerus
 - iii) Stage 3: Proximal stump at the level of glenoid
4. Patte's Topographic classification: Based upon sagittal plane
 - i) Segment 1: Isolated subscapularis tear
 - ii) Segment 2: Isolated coracohumeral ligament tear
 - iii) Segment 3: Isolated supraspinatus tear. [segment 1+ segment 3- Anterosuperior defect]
 - iv) Segment 4: complete supraspinatus and half Infraspinatus tear
 - v) Segment 5: complete supraspinatus and Infraspinatus tear
 - vi) Segment 6: complete supraspinatus, Infraspinatus and subscapularis tear

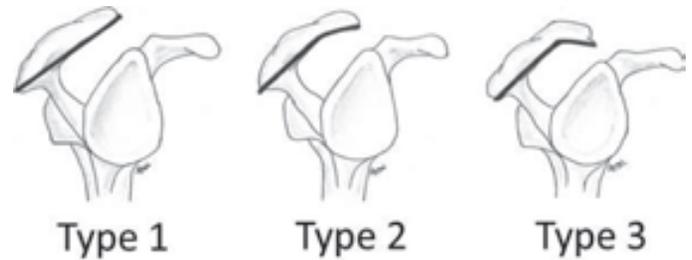


Figure 3: Bigliani's three types of acromian; flat, curved and hooked

Lafosse proposed separate classification for subscapularis tear⁶³. However, all these classification system take either one or other factor into account but none is comprehensive. Recently, ISAKOS shoulder committee has recommended rotator cuff tear classification system which takes five factors into account; location, extension, Pattern, fatty atrophy and retraction.⁶⁴

CLINICAL FEATURES

The diagnosis of rotator cuff tear can be challenging as inter-relationship between the shoulder and cervical spine produce a similar constellation of histories and pain patterns. Rotator cuff pain is frequently described as a dull ache of insidious onset extending over the lateral arm and shoulder. Typically, overhead activities exacerbate pain, and pain frequently increases at night and may awaken the individual from sleep. Complete absence of night pain while lying on the affected side fairly well rules out rotator cuff disease on that side. Patient with complete tear of rotator cuff may also complain of weakness while elevating his/her arm. On examination, the best approach to evaluate the rotator cuff is a "look-feel-move-test" sequence. Most important clue from inspection towards a cuff tear is muscle wasting of supraspinatus and/ Infraspinatus in their respective fossae especially in chronic tear. Differences between active and passive range of motion (ROM) help to rule out underlying adhesive capsulitis secondary to cuff tear. Special tests include positive 'impingement' signs. In Neer's Impingement sign, forced forward elevation in which the arm is elevated to the full overhead

position and then pushed a bit further induces pain.⁴ The forced internal rotation test or Hawkins sign is performed by raising the arm horizontally, and then internally rotating the shoulder using the flexed forearm as a lever indicates subacromial bursitis.⁶⁵

Integrity of the rotator cuff is next assessed by measuring the strength of individual cuff muscles and comparing it with the opposite side. Tests for individual muscles include the Jobe's test⁶⁶ for supraspinatus muscle, the resisted external rotation test for infraspinatus muscle⁶⁷, and Napoleon or belly press test and Gerber's Lift-off test for subscapularis.^{68,69} The belly press test is performed by having the patient place the hand on the abdomen and then holds the elbow forward while pressing on the abdomen. If the patient must flex the wrist, there may be a full-thickness tear of the subscapularis tendon. A tear of Infraspinatus and Supraspinatus shows a positive external rotation lag sign, which is the inability to externally rotate the arm against resistance or to hold the arm in external rotation against resistance. The hornblower's sign has been shown to have 100% sensitivity and 93% specificity with regard to indicating irreparable tears of the teres minor.⁷⁰ Another lag sign described is the drop sign⁷¹, which is elicited with the test for the lag sign performed with the arm, abducted 90°. The arm is then externally rotated maximally until resistance is met, and the patient is asked to hold that position. The test is positive if the arm falls into internal rotation. The test is positive for 40% of their patients with tears of both the infraspinatus and the supraspinatus and 50% of their patients with tears of the supraspinatus, infraspinatus, and subscapularis. As per current literature, combination of 2-4 tests can improve diagnostic accuracy upto the level of MRI.⁷²

DIAGNOSTIC IMAGING

The diagnosis of rotator cuff tears involves Plain Radiograph, USG and MRI. CT scan was performed in past to look for fatty infiltration but now is replaced by MRI.

1. Plain Xray of shoulder: It is essential to perform plain x-ray of shoulder in all patients with RC disease.

a) Plain antero-posterior view- May look normal/may show sclerosis of undersurface of acromian (Sourcil sign), sclerosis of greater tuberosity with occasional small subchondral cysts indicating chronic impingement. Presence of calcification in subacromial space indicates calcific tendinitis. Normal acromio-humeral interval (AHI) of 7-14 mm exists between undersurface of acromian and upper surface of greater tuberosity. Decrease in this space by less than 7 mm and elevation of humeral head has been associated with large rotator cuff tears especially Infraspinatus and subscapularis.⁷³ Late cases of rotator cuff tears may progress to rotator cuff arthropathy which is characterized by glenohumeral joint arthritis and severe proximal migration of humeral head kissing the undersurface of acromian with disturbed gothic arch

b) Axillary view: presence of os-acromiale and glenohumeral arthritis is assessed by this view.^{74, 75}

c) Supraspinatus outlet view: Helps in outlining acromial morphology according to Bigliani type I, II or III.^{25, 28}

c) Ultrasonography (USG): At present, high definition USG (8 MHz-13 MHz) is the most important diagnostic tool to identify the cuff pathology as it is non-invasive, quick, reliable, cheap and most importantly; it is a dynamic investigation which can detect dynamic impingement component in the cuff disease as compared to MRI. The sensitivity and specificity of USG is reported to be more than 90% for full thickness tear which is

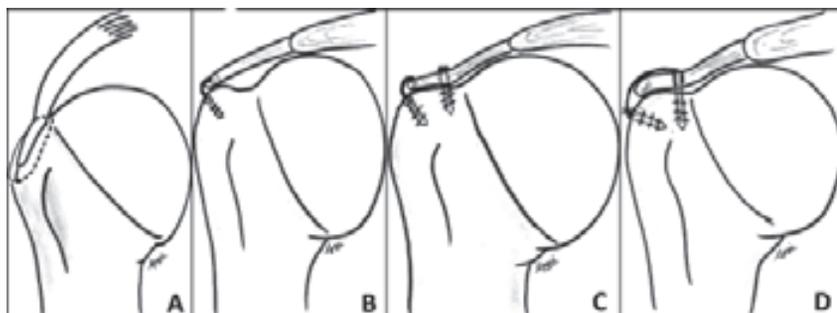


Figure 4: Various types of cuff repair; (A) Transosseous, (B) Single row (SR), (C) Double row (DR) and (D) Suture bridge technique.

comparable to MRI.⁷⁶⁻⁷⁹ Sensitivity of USG and MRI is low for partial tear.

However, USG has its own set of disadvantages. It is an operator dependent tool, so reports can vary considerably according to radiologist's experience. It cannot detect degree of retraction of cuff, fatty infiltration and degree of muscle atrophy cannot be commented upon with high sensitivity.

2. Magnetic resonance imaging (MRI): It is the investigation of choice for RC disease as it can demonstrate any (full or partial) rotator cuff tears with 98% sensitivity and 79% specificity⁸⁰. MRI can detect cuff retraction, fatty infiltration and muscle atrophy which are important preoperative predictors for good outcome.
3. Arthroscopy: Shoulder arthroscopy is the gold standard tool for the diagnosis of rotator cuff tears in doubtful cases. It helps in thorough visualization of cuff both from articular and bursal side and can detect small partial thickness tears on either side which can be missed on USG/MRI. It also enables to visualize rest of the joint for any other concurrent pathology.

DIFFERENTIAL DIAGNOSIS

Several conditions mimic full or partial thickness cuff tear.

1. Suprascapular nerve entrapment: It may present as full thickness (FT) cuff tear. However, these patients are usually young and may be athletes and present with gross cuff wasting especially Infraspinatus. Cuff test reveal weakness especially external rotation strength. Many of them are associated with labral tear. However, ROM is usually painless which is unlike of cuff tear. USG shows normal cuff without tear and MRI reveals spinoglenoid notch ganglion. Nerve conduction test are confirmatory.
2. Acute calcific tendinitis: It is an acute non-traumatic condition which develops overnight and present as inability to elevate shoulder with severe pain. Test for cuff integrity are futile to perform due to

excruciating pain. Plain radiograph and USG helps in confirming the diagnosis.

3. Undisplaced greater tuberosity fracture: Patient gives acute history of fall with inability to lift arm. Plain xray is usually normal. CT and MRI can confirm the diagnosis.
4. Acute cervical Intervertebral disc prolapse at C5-6: H/O severe neck pain with radiation towards arm and forearm. Neck movements are very painful with Spurling sign is positive. Passive shoulder movements are painless.

TREATMENT

Current Indications of Rotator cuff repair

1. Patients with Acute traumatic full thickness cuff tear with inability to elevate arm with USG and/MRI showing full thickness retracted cuff tear: These traumatic tears never heal and due to absolute inability of patient to elevate the arm, patients are at high risk of stiffness. So, they should be managed by operative repair.
2. Full thickness degenerative cuff tear of any size involving one or more tendons after failed trial of conservative treatment for 2-3 months without any improvement in pain and/ weakness: Degenerative cuff tears do not heal with conservative management. However, their pain might minimize or subside and sometime reasonable function is restored. Prolonged conservative treatment can cause fatty infiltration and muscle atrophy. Such patients even after heroic repair, do not exhibit good outcome and tear, which was repairable then becomes irreparable later.

Contraindication to Rotator cuff repair

1. Absolute contraindication: Rotator cuff arthropathy
2. Relative contraindication:
 - a) Massive degenerative tears with retracted tendon edge beyond glenoid with grade 3 or 4 fatty infiltration without evidence of cuff arthropathy- Partial repair of cuff or

transverse force couple balance restoration can restore some useful function.

b) Age more than 70 years: Even though advance age is correlated with failure of repair. However, repair can be attempted if physiological age seems to be less, low risk-reward ratio and prognosis is well explained to the patient.

TECHNIQUE OF ROTATOR CUFF REPAIR

Rotator cuff tear alone can be repaired by direct open/arthroscopic assisted mini-open repair or by all-arthroscopic technique. The outcome of repair by mini-open or arthroscopic techniques is comparable.^{8, 9, 81-83} However in the current advance scenario of cuff repair surgeries; all objectives of RC repair which are mentioned below can be achieved only arthroscopically especially when it comes to tackling the issues of labrum, cartilage and biceps pathology and lesions of subscapularis tendon. The type of repair opted by the surgeon depends upon his preference, expertise, training, access to modern instruments etc. Whichever technique is opted for RC repair, it should involve certain principle of rotator cuff repair.

1. Confirm the lesion (RC tear) and manage remaining pathologies of biceps, labrum and cartilage, if any.
2. Subacromial bursectomy with acromioplasty for type 3 acromian/acromial spur.
3. Debridement of frayed margins of torn tendon edge.
4. Footprint preparation.
5. Check the reducibility of the tendon at the footprint by grasping tendon edge, whether it can be brought to footprint without tension.
6. Mobilization of tendon by peri-tendon release/interval release if tendon is not reducible at footprint without tension.
7. Placement of anchors at footprint/transosseous tunnel placement with sutures.
8. Repair of tendon with sutures.
9. Tie knots and complete repair.

10. Closely supervised and individualized rehabilitation programme.

A) Direct open cuff repair: Direct repair of RC tear can be performed in supine/lateral/ beach chair position depending upon surgeon's preference. The technique is simple and cuff repair can be performed with simple instruments. For isolated cuff repair without acromioplasty, mid-deltoid splitting approach is most suitable while keeping the length of incision within 5 cm of lateral acromial margin to avoid damage to the axillary nerve. Cuff can be repaired using suture anchor or by transosseous technique. However, in an attempt to perform subacromial decompression with acromioplasty, deltoid is taken down from the anterolateral edge of acromian. It is then meticulously sutured back on to the acromian edge. If deltoid fails to heal to the acromial edge, it leads to deltoid dehiscence which is a disastrous consequence and leads to poor functional outcome.^{60, 84, 85} Hence in the current scenario of modern arthroscopy, direct open repair of RC is not advisable especially along with open acromioplasty. Apart from prolonged hospital stay, bigger scar and higher chance of stiffness, other co-existing pathologies of biceps, labrum and cartilage which contribute for pain and disability along with cuff tear are ignored which leads to poor outcome.

B) Arthroscopic techniques: During the evolution of repair of rotator cuff, Levy⁸⁶ popularized mini-open arthroscopic repair techniques and Gartsman popularized all arthroscopic technique of cuff repair.⁸⁷ There are three ways in which RC can be repaired arthroscopically.

1. Arthroscopic assisted open RC repair: In this technique, diagnostic arthroscopy of shoulder along with subacromial decompression is performed. Rotator cuff tear is then repaired by mini-open mid-deltoid splitting approach. Mini-open repair of cuff carries risk of prominent scar, adhesion of scar to cuff and higher incidence of stiffness.⁸⁸
2. Mini-open arthroscopically assisted repair: It includes diagnostic arthroscopy, treatment of concomitant lesions, subacromial decompression

with or without acromioplasty, release and mobilization of tendon, debridement of frayed margins and placement of tagging sutures over the torn cuff ends. Then, repair is undertaken by mini-open mid deltoid splitting approach for suture management and secure bone-tendon fixation.

3. All arthroscopic RC repair (AARCR): Diagnostic arthroscopy, treatment of glenohumeral pathology, subacromial decompression and further mobilization, release and cuff repair is carried out arthroscopically. Presently, all arthroscopic repair of cuff is emerging as the gold standard procedure.

Common advantages of Arthroscopic assisted mini-open and AARCR techniques:

1. Deltoid preservation: Traditional open technique for cuff repair require taking down deltoid from acromion for acromioplasty which is avoided in mini-open or all-arthroscopic techniques. Preserving deltoid attachment is important as its dehiscence can lead to disastrous consequence.^[60, 84, 85] Also, rehabilitation is quicker as one need not to wait for deltoid to heal on to acromion.
2. Appropriate arthroscopic evaluation and treatment of glenohumeral pathology: Initial diagnostic arthroscopy can detect intraarticular lesion whose prevalence is about 60-76%.⁸⁹⁻⁹¹ They are or can be potential source of residual pain and disability, if ignored while treating the cuff tear alone.

Advantage of Allarthroscopic repair:

1. Smaller incisions with cosmetic scars, less tissue morbidity and quicker recovery and shorter hospital stay.
2. Superior deltoid preservation and minimal surgical insult:
3. Pattern of tear, amount of retraction, lamination and quality of tendons is better appreciated arthroscopically.
4. Circumferential release of retracted tendon and mobilization of tendon is easy arthroscopically.

5. In the limited subacromial space, taking bite through the tendon from various angles and corners of cuff is easy with fine arthroscopic instruments rather than swinging big, curved needles by mini-open approach.
6. Decreased Postoperative pain and rehabilitation: AARCR leads to postoperative pain and bodily pain scores as compared to mini-open.^[81] This facilitates quicker rehabilitation.

Difficulties with arthroscopic repair:

1. Prolonged training at specialized center is required to acquire skills for AARCR and further steep learning curve. Operating in different position (beach chair/lateral), various portals and switching arthroscope and instruments between different portals needs great orientation and skill.
2. Instruments required for arthroscopic shoulder surgery and specialized set up like arthroscopic pump, radiofrequency device and shoulder traction apparatus required are very costly.
3. AARCR can take long time for beginner to perform though for an experienced surgeon, arthroscopic repair can be performed within a reasonable time frame varying from 90-120 minutes depending upon type of cuff tear and number of tendon involved. Prolong surgical time increases the risk of complications associated with prolonged anaesthesia. It especially becomes a concern in beach chair position with induced hypotension.⁹²
4. Prolonged operative time with continuous saline inflow leads to gross swelling of soft tissues around shoulder which makes portal management difficult.
5. Suture management is the key to successful AARCR: Multiple (2-3) anchors are required for RC repair. With each anchor loaded with 4 limbs, it needs perfect skill to manage anytime visible 8-12 limbs of suture otherwise it can led to unloading of suture from anchor or entangling of sutures with each other.

TECHNIQUES OF REPAIR

Open Transosseous/Single row/Double row/Transosseous equivalent suture bridge technique

Open Transosseous RC repair: Open Transosseous technique is a well-established technique of RC repair. It involves placement of transosseous tunnels through the bone and then sutures are passed via tunnels and through the cuff tendon and tied over the bone. It is a simple and low cost technique performed with simple instruments wherein RC can be repaired without anchors making it a very economical procedure. The results of open transosseous, suture anchor and transosseous equivalent technique are comparable.^{93, 94} However, The cuff repair can fail by sutures failing at the tunnel margin due to friction. Currently, transosseous technique is increasingly being performed arthroscopically with good results comparable to other anchor related techniques.⁹⁵

Single row (SR) technique: In SR technique, single row of anchor (one or multiple) is placed on to the lateral part of the footprint between cartilage-greater tuberosity junction. Sutures in the anchor are used to take bite through tendon and later tied over tendon using simple, modified Mason Allen or mattress suturing technique. In this technique, tendon is secured on to the smaller medial-lateral footprint area. Hence with smaller contact area, repaired tendon is made to heal over smaller area which "theoretically" predisposes SR repair to poor healing potential.^{96, 97} Advantage of single row includes simple technique, low cost, quick to perform, less trauma to tendon and less damage to vascularity of tendon margins. Disadvantages include lesser coverage of footprint as SR technique cannot restore medial-lateral footprint apparently leading to poor healing at the footprint and possible higher re-rupture rates.^{96, 97} However despite theoretical shortcomings, good clinical and structural outcomes are reported throughout the literature with SR technique.^{96, 98, 99}

Classic Double row (DR) technique: Ian Lo et al in 2003 described DR technique with the aim of re-establishing the anatomical medio-lateral footprint restoration which is not possible in SR repair.^[100] Two

rows of anchor are deployed, medial and lateral. Medial row is placed adjacent to cartilage-footprint junction and lateral row is placed at the lateral end of footprint adjacent to tip of greater tuberosity. Medial row sutures are used to take bite through tendon more medially near musculotendinous junction and lateral row suture limb a bit more laterally. Then, both row sutures are tied. This creates a water tight repair at the footprint encompassing a larger medial-lateral footprint area restoring near anatomical footprint, improved initial strength and stiffness and decreased least gap formation and strain as compared to SR or transosseous repair.¹⁰¹⁻¹⁰³ Theoretically, this can lead to better healing at tendon-bone junction. Advantages of DR includes better anatomical restoration of footprint and stronger initial fixation strength and so it is claimed to have better clinical outcome as compared to single row.^{99, 104} Disadvantage of DR includes; increased operative time, complexity of procedure and higher cost of more implants used without having any major added clinical advantage over SR. Also, DR repair can cause too tight a repair endangering the vascularity of tendon which can lead to re-rupture of repair especially from musculotendinous junction which is very difficult to re-repair.¹⁰⁵

Transosseous double row equivalent (TOE) or Suture bridge technique (2nd generation DR technique): Introduced by Park¹⁰⁶, the placement of medial row anchor and suture bite through the tendon is similar to DR technique. The sutures passing over residual lateral margin of cuff like a bridge are anchored laterally 1cm below the tip of greater tuberosity using foot print anchors. These "suture ends" bridges over the lateral cuff margin act as "equivalent to transosseous sutures" help in compressing the cuff over the footprint without passage of sutures through lateral stump. This spares the lateral edge of tendon from another set of sutures passing through the substance probably preserves the vascularity of tendon. Recent studies have shown similar results with TOE with respect to DR technique.¹⁰⁷ TOE is comparable with DR in complexity of procedure, cost, longer operative times, morbidity etc.

Subacromial decompression: With extrinsic compression by Coracoacromial arch causing cuff tear, Neer advocated Acromioplasty which involved taking down anterolateral edge of acromion along with release of Coracoacromial ligament from its attachment from the anterolateral edge of acromion to prevent further damage to cuff and protect cuff after repair of tear. Proponents of Intrinsic theory damage to cuff recommend only subacromial bursectomy. Emerging current consensus is that if acromion is of type 3 or it has downward projecting acromial spur, acromioplasty is indicated.¹⁰⁸ It clears the SA space of downward protruding spurs or tip of type 3 acromion which can endanger the integrity of repaired cuff. However, type 1 should be left alone and type 2 remains debatable. The results of cuff repair with or without acromioplasty remains same in literature. Routine acromioplasty however is not indicated anymore.^{72,109} Acromioplasty is contraindicated in massive cuff tears where CA ligament prevent further antero-superior migration of head.¹¹⁰

REHABILITATION

Apart from biological and surgical factors, the outcome of rotator cuff repair also depends upon how well rehabilitation programme is executed. Whether it has to be a slow and protective or accelerated rehabilitation, it is still unclear.¹¹¹ At times, it is individualized according to patient's need.¹¹² It also needs a perfect communication between surgeon and dedicated shoulder physiotherapist. Various rehabilitation protocols have been designed around the "fundamentals of tendon-bone healing potential". Histological studies suggest three phases of RC healing on to the bone after repair.¹¹³ These include; Phase 1 of inflammation (inflammatory cells, platelets and fibroblast migrate at the site), phase 2 of proliferation (cellular proliferation and matrix deposition and yield of type 3 collagen) and phase 3 involving remodeling (gradual conversion of type 3 collagen into type 1). First two phases lasts for 4-6 weeks and remodeling starts after 6 weeks. Finally, type 3 collagen is replaced by type 1 collagen and cuff heals on to the footprint with scar tissue formation. Natural tendon to

bone transition including unmineralized and mineralized fibrocartilage is NOT recreated during remodeling phase.¹¹⁴ Remodeling tissue does not reach maximal tensile strength before 12-16 weeks hence isometric strengthening of cuff should be avoided before 3 months.

Clinically, rehabilitation can be divided into four phases.

1. Immediate post-operative phase: It involves pain control. Operated site remain painful for few days to weeks. Judicious use of analgesics is advised for appropriate duration according to each patient's need. Local ice packs or cryotherapy are very helpful in reducing pain and inflammation and decrease the use of analgesics.¹¹⁵ Prolong use of NSAIDs may inhibit tendon healing.¹¹⁶
2. Phase 1 (0-2 months): Gradual achievement of passive range of movement.
3. Phase 2 (2-4 months): Initiate active assisted progressing to achievement of full active range of motion.
4. Phase 3 (4-8 months): Advance rehabilitation aiming complete ROM, strength, endurance and establishing proper neuromuscular and proprioceptive control of shoulder and scapula.

Period of immobilization after cuff repair varies from 2-4 weeks with its merits and demerits.^[117] Too early mobilization can lead to failure of healing and too long an immobilization leads to stiffness and pain.^{111, 112, 118, 119} However, current literature recommends brief period of immobilization in mild abduction as it improves collagen strength, orientation and viscoelastic properties and vascularity of repair tissue.^{21, 117} Return to sports is recommended after 6-8 months.

Complications of cuff repair:

1. Stiffness of shoulder
2. Residual Pain
3. Infection
4. Re-rupture of repaired tendon
5. Anchor loosening and migration

RECENT ADVANCES IN CUFF TREATMENT

Current research is aimed to facilitate healing process after cuff repair especially in old degenerative tears. Constant research on use of growth factors (bone morphogenetic protein, fibroblast growth factor, platelet derived growth factor, transforming growth factor), stem cells augmentation of tendon healing and rotator cuff repair, or gene therapy is under way.^{120, 121} Role of scaffold, which is used in large to massive cuff tear to compensate for defect, is being evaluated. Scaffold not only mechanically reinforce defective part of tendon, but also stimulates the intrinsic healing potential of tendon.¹²²⁻¹²⁴

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Review Article

Subvastus approach

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INTRODUCTION

There are many described anterior approaches to the knee, the most common being medial parapatellar. Amongst other approaches described are midvastus, subvastus and also lateral parapatellar approach. Since total knee arthroplasty is the most commonly performed surgery through the anterior approach worldwide, surgeons have used one or more of these approaches for TKA as demanded by the clinical presentation and deformity. Of late, since the acceptance of minimally invasive technique, mini subvastus approach has also gained popularity.

Although medial parapatellar approach gives wide exposure and even most complex deformities and revisions can be accomplished with this approach, it however has its problems in particular with patellar tracking and post-operative pain.

We are hereby describing the subvastus approach for various clinical indications including primary TKA, osteochondral fractures of patella, synovectomy and arthrolysis for septic arthritis.

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The subvastus approach was first described by Erkes in 1929 and modified by Hoffmann in 1991¹⁰. While concerns have been raised regarding intraoperative visualization and proper component positioning, promising results have been recently reported suggesting improved early recovery with equivalent complication rates.

As with any procedure, patient selection is paramount to success and not all patients are appropriate for this approach. However, in patients who meet criteria, this approach offers significant benefit to patients over traditional approaches including less post-operative pain and easier, quicker rehabilitation in the early post-operative period

BENEFITS

Previous studies¹⁻⁹ have confirmed that the subvastus approach offers the benefits of less lateral retinacular release, greater quadriceps strength, less blood loss, and improved patellar tracking when compared with the medial parapatellar approach.

In the medial parapatellar approach, judging the patellofemoral tracking can be difficult as the medial supporters of the patella have been divided whereas in the subvastus approach judging the tracking of the patellofemoral joint is much easier as the medial supporters of the patella remain intact.

There is a higher incidence of lateral releases in knees operated by the medial parapatellar approach. This

increases the risk of a 'cold patella,' as vascularity of the patella can be jeopardized. The blood supply to patella is maintained via the intramuscular descending genicular artery. In the subvastus approach as the extensor mechanism is not violated, patellofemoral tracking remains immaculate and can be readily visualized, thus obviating the need for unnecessary lateral releases.

LIMITATIONS OF SUBVASTUS APPROACH

1) Inadequate exposure

The disadvantages, such as more technical requirements and greater difficulty in knee exposure and patellar eversion, limits the increased use of this technique. The subvastus approach is considered to be contraindicated in revision arthroplasties which requires full visualization of operative site. Its use is also avoided in knee with valgus/ varus deformities more than 15 degrees as these deformity corrections may require some additional procedures which may be difficult with small incision

2) Component malalignment

The component malalignment can occur because of inadequate exposure. Dalury and Dennis⁵ noted an increased incidence of tibial component malposition and lateral tilting of the patella in their series of patients undergoing mini-incision TKA. However, it can be avoided by careful identification of the anatomical landmarks and the use of standard surgical jigs. When the lateral tibial plateau is adequately exposed, the risk of tibial malalignment or downsizing can be minimized. Similarly, the transepicondylar axis can be drawn and internal rotation of the femoral component can be avoided.

The subvastus approach is more difficult to perform in patients having a limited range of knee movement; i.e. a stiff knee. (Stiff knee is defined as knee with < 50° range of movement). The more stiff the knee is, the greater is the difficulty in subluxing the patella in the lateral gutter. Forcible attempts at flexion of the knee without subluxing the patella laterally could be a factor in injury to the patellar tendon and the medial collateral ligament.

COMPLICATIONS

Minimal approaches may present techniques that are new to the surgeon and increase the level of difficulty. Poor alignment, inadequate ligament balancing, failure to remove excess cement, and excess skin stretching are all possible with less invasive surgical techniques.

USES OTHER THAN TKA

In addition to total knee arthroplasty and medial unicompartmental knee arthroplasty, the subvastus approach can also be applied to the treatment of other intra-articular pathologies, primarily chondral defects. Procedures such as autologous chondrocyte implantation and osteoarticular allografts can easily be performed through this approach.

SURGICAL TECHNIQUE¹⁴

The patient is positioned supine in the standard fashion. The skin incision can be made directly midline or slightly medial to midline, depending on the nature of the pathology. Generally, it extends from upper pole of the

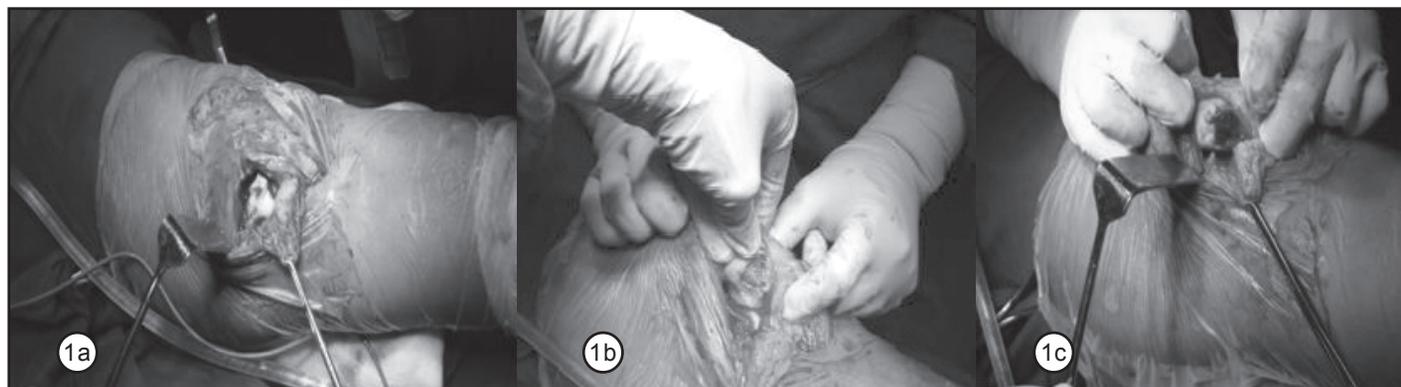


Figure 1a, 1b, 1c: Repair of osteochondral defect

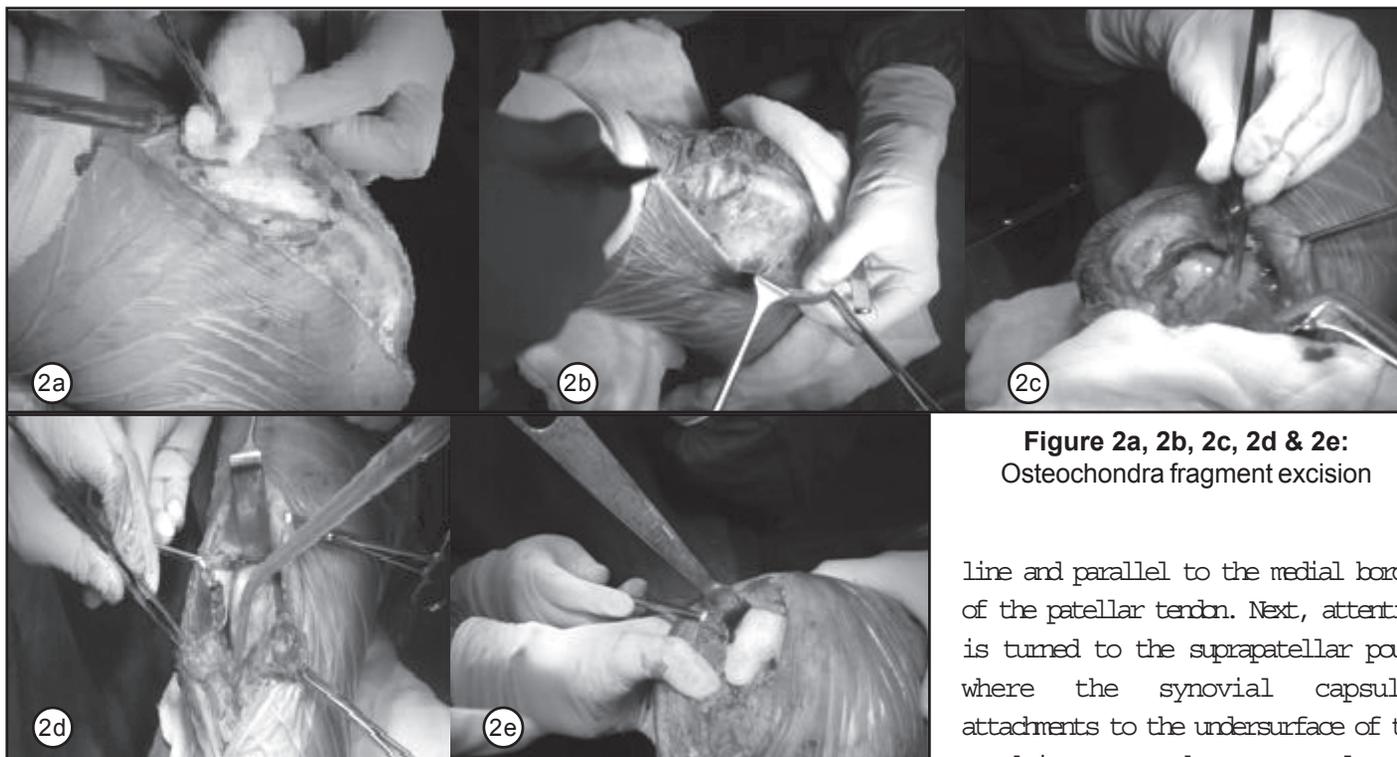


Figure 2a, 2b, 2c, 2d & 2e:
Osteochondra fragment excision

patella to the inferior aspect of the tibial tubercle. The incision is carried sharply through the subcutaneous tissue down to the retinacular tissue. Full-thickness medial and lateral flaps are then created sharply. creation of large, full-thickness flaps is important because this allows the extensor mechanism to be mobilized deep to the subcutaneous tissues.

The distal insertion of the vastus medialis obliquus on the patella is exposed. The fascia overlying the VMO is released sharply, taking care not to injure any underlying muscle fibers. The fascia is released posteriorly towards the attachment of the VMO on the medial intermuscular septum. This exposes the entire distal extent of the VMO. The VMO is then retracted proximally and laterally while maintaining its attachment to the patella. An oblique capsular incision is then made just distal to the VMO, beginning posteriorly at the level of the intermuscular septum and extending laterally, parallel to the inferior border of the muscle, towards the medial border of the patella. At the medial border of the patella, the arthrotomy is extended distally, taking care to leave a cuff of tissue attached to the patella for closure. The arthrotomy incision is carried distally across the joint

line and parallel to the medial border of the patellar tendon. Next, attention is turned to the suprapatellar pouch where the synovial capsular attachments to the undersurface of the quadriceps tendon are released completely from medial to lateral. This is the key maneuver for being able to fully mobilize the extensor mechanism.

After completing this, the patella can then be subluxed into the lateral gutter. Flexing the knee to approximately 90 degrees then provides excellent exposure of the entire joint and the appropriate procedure can be performed. A standard closure is performed at the end of the case.

SUMMARY

Subvastus approach to provide excellent exposure and allow quicker advancement of rehabilitation after knee surgery. As with any procedure, there is a definite learning curve associated with the subvastus approach. The technique and indications have evolved with time and experience. Less emphasis is placed on the length of the skin incision and more emphasis placed on careful dissection of large medial and lateral skin flaps and atraumatic mobilization of the muscle. The subvastus approach has definite benefit of less post operative pain and early rehabilitation and better patellofemoral stability but its advantage over other approaches in long term follow up is not proved.

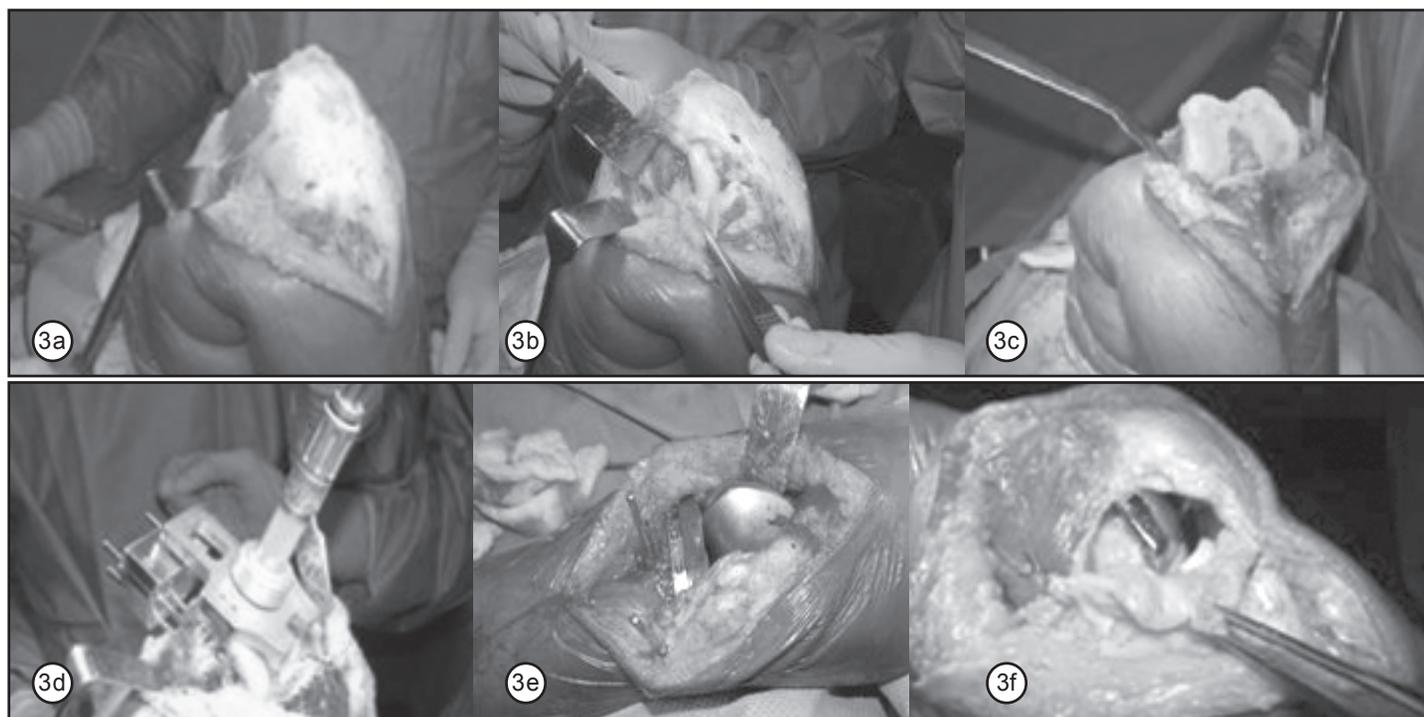


Figure 3a, 3b, 3c, 3d, 3e & 3f: Subvastus approach for TKA

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Original Article

Ender nailing for paediatric diaphyseal femur fractures

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ABSTRACT

Introduction: Femoral fracture is one of the most common major pediatric injury treated by orthopedic surgeons. The conventional treatment with closed reduction, traction, immobilization and hip spica application has its own drawbacks. Hence, recently internal fixation with flexible nails has become the treatment of choice.

Materials & Methods: 22 children aged 3 to 14 years with 22 diaphyseal femur fractures were treated with Ender nailing between April 2011 to October 2013 at Father Muller Medical College, Mangalore were studied with regards to the clinical and radiological outcomes and complications.

Results: Good to excellent clinical and radiological results were seen in all the cases with only minor complications. All fractures united within a period of 8 to 16 weeks with excellent callus formation. The complications included knee stiffness in 5 cases, lower migration of nail in 3 cases and thigh pain in 3 cases. Knee stiffness improved following implant removal. 3 cases had acceptable degree of malunion. There were no cases of infection, non-union, delayed union or gross limb length discrepancy. Implants were removed within a period of 4 to 24 months of the initial surgery. There were no cases of implant failure or re-fractures.

Discussion: Recently, surgical treatment has been preferred over conservative methods of traction and hip spica application for fracture shaft of femur in children. This owes to the benefits of early fracture stability with reduced pain, less chance of malunion, avoiding prolonged and cumbersome immobilization techniques and avoiding difficulty in perineal care after hip spica application. Ender nail is an ideal implant for these fractures because of its shape, flexibility and no damage incurred to the growth plates. In this study, we found increased patient compliance, with 100% good results and children were back to school very early.

Key words: Fracture femur, Ender nailing.

INTRODUCTION

Femoral fracture is the most common major pediatric trauma treated by orthopedic surgeons¹. The conventional treatment with closed reduction, traction immobilization and hip spica application has its own drawbacks^{2,3,4,5}. Loss of reduction in hip spica, discomfort to the child and problems with nursing care, loss of

attendance in school are few problems encountered with the conservative method. Closed reduction and internal fixation with Ender nails is an easy and economical procedure and the implant is quite suitable for the femoral shaft fractures in children^{6,7}. The present study evaluates the clinical and radiological outcome and complications of closed Ender nailing for diaphyseal fractures of femur in paediatric age group.

MATERIAL & METHODS

We have studied 22 diaphyseal fractures of femur in 22 children aged between 3 and 14 years, treated with closed Ender nailing between April 2011 and October 2013 at Father Muller Medical College, Mangalore

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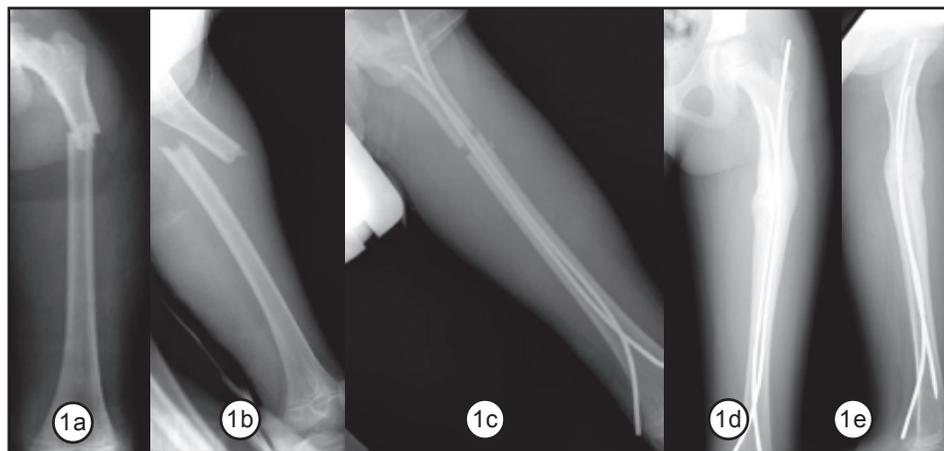


Figure 1a & 1b : Pre-operative X-rays; **Figure 1c** : Immediate post-operative X-ray; **Figure 1d & 1e** : At 6 months post-operative X-rays showing good union

All the fractures were immobilized initially with fixed traction over Thomas splint. During the surgery, the fractures were reduced with the help of fracture table and image intensifier under general anesthesia. Manual traction was necessary in few younger patients where the limbs were too short for the fracture table. A 2 to 3 cm medial lower thigh incision was used as the skin incision. With the help of a bone awl, an entry hole was made in the femur just above the growth plate under C-arm guidance. One or two Ender nails of 4.5 mm or 3.5 mm thickness and of adequate length were then passed depending on the size of the medullary canal. In 2 cases of distal 3rd fractures, the second nail was passed from a lateral entry point. The nails were passed till the neck of femur just distal to the proximal femoral physis confirming reduction of the fracture under C-arm guidance.

Post operatively the limb was rested over a Thomas splint for 1 to 2 weeks. Knee exercises were started as early as possible. Non weight bearing crutch walking was started for older children after 2 to 3 weeks and partial weight bearing after 3 to 4 weeks. Full weight bearing was delayed for 6 to 8 weeks depending on the radiological signs of union. Minimum follow up period was 6 months (average 12.1 months).

RESULTS

Children were aged from 3 to 14 years with an average of 8.4 years, with a marked male preponderance (14:8). Two thirds of the fractures were at middle third level (64%), followed by upper third (21%) and lower third (15%). Commonest fracture pattern was transverse (45%), followed by long oblique (32%) and short oblique (23%). Out of 22

fractures, 3 were type I open fractures. All others were closed fractures.

Out of 22 fractures, 20 were fixed primarily. In the other 2 cases, Ender nailing was done subsequently for loss of reduction in hip spica. Surgery was performed as early as 1 to 3 days in most of the cases (17 out of 22). In 2 cases, surgery was delayed for more than 2 weeks as they were initially managed with hip spica and later on opted for internal fixation with Ender nailing for loss of reduction in the cast and complications due to cast.

All the fractures were fixed with closed reduction only. The average operative time was 26 minutes. The amount of blood loss during surgery was negligible. Only one Ender nail was used in 8 cases, whereas in the remaining 14 cases 2 Ender nails were used. Both 4.5mm and 3.5mm thickness nails were used as per the requirement. The average hospital stay was 7.8days (5 to 12 days).

Radiologically good callus was seen at 3 weeks in most of the fractures and two thirds of the fractures united as early as 8 weeks. The average union time was 9.5 weeks. There were no cases of nonunion or delayed union.

Complication of knee pain and stiffness was seen in 5 children. Three of them were due to distal migration of the nail and 2 were seen in children who had Ender nail inserted from a lateral entry portal.

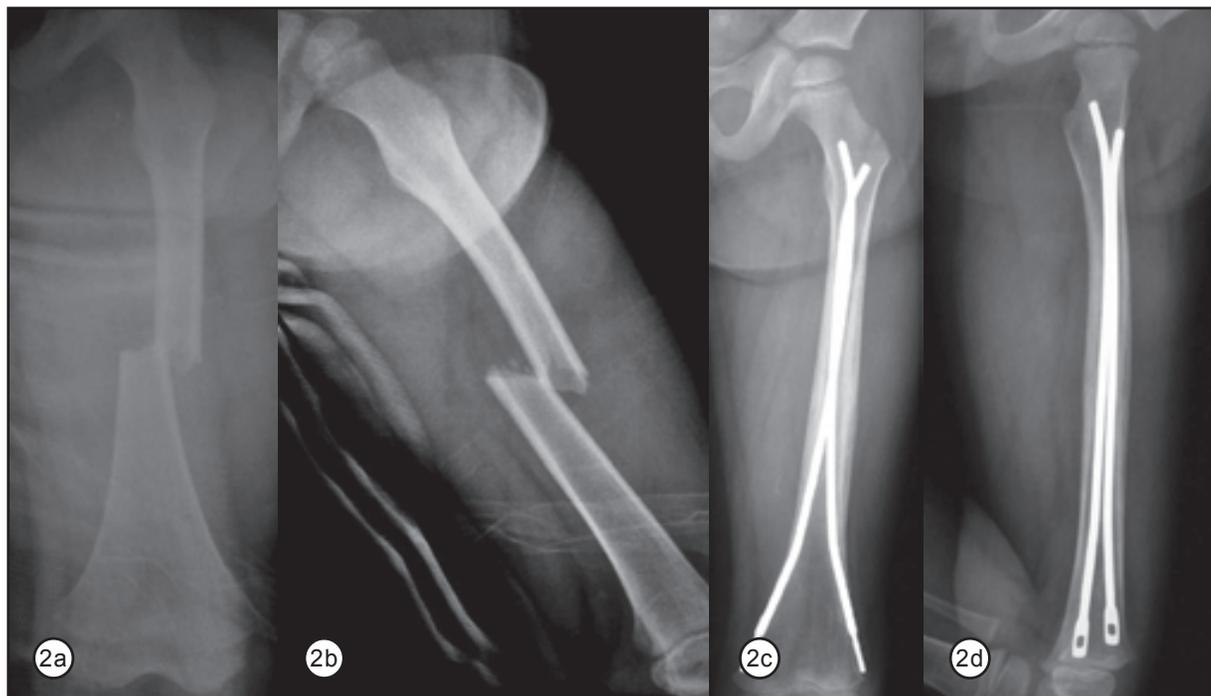


Figure 2a & 2b: Pre-operative X-rays, **Figure 2c & 2d:** At 12 months post-operative X-rays showing good union

Acceptable degree of malunion was noted in 3 children. Two had shortening of less than 1cm due to overlapping of long oblique fractures and the third child had 5 degrees of valgus in a lower 3rd femur fracture treated with lateral Ender's nail.

All children had symmetrical walking pattern once the fractures healed completely. Most of the implants were removed within a period of two years. There were no cases of implant breakage or re-fractures reported during the study period.

DISCUSSION

A spica cast applied early is a very effective treatment^{3,1}. In the last 2 decades there has been a strong trend towards the treatment methods that allow rapid mobilization^{7,8,9}. Most of the orthopedic surgeons recognize the adverse

impact of prolonged hospitalization and spica cast immobilization on children and their families⁴.

Flexible unreamed nails have been successfully used in long bone fractures in adults as well as in children¹⁰. These nails rely on 3 point fixation in the medullary canal and provide a favorable mechanical strength owing to the shape and resilience of the nail. They are particularly beneficial in children as they can be passed avoiding the growth plates. The benefits also outweigh when compared to external fixator application¹¹. The fracture table makes the procedure simple and also reduces the operation time and radiation exposure.

M. F. Macnicol, of The Royal Hospital for Sick Children has mentioned three fold cautions when treating femoral shaft fractures in children in terms of convenience, cost and complications.

In this study we have operated on 4 children who were less than 6 years old. Most often these were either open fractures or parents' choice as they did not want to subject their child to prolonged traction and spica cast.

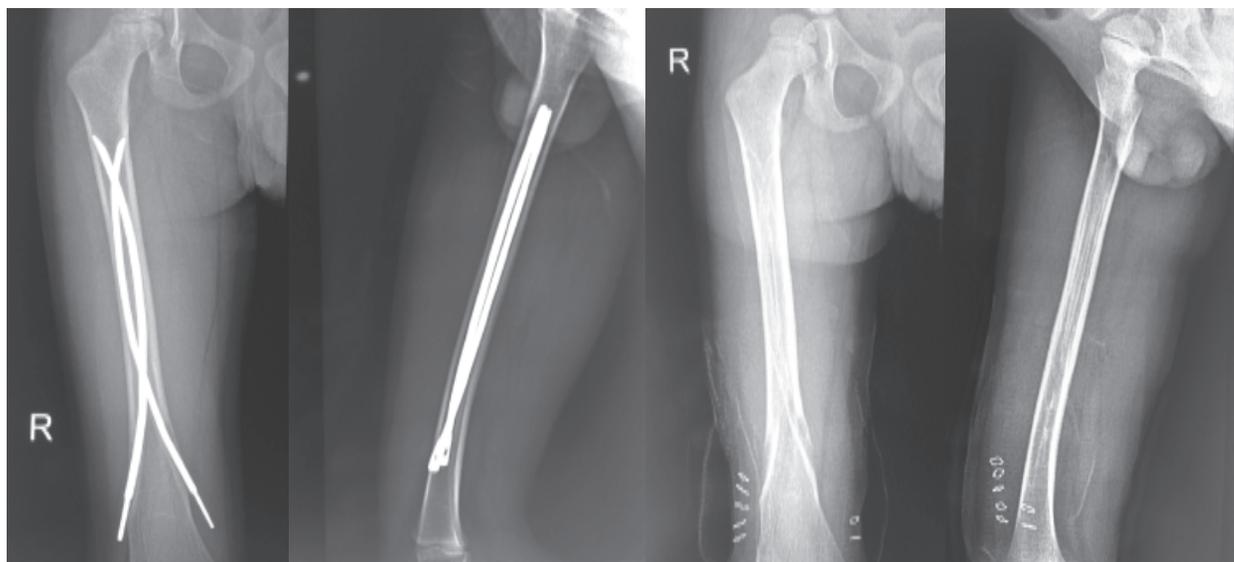


Figure 3a & 3b: Old fracture well united with Ender’s nails in situ, **Figure 3c & 3d:** X-rays after implant removal

All the fractures united well without any delayed unions. Flexible unreamed Ender nail acts as an ideal biological splint allowing micro motion at fracture site and producing excellent callus⁷.

The complications included knee stiffness mainly due to the irritation at the distal end of the nail. These could be easily tackled by implant removal once the fracture has healed. As the shape of Ender nail is well suited for femur with three point fixation there are less chances of malunion. It is advisable to pass the nails from the medial entry to avoid valgus malunion. It is unnecessary to worry about the overgrowth as even if it happens, is negligible⁴.

Flynn et al have concluded from their prospective study that the results support the recent empiric observations and published results of retrospective series indicating that a child in whom a femoral fracture is treated with titanium elastic nails achieves recovery milestones

significantly faster than a child treated with traction and a spica cast. Hospital charges for the two treatment methods are similar. The complication rate associated with nailing compares favorably with that associated with traction and application of a spica cast⁵.

CONCLUSION

Closed intramedullary Ender nailing therefore appears to be a simple, safe and effective method of treating femoral diaphyseal fractures in children. However the availability of flexible nails and the attractions of early definitive surgery must not blind surgeons to the adequacy and proven value of the skilled conservative management of fractures of the femoral shaft in children less than ten years of age. The decreased incidence of complications, cost and convenience favors this method of treatment for diaphyseal femur fractures in children.

Table 1: Level of fracture and number of nails used

Fracture Level	No: of cases	No: of ender nails used
Middle third	8	1
	6	2
Upper third	5	2
Lower third	3	2

Table 2 - Time (weeks) for fracture union

Time for fracture union	No: of cases
Less than 6 weeks	8
6 to 10 weeks	10
More than 10 weeks	4

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Original Article

Anatomic ACL reconstruction (AACLR) - the remnant preserving way

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ABSTRACT

Introduction: To evaluate the outcome of anatomic arthroscopic anterior cruciate ligament (AACLR) reconstruction with tibial remnant preservation technique using hamstring autograft.

Material & Methods: From June 2010 to June 2012, we prospectively analysed 40 patients who underwent anatomic ACL reconstruction with preservation of the tibial remnant. The outcome assessment was made by using manual stability test (Lachman's, Pivot Shift) Lysholm's score, IKDC grade, VAS score and proprioception measurement (T TDPM)

Results: The follow up period ranged from 6 months to 24 months. There was no graft related issue, synovitis or limitation of range of motion. The Lysholm's score, the IKDC grade showed good improvement over the pre-operative status. The passive angle reproduction test also improved significantly.

Conclusion: The technique of preserving the remnant of torn ACL during ACLR improves the outcome and contributes to better functional recovery.

Key Words: Anterior Cruciate ligament, Tibial remnant

INTRODUCTION

The ACL is the primary stabiliser of the knee and its ability to control the knee movement is compromised by injury. The treatment of ACL injury may require ACL reconstructive surgery for functional recovery. There are many graft choices and surgical technique to choose from to achieve this goal. However in the recent years, there is continued interest in the proprioceptive function of the knee, due to the mechanoreceptors that are present in the tibial remnant which are found to influence the outcome of ACL surgery (Ochi M et al, Georgoulis AD et al). The purpose of the paper is to analyse the clinical outcome of anatomic ACL reconstruction following

preservation of tibial remnant as much as possible including the synovium to keep the mechanoreceptors, improve revascularisation and ligamentization

MATERIAL AND METHODS

From the year June 2010 to June 2012, 40 patients underwent AACLR using the quadrupled hamstring graft in which the tibial remnant was preserved (Figure 1). All the cases with meniscus injury were included but PCL and MCL injury above moderate grade were excluded. There were 33 male and 7 female patients and the age ranged from 16-58 years. The leading cause of injury was RTA due fall from two wheeler-18 cases, sporting injury-football-8cases, badminton-4cases and self-fall 10 cases. There were 8 cases of medial meniscus, 6 cases of lateral meniscus and 4 cases of both meniscus injuries. The cases were operated between 3 weeks to 2 years since the time of injury. All the cases were operated by a

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single surgeon and the results were analysed by an independent investigator. The outcome assessment were made using the manual stability test, Lysholm score, IKDC grade, VAS score and threshold to detect passive motion (TIDPM) using electronically calibrated CPM set at the rate of 1 degree per second.

SURGICAL TECHNIQUE

Under epidural anaesthesia and proximal thigh tourniquet ACL tear is confirmed by clinical examination. The patient is placed is supine, with a lateral thigh support and a sand bag to help keep the knee at 90 degree flexion.

High anterolateral (AL), anteromedial (AM) and accessory anteromedial (AAM) portals were used. Tourniquet is not inflated but is used as a stand by only. Hamstring graft is harvested and prepared by standard technique.

Partial fat pad resection is must for identification of stump and have access for ACLR. Time is then spent in identifying the type of ACL tear, size of the stump and the healing pattern of the ACL stump. Associated meniscus pathology is addressed first.

Over the top position, the anatomic site of ACL attachment on the femoral side is identified (Figure 2). Using a 5mm femoral offset guide via the AAM portal with knee flexed to 110 degree the the guide pin is drilled. A 4mm drill bit is then used over the wire to drill. Depth of the femoral tunnel is measured, which roughly should be between 34mm-38mm. The desired length and depth of femur tunnel is drilled using acorn reamers. Femur tunnel is cleared of the entire debris using shaver and it is checked for any blow out. The No. 1 vicryl is then pulled via the AAM portal over a guide pin into the femoral tunnel and left in place to shuttle the hamstring graft later.

The tibial tunnel is made using the standard technique however with precaution to preserve the stump, entry

made into the centre of the stump and reamer is used in reverse mode to prevent violation of stump. (Figure-3)

The No 1 vicryl is pulled with help of depth gauge into the tibial tunnel. The hamstring graft is rail roaded over a 15 mm endobutton and locked in the femoral tunnel, knee is cycled 25-30 times to remove the slack in the ligament and then secured at the tibial tunnel with a bio-absorbable screw in a standard fashion (Figure 4). Wounds are closed with No 1-0 monofilament, dressed and RJB is applied.

POST-OPERATIVE MANAGEMENT

The limb is immobilised in a short knee brace. Epidural is continued for 2-3 post-op days. Ice packs are given round the clock to reduce pain and enable optimum rehabilitation. Patient is allowed partial weight bearing by 1st post-operative period. Standard physiotherapy regime is followed; the knee brace is discontinued by 8-12 weeks.

RESULT

All the cases were followed up at the hospital and a minimum of 6 months and at least 1 year of follow up patients were included for analyses. The manual stability tests were negative at follow up. There were no graft related issues, synovitis or limitation of range of motion. As compared to the pre-operative period, the mean Lysholm scores improved significantly in all the post-operative follow-up periods, with a near normal score being achieved at 6 months post op (70.5 ± 3.3 Vs 97.2 ± 4.5). A Wilcoxon Signed Ranks Test showed a statistically significant change in the Lysholm scores in individuals who underwent the procedure at all the follow up periods ($P = 0.001$).

The IKDC grades were C in 33 cases and D in 7 cases pre-operatively. At 6 months there were 26 grades A and 14 grades B while at 1 year there were 31 grades A and 9 grades B case. The intensity of pain was documented by using the Visual analog scale (VAS)

Table 1: Lysholm Scores

	N	Mean	Std. Deviation	Minimum	Maximum
Lysholm Pre-Op	40	70.5750	3.31962	65.00	78.00
Lysholm Post 3 Months	40	92.0750	5.83266	75.00	100.00
Lysholm Post 6 Months	40	97.1750	4.52847	85.00	100.00
Lysholm Post 1 Year	40	98.3750	3.27921	90.00	100.00

postoperatively under two conditions, at rest and during exercise. A progressive reduction in the pain scores at rest was observed from 3 months to 1 year post op (1.4 ± 1.2 Vs 0.5 ± 0.8), the pain on exercise also showed significant reduction over the long term (3.3 ± 1.7 Vs 0.8 ± 1).

Table 2: Visual analog scale

	N	Mean	Std. Deviation	Minimum	Maximum
Pain at rest 3 months	40	1.4025	1.25891	.00	3.70
Pain on Exs 3 months	40	3.3350	1.69472	.00	6.90
Pain at rest 6 months	40	.5600	.91925	.00	3.20
Pain at rest 1 Year	40	.4850	.81855	.00	3.00
Pain on Exs 6 months	40	1.4675	1.29246	.00	3.80
Pain on Exs 1 Year	40	.8600	1.06116	.00	3.50

The threshold to detection of passive motion (TIDEM) was evaluated at two time frames at two different knee angles (15 & 45 degrees). The scores were compared to the unaffected knee. The mean TIDEM scores at both the angles improved significantly over time with the mean scores approaching closer to the values of unaffected knee in the long term (1.2 ± 0.4 Vs 1). A Wilcoxon signed ranks test showed the change in scores over time to be statistically significant at all the follow up periods for both the knee angles ($P = 0.001$).

Table 3: The threshold to detection of passive motion (TIDEM)

	N	Mean	Std. Deviation	Minimum	Maximum
TTDPM15UA	40	1.0000	.00000	1.00	1.00
TTDPM45UA	40	1.0000	.00000	1.00	1.00
TTDPM15A6month	40	1.7250	.78406	1.00	3.00
TTDPM15A1yr	40	1.2750	.45220	1.00	2.00
TTDPM45aff6m	40	1.5250	.59861	1.00	3.00
TTDPM45aff1yr	40	1.2750	.45220	1.00	2.00

STATISTICAL ANALYSIS

Statistical analyses were performed with SPSS version 19. Since the purpose of the analysis was to compare the change in the outcome measures from pre-op to post op periods, a 2 related samples test was used. Since the data does not full fill the assumptions of normality, the

Wilcoxon Signed-Rank Test which is the nonparametric test equivalent to the dependent t-test was used for the analysis.

DISCUSSION

The role of ACL as a mechanical stabilizer is well established. However in recent times the emphasis is on its function as a sensory organ that provides secondary stability from compensatory contracture of muscles

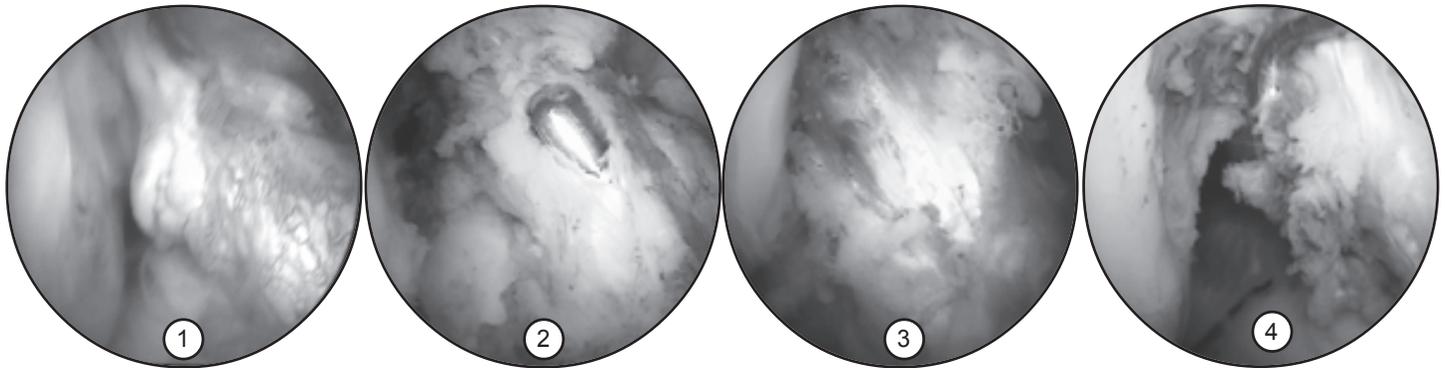


Figure 1: Tibial remnant healed to PCL; **Figure 2:** Over the top position identified; **Figure 3:** Tibial tunnel(TT) through the centre of the preserved remnant; **Figure 4:** Hamstring graft rail roaded through the centre of TT surrounded with the remnant as an envelope

around the knee joint, with a bio feed back system initiated by mechanoreceptors³. The loss of proprioception after a ligament injury results in changes in gait and deteriorates position sense which may result in cartilage damage or injury due to other cause. During ligamentization most of the mechanoreceptors are found to recover, but most were animal studies⁵. The success of ACL surgery not only depends on the mechanical factor but also on the proprioceptive function⁷. The mechanoreceptors were found in the sub synovial membrane of the tibial attachment and they are present even 3 years after injury⁹. Hence Schutte MJ, et al. concluded that it was of potential benefit to preserve the tibial remnant for better function without the risk of formation of cyclops. Ochi et al¹ who investigated position sense before and after ACLR and correlated SSEP and instability and concluded that sensory reinnervation does occur in reconstructed ACL and closely influences the functional outcome. Borsa et al¹⁰ showed that in ACL deficient knees proprioception is more sensitive at 15 degrees and moving in direction of extension than at 45 degrees. Yoon et al¹¹ compared the outcome between single bundle reconstruction and remnant preserving ACLR which showed superior results with remnant preservation technique. Our results also closely matched too few of the studies already described in the literature (Lee BI et al¹³) The advantage of this procedure is promotion of synovialisation, revascularization without impingement at the notch and no cyclops formation There

is also no need of special equipment for surgery and reduced risk of tibial tunnel enlargement due to leakage of fluid. The limitation could be the extreme variation in time from injury to treatment.

CONCLUSION

The technique of preserving the remnant of torn ACL during ACLR improves the outcome and contributes for better functional recovery.

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Original Article

Functional outcome of cervical fusion in cervical disc herniation

Thomas Devasia, Jacob Chacko

ABSTRACT

Background: Cervical radiculopathy is the most common symptom of cervical disc herniation. The natural course of radiculopathy due to degenerative diseases is generally favourable, with spontaneous resolution of symptoms in majority of patients with time. Patients with symptoms refractory to conservative treatment are offered anterior cervical discectomy with interbody fusion. ACD is widely used to treat cervical radiculopathy due to cervical disc herniation but cervical fusion is still controversial. This study is intended to observe the role of anterior cervical discectomy and fusion with iliac bone graft with anterior cervical plating in cases of cervical disc herniation, its effects on neurological and functional improvement and complications if any associated with the procedure.

Materials and methods: This is a prospective follow up study of functional outcome in patients with cervical disc herniation with neurological deficits who underwent anterior cervical discectomy and fusion with iliac bone graft and anterior cervical plating. A sample size of minimum 30 patients were selected to undergo the surgery, using purposive sampling technique between August 2011 and August 2013. Clinical improvement was studied during follow up at 6 weeks, 3 months and 6 months using 'Neck Disability Index Scoring System' and visual analogue score for radicular pain. Statistical analysis of the data was done by Friedman test value and Wilcoxon signed rank test.

Results: Majority of the patients were of the age group of 41-50 years with a mean age of 47 years. C5-C6 was seen to be the most commonly involved level. Statistically significant improvement in the neck disability index and visual analogue score for radicular pain was seen with a P value of less than 0.05, with no deterioration of neurology in any patient. Two of the 30 patients had unfavourable results as evident by the Neck Disability Scoring at the end of 6 months. There were no complications with respect to the surgery noted in the study group.

Conclusion: Cervical plating increases the rate of fusion and decreases the changes of graft related complication such as back-out or pseudoarthrosis. Thus this study shows that the improved clinical outcome and fusion and low complication rate associated with anterior cervical plating may justify its use for cervical disc herniation.

Key words: Anterior Cervical Discectomy and Fusion, Cervical Plating.

INTRODUCTION

The cervical radiculopathy is the most common presenting symptom in patients with cervical disc herniation. Contributing factors may include some combination of disc herniation, osteoarthritis of uncovertebral and facet joints, decreased intervertebral height and spondylolisthesis of cervical vertebrae.¹

The natural course of radiculopathy due to degenerative diseases is generally favorable, with spontaneous

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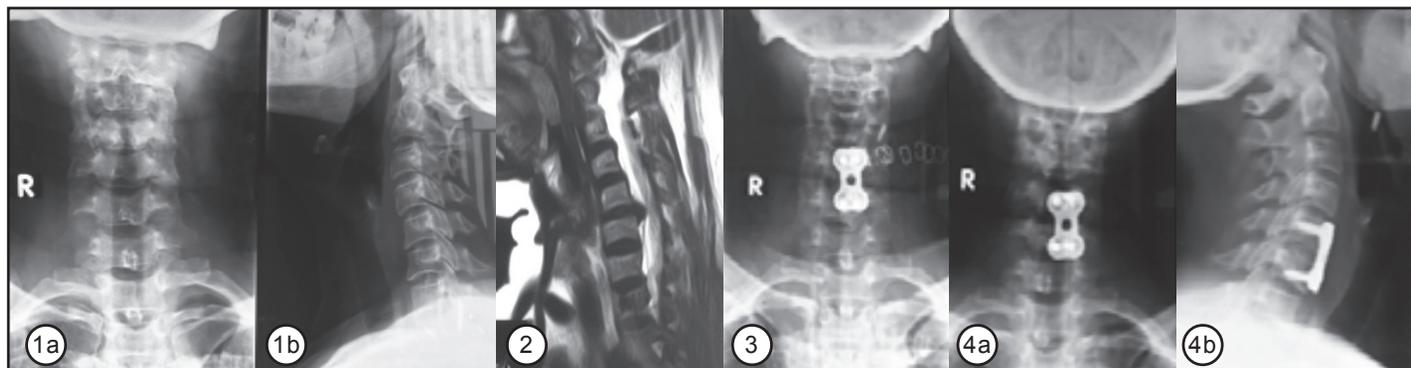


Figure 1a & 1b: Pre-operative X-Ray; **Figure 2:** Pre-op MRI showing IVDP C5-C6; **Figure 3:** Post-op X Ray with iliac bone graft; **Figure 4a & 4b:** Follow up X Ray showing fusion of C5-C6 at 6 months follow up.

resolution of symptoms in a majority of patients with time. Patients whose pain does not naturally resolve require some form of intervention. Surgery may be indicated for compressive cervical radiculopathy with persistent radicular pain after conservative treatment and progressive or profound motor weakness.

Anterior cervical discectomy and fusion (ACDF) was first described by Cloward, and Smith and Robinson^{2,3} in 1958 and shortly later by Hirsch in 1960 who described anterior cervical discectomy (ACD) and debated the necessity of inter-body fusion.⁴ The indications for ACDF include radiculopathy, myelopathy, myeloradiculopathy and traumatic instability involving single or multiple levels.⁵

Patients with cervical radicular syndrome due to disc herniation refractory to conservative treatment are offered ACD which is the standard procedure, often in combination with interbody fusion, but accelerated adjacent disc degeneration is a known entity on the long term.⁶ ACD is widely used to treat cervical radiculopathy due to cervical disc herniation but cervical fusion is still controversial. Studies have shown that ACD without fusion yields satisfactory results and spontaneous vertebral fusion occurs in most cases.⁷

This study is intended to observe the role of anterior cervical discectomy and fusion with iliac bone graft with

anterior cervical plating in cases of cervical disc herniation, its effects on neurological and functional improvement and complications if any associated with the procedure.

MATERIALS AND METHODS

This was a prospective study of thirty four patients who were diagnosed with cervical disc herniation and who underwent anterior cervical discectomy with fusion with iliac bone graft and anterior cervical plating in the department of orthopaedics at Father Muller Medical College, Mangalore, between August 2011 and August 2013. Clinical improvement was studied during follow up at 6 weeks, 3months and 6 months using neck disability index⁸ scoring system and visual analogue score⁹ for radicular pain.

Symptomatic patients with persistent radicular pain were treated conservatively with physiotherapy and medications for a period of 3 months before surgical intervention was offered. Pre op X ray and MRI were done for all patients. Post operatively, patient was mobilized with a hard cervical collar and followed up for a minimum period of 6 months and functional outcome was assessed. Patients with associated fractures and infections of the cervical spine were omitted from the study.

RESULTS

A total of 34 patients with cervical disc herniation with neurological deficits, who were to undergo anterior cervical discectomy and fusion and who fulfilled the inclusion criteria, were selected for the study. Four patients were lost to follow and the remaining 30 patients were included in the study and followed up for 6 months at regular intervals.

Majority of the patients in our study, i.e. 12 patients (40%) were in the age group of 41-50 years, the mean age being 47.2 years (28 to 75 years). There were 8 patients in the age group below 40, 6 patients between 51 and 60 years and 4 patients above 60 years of age.

Of the total number of 30 patients, 18 (60%) were males and 12 (40%) were females i.e. there was an overall male preponderance seen in this study.

Inter vertebral disc prolapse (IVDP) at C5-C6 level was seen to be the most common level of involvement and was seen in 18 of the 30 patients (60%). Four patients (13.3%) had IVDP C6-C7, three patients (10%) had IVDP C4-C5 and five patients (16.6%) had a 2 level disc prolapse. (3 patients had IVDP C4-C5, C5-C6 and 2 patients had IVDP C5-C6, C6-C7). All patients underwent anterior cervical discectomy and fusion with bone grafting and anterior plating. There was no worsening of neurology in any of the patients following surgery.

The mean pre operative neck disability index score was 29.47 which decreased to 18.57 at 6 weeks post op, 10.17 at 3 months and 8.17 at 6 months post operatively. A highly significant difference was seen in the neck disability index score at follow up visits, which indicates that all patients in the study showed marked improvement after surgery. (29.47 to 8.17; $p = 0.000 < 0.05$). Wilcoxon signed rank test also revealed a highly significant improvement in the NDI score at each follow up visit. ($p = 0.000 < 0.05$)

The visual analogue score for radicular pain had a mean pre operative score of 8.93 which decreased to 4.2 at 6 weeks post op and 2.63 at 3 months and 2.13 at 6 months post operatively. The improvement in the score between the pre operative and 6 months post operative period was highly significant with a p value = $0.000 < 0.05$.

Wilcoxon signed rank test also revealed a highly significant improvement in the VAS score at each follow up visit. ($p = 0.000 < 0.05$)

All 30 patients showed an improvement in the neurological outcome when compared to their pre operative status.

At the first follow up visit after 6 weeks, none of the patients had any morbidity at the donor site, which was the left iliac crest.

Of the total number of 30 patients, 2 cases showed unfavourable results in the form of persistent weakness of the involved upper limb due to inadequate decompression of the involved segment. These two patients had a severe grade of disability as per the neck disability index.

No other complications such as donor site morbidity, implant or graft back out or infection, were noted in the study group.

DISCUSSION

Intervertebral disc prolapse is a common condition affecting middle and older age group of people with no sex predilection. Fraser et al in their study found the mean age of patients to be 46.7 years, with 46.6% females and 53.5% males.¹⁰ In accordance with this study, our study also showed an overall male preponderance with 60% males and 40% females and a mean average age of 47.2 years (28 to 75 years).

Gore DR et al in their study noted that majority of the patients had an IVDP at the C5-C6 level.¹¹ Similarly, 18

patients (60%) in our study had IVDP at C5-C6 level, 4 patients (13.3%) had IVDP at C6-C7 level, 3 patients (10%) had IVDP at C4-C5 and 5 patients (16.6%) had a 2 level disc prolapse.

Anterior cervical discectomy followed by fusion is a widely accepted surgical procedure for the treatment of degenerative cervical spine disease. The primary goal of these techniques is to decompress the spinal cord and the affected nerve roots while restoring cervical alignment at the same time. The autologous iliac crest bone graft is still probably the most commonly used material for creating bone connection of 2 adjacent vertebrae.^{12,13}

McConnell et al in their comparison of coralline hydroxyapatite with autograft referred 22 % of short and long term morbidity associated to bone harvesting from the iliac crest.¹⁴ Silber et al noted the need for chronic pain medication in 11.2% of patients.¹³ Gore et al in their study noted a donor site complication of 13%.¹⁵

However no such negative clinical experience with autograft harvesting and donor site morbidity, were noted in our study.

Ryu et al in their biomechanical study demonstrated that without anterior support by plating, the anterior cervical discectomy and fusion did not provide an increased or even the same stability compared with an intact spine specimen.¹⁶ The stability was generally increased when grafting was accompanied by anterior plating.¹⁷ The increased stability across the operated segment decreases motion between the graft and vertebral endplate and increased the chance of solid fusion.

Connolly et al in their study noted that plating not only acts as a buttress preventing graft extrusion, but decreases the extent of graft collapse and subsidence, preventing the formation of post operative cervical kyphosis.¹⁸ It also maintains sagittal balance and preserves the normal biomechanics of the unfused cervical segments, contributing to a decreased incidence of post operative axial neck pain and reduced potential for adjacent-level disease.¹⁸

Fraser et al in their study noted that the fusion rates were maximum in the group with plating. The overall fusion rate was 84.9% for ACD, 92.1% for ACDF and 97.1% for ACDFP.¹⁰ Mobbs et al in their study noted a higher fusion rate in the ACDFP group (99%) than in the ACDF group (93%).¹⁹

In our study, all 30 patients underwent anterior cervical discectomy and fusion with the help of anterior plating with an iliac crest bone graft. In accordance with the results of the previous studies, our study also showed an increased rate of fusion in the ACDFP group. Post operatively, patients were put on a hard cervical collar. On follow up, patients showed gradual fusion at the operated level until the final follow up of 6 months.

Twenty eight of the 30 patients (93%) in our study had significant initial pain relief following surgery which is in concordance with studies conducted by Brigham et al²⁰ and DePalma et al.²¹

Lofgren et al in their study noted that the VAS score reduced from a median of 66 in the neck and 60 in the arm before surgery to 36 and 28 at 1 year, and to 24 and 28 after 2 years of surgery in the group with autograft.²² The number of patients showing clinically relevant improvement in neck pain was 63% and in arm pain 58%. The follow up VAS scores at 4, 12 and 24 months in both neck and arm showed statistically significant improvement with a p value of <0.05.

In our study, the mean VAS score at pre operative stage was 8.93, which reduced to a mean of 4.2 at 6 weeks follow up and further reduced to a mean of 2.63 and 2.13 at 3 months and 6 months follow up respectively which was statistically highly significant with a p value <0.05. Using the Wilcoxon signed rank test, it showed that there is a highly significant reduction in VAS score when compared to adjacent time intervals. p<0.05

In a study conducted by Lofgren et al it was noted that the NDI improved from median of 44 pre operatively to 25 in the 2 year follow up which was found to be statistically significant.²² Clinically relevant improvement

in the NDI was found in 61% of patients. At all follow ups, the reduction in NDI was found to be significant.

Similarly, in our study, the mean NDI in the pre operative group was found to be 29.47 which reduced to a mean value of 18.57 at 6 weeks, 10.17 at 3 months and 8.17 at 6 months follow up respectively which is highly significant with a $p < 0.05$. The NDI scores were seen to be highly significant when compared to adjacent time intervals using the Wilcoxon signed rank test.

Oktenoglu et al in their study showed a statistically significant reduction in neck pain VAS score in the group in which fusion was supplemented with anterior plate fixation over the group in which fusion was not supplemented with plate fixation and attributed it to the immobilization of the degenerated segment with the help of plating.⁷

Hoffmann et al²² in their study showed a 28 and 22 mm reduction in pain rating (VAS) in the neck and arm, and 12 points improvement in NDI, and improvement for 77 % of the patients in the global assessment which have similar results to the studies done by Sarpath et al.²³

The results of our study are in accordance with the above studies with a statistically significant improvement in both the VAS and NDI scores.

SUMMARY

A prospective study of 30 patients, admitted with cervical disc herniation with neurological deficits who underwent anterior cervical discectomy and fusion with iliac bone graft and anterior cervical plating in the Department of Orthopaedics in Father Muller Medical College Hospital, Mangalore between August 2011 and August 2013, was conducted. Clinical improvement was studied during follow up at 6 weeks, 3 months and 6 months using the Neck Disability Index scoring system and the Visual Analogue Scoring system for radicular pain.

Of the 30 patients in the study, 40 % were in the age group of 41-50 years with a mean age of 47 years. 18 patients (60%) of the total 30 patients had IMDP at C5-C6 and this was seen to be the most commonly involved level in our study group.

There was statistically significant improvement seen in the patients when Neck Disability Score and the Visual Analogue Score for radicular pain were calculated. Each follow up visit showed statistically significant improvement in the NDI and VAS compared to the previous visit when compared with the Wilcoxon signed rank test. Only two of the 30 patients had unfavourable results in the form of persistent monoparesis as evident by the Neck Disability Scoring at the end of 6 months.

Table 1: Level of Involvement

Level of Involvement	Frequency
C4 - C5	3
C5 - C6	18
C6 - C7	4
C4-C5, C5-C6	3
C5-C6, C6-C7	2

CONCLUSION

Anterior cervical plating plays an important role in influencing the post operative cervical spine alignment and also the clinical outcome of patients.²⁴ Cervical plating should be considered for patients undergoing an ADF to decrease the rate of pseudarthrosis. The use

Table 2 : Neck disability index

Neck Disability Index				
Disability	Pre-op	6 Weeks	3 Months	6 Months
Minimal (0-20%)	0	0	22	28
Moderate (21-40%)	1	23	6	0
Severe (41-60%)	19	6	2	2
Crippled (61-80%)	10	1	0	0
Bed-bound (81-100%)	0	0	0	0
Total	30	30	30	30

of anterior plating after anterior cervical discectomy and fusion with autologous bone graft greatly enhances arthrodesis.²⁵ Thus this study shows that the improved clinical outcome and low complication rate associated with anterior cervical plating may justify its use for cervical disc herniation.

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Original Article

Allografts – How safe?

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The need for using grafts in a human body has been recognized centuries ago and thus, various xenografts were in use. Human allograft was successfully used under aseptic precautions in 1881.¹

With advances in the field of medicine and immunology, human allograft came into use more frequently. The US Navy Tissue Bank started in 1950s¹. The University of Miami Tissue Bank, one of the oldest in the world started in 1970². This concept of tissue banking did not find acceptance in India due to various cultural, religious and other factors.³ The bone bank started at Tata Memorial center in 1988, was the first in India, but again, it has remained as a bone bank alone.⁴

It is beneficial to an orthopedic surgeon to be aware about the practices in tissue banking, since he is involved in donor and recipient consenting. He also needs to explain the risks and benefits and also procedures involved in the procurement and application of these allografts to his patients and relatives. One of the foremost thoughts which arises in our minds is the issue of safety of these grafts, the risk of transmissible diseases and quality of tissue. Procurement of a tissue, from a living or deceased donor, is performed after a rigorous donor selection criteria.

In the case of living donors, the donor herself can reply to all questions, but in the case of a deceased donor, we rely on the history given by the patient's nearest relative. The following are the inclusion and exclusion criteria for donor selection

Tissues from cadaver donors are harvested in an operating room environment at our tissue bank. Regular microbial checks including air sampling is performed and stringent norms laid down by the European Association of Tissue Banking are followed. Our operating room has a colony count of 17 CFU, which is extremely low as per standards laid down for operating theatres. (accepted is 180 CFU)

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The harvested tissue is processed primarily & preserved by deep freezing (-80 deg) and secondary processing is done on demand. This is done at our tissue bank in a clean room with air samples yielding < 10 CFU (colony forming units) and in a laminar airflow cabinet having <2 CFU in the air sample. Double packing is performed under the same air flow and sealing with a vacuum packing machine is performed.

A recipient consent form duly filled and signed by the surgeon requesting the graft is essential to ensure that the patient receiving the graft is fully aware of the pros and cons of using allograft and has documented his consent for the same. This form is also necessary to trace a particular recipient at a later date if required.

The standard operating procedures followed during obtaining graft from living donors and also the receipt are indicated in the Table 2.

Table 1: Criteria for donor selection

Inclusion criteria	Exclusion criteria
<ol style="list-style-type: none"> 1 A body received within stipulated time 2 Young and healthy donor 3 Absence of communicable disease 4 Elimination of all conditions mentioned in exclusion 	<ul style="list-style-type: none"> Tuberculosis Chest infection (Bronchopneumonia) Urinary tract infection Bed sores Other infection Malignancy Auto-immune disease (Rheumatoid Arthritis) Avascular necrosis Renal failure On long term steroids Hepatitis Jaundice Liver disease Drug addiction Abnormal sexual behavior Other causes at our discretion

The allograft from our tissue bank has been used predominantly in our institutions, but also at 4 different hospitals across the city, in Orthopedic oncology and reconstructive surgery of the knee .

Bone allograft has been used in our hospitals for

- a) Fresh trauma with bone loss
- b) Primary Hip Arthroplasty with Bone defect
- c) Non tumorous condition such as Fibrous dysplasia with deformity
- d) Tendo Achilles has been used for ACL reconstruction.
- e) Limb Salvage in malignant bone tumors
- f) Spinal fusion in Spondylolisthesis
- g) Revision arthroplasty
- h) By Facio -maxillary surgeons for filling cavitary defects
- i) By Neurosurgeons for filling bony defects in the skull

Fresh frozen allograft has been in use in our hospital over a period of five years, and no infection has been noted. Preservation at -80 deg C for 4 weeks renders bone allograft non immunogenic and there is no need for

administration of any immunosuppressant drugs for any recipients.

Tissue Banking has assumed industry proportions in the US with close to a million grafts being used annually. This has also necessitated the formation of an American Association of Tissue Banking, which has formulated good tissue practices for tissue banks. Adherence to these will enable a Tissue Bank to be recognized by the AATB. The risk of transmitting a communicable disease is very negligible. Records have revealed that only one case of HIV has been transmitted in the over 8 million grafts, and that also was in 1983, in the pre HIV testing era, after that not even one case has been noted. Only one case of Tuberculosis was noted in 1953, way before most anti TB drugs were discovered. Overall, only 26 cases of suspected infections transmitted by allograft are reported, of which 13 were from a single non accredited tissue bank.¹ More recent literature has reported even lesser instances of disease transmission due to newer methods of investigations such as Nucleic Acid Testing, which minimizes the window period of disease detection in case of HIV, HCV and HBV to a week.

Standard operating procedures for bone harvesting in operation theatres

- 1) Femoral head or TKR slices to be washed with pulse lavage / soaked in saline for 15 minutes
- 2) Soaked in Gentamicin 160 mg in saline for 15 minutes.
- 3) Graft alone to be stored in the inner container of the 2 container pack.
- 4) Inner sterile container to be packed in the outer sterile container.
- 5) The outer sterile container to be double packed and sealed in the same manner as provided by the tissue bank.
- 6) Patient label to be affixed outside.

Cultures:

Swab from the TISSUE before packing to be taken and sent – chargeable to donor

Collected sample along with the **completed donor consent form** and lab number for C/S request to be sent to the Tissue bank at the earliest.

All donated tissues to be accompanied with documentary evidence of HIV, HbSAg and HCV negativity.

In the event of graft procurement taking place at odd hours: The packed and sterile graft to be placed in refrigerator in the freezer compartment and handed over the next morning.

An authorized person will collect the graft once intimated.

Procedure to obtain bone allograft from the MSR Tissue Bank

- 1) Completed recipient consent form to be submitted the previous evening or the same morning.
- 2) Patient IP number to be mentioned clearly.
- 3) Pack opened and the graft washed thoroughly with saline till no fat is washed out.
- 4) The allograft is to be soaked for 15 minutes in Gentamicin and prepared as per required shape.
- 5) The graft or any part of it cannot be received back or exchanged.

The question asked at the commencement of the article is thus illustratively answered, leaving no doubts in the mind of the orthopedic surgeon that allografts are indeed a very safe and effective way of addressing many problems in modern Orthopedic Surgery where patients own tissue is either unavailable or cannot be used for medical reasons.

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The effect of tranexamic acid in THR and hemiarthroplasty

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ABSTRACT

Background: Tranexamic acid is antifibrinolytic drug which has the property to reduce intraoperative and postoperative bleeding. There are several studies supporting the use of tranexamic acid in total knee joint replacements and few in total hip replacements. These studies have shown interesting results, but its benefits in THR and hemiarthroplasty have not yet widely known. This study was intended to establish the effects of tranexamic acid in minimizing the intra operative and post operative blood loss in THR and hemiarthroplasty.

Material and methods: This was a prospective follow up study conducted in Father Muller Medical College Hospital, Mangalore over period of two years from June 2011 to June 2013. A total number of 69 patients who underwent hip surgeries by single surgeons were selected for this study. Total hip replacements and hemiarthroplasty were included for this study. The patients were grouped as treatment and control group. The treatment group and control group were selected by purposive sampling. In the treatment group, the patients undergoing surgeries around hip joint received single dose of intravenous tranexamic acid 10mg/kg body weight 10 minutes before skin incision and equal volume of saline was injected in the control group. Intra operative blood loss was calculated by galvanometric method²⁰, weighing the sponges used and soiled by blood during surgery and measuring the amount of blood collected in suction apparatus used during the surgery.

The haemoglobin level assessed post operatively and compared with preoperative haemoglobin level. The amount of fluid collected in the post-operative drain were also measured. All the collected data are analyzed with Fisher exact test.

Conclusion: Tranexamic acid administrated before surgical incision is efficient in reducing bleeding during common surgeries around the hip joint. Especially surgery where more amount of blood loss was expected, like total joint replacement and hemiarthroplasty, the drug had shown significant benefit compared with the control group.

KEY WORDS: Tranexamic acid, Total hip replacement, Hemiarthroplasty

INTRODUCTION

Most of the major orthopaedic surgeries normally result in significant blood loss which increase the morbidity and mortality especially in patients whose haemoglobin level is low prior to surgery.

As a result, the blood loss in the elective orthopaedic surgeries results in transfusion rates that vary from 11% to 65%, depending on type of surgery¹. The blood transfusion is a life saving measure in haemorrhage but it is expensive, resource is rare and transfusion is involved with varied hazards. The risk of infection, immune suppression, allergic manifestations, anaphylaxis, volume over load, transfusion-related lung injury, and graft versus host reactions etc. are not uncommon even with compatible transfusions². The packed red cells can cause hypothermia and coagulopathy. There are some

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people, who refuse blood transfusion because of religious or personal beliefs³. Therefore it may be better to restrict blood transfusion in dire necessity only.

The successful outcomes around hip surgeries require adequate intra operative haemostasis in order to avoid haematoma formation and minimize blood loss through suction drains. Achieving satisfactory post operative range of movements also depend on soft tissue haemostasis. Persistent bleeding after surgery can cause pain, wound haematoma, seroma formation and arthrofibrosis leading to sub-optimal outcomes after surgeries⁴. So, it is important to consider minimise blood loss during surgeries around the hip joint. Efforts have been made to develop biological methods of haemostasis during the procedure. Tranexamic acid is well accepted haemostatic drug during coronary artery bypass surgery, epistaxis, menorrhagia, in haemophilia patients and dentistry. There are several studies supporting the use of tranexamic acid in total knee joint replacements. This study was aimed to ascertain the effectiveness of tranexamic acid in minimizing the intra operative and post operative blood loss in common surgeries around the hip joint.

MATERIAL AND METHODS

This was a prospective randomized case and control study. The study period was 2 years from June 2011 to June 2013. A total number of 69 subjects who underwent THR and hemiarthroplasty were enrolled in the study. The written informed consent was taken from the patients who were included in the study.

The preoperative haemoglobin was assessed in all the patients. The patients were grouped as treatment (case) group and control group. The randomization was done by the rules of odds and even. In 34 subjects of treatment group, a single dose of tranexamic acid, 10miligram per Kg bodyweight was given intravenously. The second group included the remaining 35 subjects in whom tranexamic acid was not given was considered as control group.

The patient under 18 years of age and the patients with renal failure, with upper genitourinary bleeding, with subarachnoid bleed and with acquired colour vision defect were excluded from study.

The 69 patients were operated by single surgeons. In the total hip replacements surgeries, there were 21 cases in the treatment group and 23 in the control group. There were 13 cases in the treatment group and 12 in control group among the 25 patients in whom the hemiarthroplasty was done. The cases of treatment and control group were selected by purposive sampling.

Injection tranexamic acid was administered in a dose of 10mg/kg as bolus injection (treatment group) given slow intravenously over 5 minutes. The heart rate, respiratory rate and blood pressure were checked and charted intraoperatively and postoperatively.

A single brand of tranexamic acid from a reputed firm was used in all cases in order to minimize the brand related bias and for standardization. Intraoperative blood loss was calculated by galvanometric method²⁰, weighing the sponges used and soiled by blood during surgery and measuring the amount of blood collected in suction apparatus used during the surgery.

The venous blood samples were collected from all the patients preoperatively and post operatively for determination of haemoglobin level. Postoperatively the drained fluid collected in the drain was also measured till the drain were removed.

The haemoglobin level was assessed post operatively and was compared with preoperative haemoglobin level. The data were analyzed with Fisher exact test.

The patients were followed up till they were discharged from the hospital and were observed specifically for the symptoms and signs of deep vein thrombosis.

RESULTS

There were 69 patients in our study group of which, 34 patients received tranexamic acid were in the treatment group and remaining 35 patients who did not receive the drug were in the control group

Table 1 : Distribution of patients

Drug	Total	Percentage
Control	35	50.7
Treatment	34	49.2
Total	69	100

Of the 44 total hip replacements performed, 11 patients out of 21 patients of treatment group had blood loss below 600ml, whereas in the control group only 9 patients out of 23 had blood loss below 600ml. Tranexamic acid has significant effect in preventing blood loss during THR. (Table 2)

Table 2 : Intra op blood loss in THR:

	<600	700-800	800-900	900-1000	Total
Treatment	11	6	4	0	21
Control	9	0	5	9	23

P value 0.0001. In THR significant decrease in intraoperative blood loss noted.

We included 25 patients who had undergone hemiarthroplasty for this study. In the treatment group, 9 patients out of 13 patients had blood loss below 600ml and in the control group 2 patients out of 12 had blood loss below 600ml. 10 patients had blood loss more than 600ml. (Table 3)

Table 3 : Intraoperative blood loss during hemiarthroplasty:

	<600ml	600-700ml	700-800	800-900	900-1000	>1000	Total
Treatment	9	1	1	1	1	0	13
Control	2	0	1	5	2	2	12
Total	11	1	2	6	3	2	25

P value 0.016. Significant decrease in intra operative blood loss

A. Post-operative blood loss:

Drain was kept in patients who underwent hemiarthroplasty and total hip replacements. Most of the drains are removed within 24 hours. The fluid collected in the post-operative drains were measured.

Of 44 patients of THR group, tranexamic acid was received by 21 patients. In this, (the treatment group), 17 patients out of 21 patients had fluid (blood) drain below 100ml on the first post operative day. In control group 2 patients out of 23 had drained fluid more than 100ml on the first postoperative day, only 2 patients had less than 100ml drain.

Table 4 : Drain on the first post operative day following THR:

	50ml	50-100ml	100-150ml	>150ml	Total
Treatment	3	14	3	1	21
Control	0	2	8	13	23
Total	3	16	11	14	44

P value 0.0001 significant decrease in post operative blood loss noted.

Among the 25 patients of hemiarthroplasty group, 11 out of 13 patients of treatment group had drain below 100ml on the first post operative day. In control group only 2 patients out of 12 had drain less than 100ml.

Table 5: Blood loss on first post operative day after hemiarthroplasty:

	<50ml	50-100ml	100-150ml	>150ml	Total
Treatment	2	9	2	0	13
control	0	2	8	2	12
P value 0.0001 significant decrease in post operative blood loss noted.					

B. Change in the haemoglobin level:

19 out of 21 patients who received tranexamic acid during THR had preoperative and post operative haemoglobin difference less than 1mg/dl whereas those in control group, all patients had preoperative and post operative haemoglobin difference more than 1mg/dl.

Table 6: The difference between pre and post operative haemoglobin level among THR patients:

Pre-Post op Hb	Treatment	Control	Total
<1	4	1	5
1.1-2	15	9	24
2.1-3	2	7	9
>3	0	6	6
Total	21	23	44

P value 0.001 .Significant difference noted in the pre and post operative Hb levels in THR.

In patients who underwent hemiarthroplasty, the treatment group, 10 out of 13 patients had preoperative and post operative difference in the haemoglobin less than 1mg/dl. In control group, 2 out of 12 patients had preoperative and post operative haemoglobin difference less than 1mg/dl.

Table7: Difference between Pre and Post operative Haemoglobin level following hemiarthroplasty:

Pre-Post op Hb	Treatment	Control	Total
< 1	10	2	12
1.1-2	3	5	8
2.1-3	0	3	3
> 3	0	2	2
Total	13	12	25
P value 0.023. Significant difference noted in the pre and post operative Hb levels in surgeries fixed with PFN.			

DISCUSSION

Tranexamic acid is an anti fibrinolytic drug which by competitive inhibition prevents conversion of plasminogen to plasmin and thereby prevents the breakdown of clot. Both procoagulative factors and fibrinolysis are activated by surgical trauma²¹. In major surgical procedures large amounts of tissues will be exposed to injury. These tissues will release enzymes, primarily tPA [tissue plasminogen activator] activating the fibrinolytic system²². The fibrinolytic response is most pronounced intra operatively and early postoperatively. The half life of tranexamic acid is 180 minutes which would cover the duration of surgery.

We made no attempt to evaluate postoperative hematomas, since one of the previous studies had noted no significant difference in the amounts of the hematomas between patients treated with tranexamic acid or placebo²⁴.

Intra operative blood loss was significantly less in THR and hemiarthroplasty patients. These results of our study are in comparison to the study of Jashwant Singh .et al⁹.

Drain was used in the case of THR and hemiarthroplasty. In total hip replacement and hemiarthroplasty series we found a significant decrease in the post operative blood loss as well.

Evidences from the orthopaedic literature regarding tranexamic acid indicates a role in knee arthroplasty²⁵⁻²⁶ however, data regarding its use in other orthopaedic surgeries are less common²⁷⁻²⁸. In our opinion, its use in orthopaedic surgeries is relatively uncommon in this country. Therefore, we performed a study to examine the results of the effects of tranexamic acid on haemoglobin falls postoperatively in patients undergoing surgeries around hip. In all the surgeries of our study, we noticed that there was no significant reduction of hemoglobin between pre and post operative levels. This in turn suggests that this drug helps to decrease the perioperative blood loss. The need for blood transfusion was not compared, since no clear parameters had been defined in either group for the indications for transfusion and, therefore, was susceptible to bias. But we found that transfusion requirement was less in cases when tranexamic acid was used.

The study involved single surgeons so that we have negated the surgeon bias.

P. J. Zufferey et al.⁸ in their study concluded that tranexamic acid may promote hypercoagulable state but contrary to this in our study, we did not notice any incidence of deep vein thrombosis. This result of ours could be explained based on the research on tranexamic acid by Hippala et al which states that fibrinolytic activity in vein was not affected by tranexamic acid. It should be noted here that tranexamic acid does not promote clot formation but simply stabilizes the clot that has formed.

CONCLUSION

We conclude that, as tranexamic acid reduced the intra and post operative bleeding in our patients who underwent THR and hemiarthroplasty, its use can be extended to other major orthopaedic surgeries. Prophylactic use of tranexamic acid also provides effective, safe and economical method for reducing blood loss and also in reducing the financial burden in terms of expenses incurred on blood transfusion. Tranexamic acid helps in reducing blood transfusion complications.

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Case Report

Management of distal femur fractures by locking compression plates(LCP)

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ABSTRACT

Introduction: The supracondylar area of the femur comprises approximately the distal 15 cm of the femur, as measured from articular surface. Distal femur fractures are complex as they are unstable, comminuted and tend to occur more commonly in elderly and multiply injured patients and associated with osteoporosis, comminution, bone loss, articular involvement. These fractures have the potential to produce significant long term disability due to deformity, bone loss and malunion and even fatal mortality due to massive haemorrhage and fat embolism. It is now well recognised that the best treatment option for distal femur fracture is open reduction and internal fixation. The internal fixation of the distal femur can be difficult due to thin cortices, a wide medullary canal, relative osteopenia, and fracture comminution make stable internal fixation difficult to achieve. DF-LCP allows both locking and compression screw fixation of the distal femur fracture along with articular surface realignment.

Material and methods: The study consisted of ten patients, seven males and three were female. The patients' ages ranged from 20-86 years with a mean age of 53 years. All these cases were fixed with DF-LCP with bone grafting where the distal femur fractures were associated with extensive bone loss. Patients' age ranged from 20 to 86 years with a mean of 53. The patients were followed up from 1 to 12 months.

Results: Average time of union was 18 weeks with a range of 8 to 32 weeks. Mean extension was 1° (range 0° to 5°) with mean flexion 108° (range 40° to 140°). Mean range of motion was from 1° to 180° . Using Schatzker scoring system, there were three excellent results, four good, two fair and one failure.

Conclusion: The early results of this study are encouraging so that the technique can become part of the in the armamentarium of the orthopaedic trauma surgeon.

Key Words: Distal femur fractures; Distal femoral-locking compression plate

INTRODUCTION

The supracondylar area of the femur is defined as the zone between the femoral condyles and the junction of the metaphysis with the femoral diaphysis. This comprises approximately the distal 15cm of the femur, as measured from articular surface. It is important to distinguish extra-articular fractures from intercondylar as the treatment and prognosis will be considerably different.

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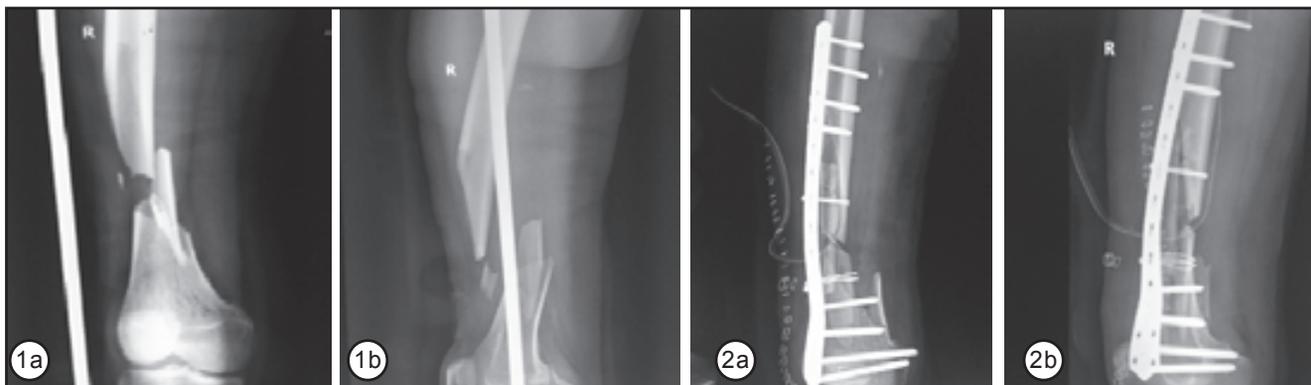


Figure 1 a & b: Pre-operative X-rays

Distal femur fractures are complex injuries that could be difficult to treat. These fractures are unstable, comminuted and tend to occur more commonly in elderly and multiply injured patients and associated with osteoporosis, comminution, bone loss, articular involvement. These fractures are usually caused by high velocity trauma and trivial trauma in osteoporotic elderly patients.

Distal femur fractures have the potential to produce significant long term disability due to deformity, bone loss and malunion and even fatal mortality due to massive haemorrhage and fat embolism.

In most distal femur fractures is thought to be axial loading with varus, valgus, or rotational forces. In younger patients, these fractures typically occur after high-energy trauma related to motor vehicle accidents. In these patients there may be considerable fracture displacement, comminution, open wounds, and associated injuries. On the other hand, in elderly osteoporotic patients, fractures frequently occur after a minor slip and fall on a flexed knee, leading to fragility fractures through compromised bone.

It is now well recognised that the best treatment option for distal femur fracture is open reduction and internal fixation. The surgical goals of treatment are anatomic reduction of the articular surface, restoration of limb alignment, length, and rotation, bone grafting for extensive bone loss and stable fixation that allows for early mobilization. Nonetheless, internal fixation of the distal femur can be difficult due to thin cortices, a wide medullary canal, relative osteopenia, and fracture comminution make stable internal

Figure 2 a & b: Immediate post-operative X-rays

fixation difficult to achieve.

DF-LCP allows both locking and compression screw fixation of the distal femur fracture along with articular surface realignment.

The following study was conducted to examine the short term clinical and radiological results particularly early complications and healing rate of distal femur fracture treated with DF-LCP.

MATERIALS AND METHODS

The study was conducted in patients treated for distal femur fracture (type A, B & C - AO classification) from the month of November 2012 to September 2013. Ten distal femur fracture patients were taken into the study, all were fixed with DF-LCP with bone grafting where the distal femur fractures were associated with extensive bone loss. Patients' age ranged from 20 to 86 years with a mean of 53 years.

The patients were positioned supine with a sand bag beneath the ipsilateral hip to internally rotate the leg. A direct lateral (posterolateral) approach was used to expose the fracture site. Skin incision was longitudinal and distally was centred over the lateral epicondyle. Fractures were reduced under direct vision using manual traction. DF-LCP plate length, axial and rotational alignment were checked and then placed over the fracture site. Fixation was achieved with distal and proximal locking screws and bone grafting done for fractures associated with extensive bone loss.

RESULTS

The sample consisted of ten patients with seven males and three were female. The patients' ages ranged from 20-86 years with a mean age of 53 years. The causes of fractures were motor vehicle accident in seven patients and a fall from a height in three patients. There were no sports or industrial accidents. Eight fractures involved the right side and two involved the left. The average length of hospitalisation was 30 days with a range of 20 to 40 days. The average number of days from injury to surgery was 9 days with a range of 3 to 15 days. The operative time ranged from 90 minutes to 180 minutes. Patients were followed up from 1 to 12 months.

According to the AO/OTA classification system, there were three Type A1, two Type A2, two Type A3, two Type C1, one Type C2 fractures. Among which five were closed and five were open fractures requiring bone grafting. Successful fracture union was defined as complete bridging callus in three cortices, together with painless full weight bearing. Average time of union was 18 weeks with a range of 8 to 32 weeks. Mean extension was 1° (range 0° to 5°), with mean flexion 108° (range 40° to 140°). Mean range of motion was from 1° to 180°. Using Schatzker scoring system, there were three excellent results, four good, two fair and one failure.

COMPLICATIONS

Included 1 periprosthetic middle and distal third right shaft femur fracture which was treated with close

reduction and internal fixation with proximal femur nailing. There was delayed union and late weight bearing in two patients. There was no non-unions, deep seated infections or osteomyelitis.

DISCUSSION

Current fracture patterns are tended towards complex comminuted open fractures due to high velocity road traffic accidents. Improved health care in terms of open reduction and internal fixation with LCP and early mobilization results in longer and healthier life span.

LCP is a single beam construct where the strength of its fixation is equal to the sum of all screw-bone interfaces. Its unique biomechanical function is based on splinting rather than compression resulting in flexible stabilisation, avoidance of stress shielding and induction of callus formation. The shaft holes on the DF-LCP are oval allowing for the options of a compression screw or a locking screw. This leads to a more precise placement of the plate, as it is able to be compressed more closely to the bone. When applied via a minimally invasive technique, it allows for prompt healing, lower rates of infection and reduced bone resorption as blood supply is preserved.

Although the follow-up period of our series was short, studies have shown that early function is comparable to final long term outcome. The outcome seems to correlate with fracture severity, anatomic reduction, aetiology, bone quality, length of time elapsed

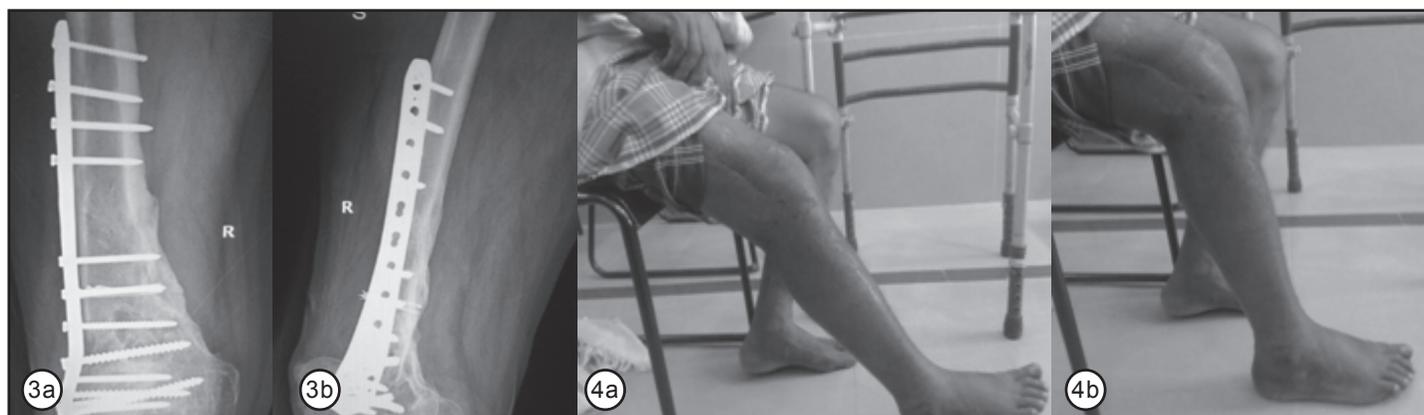


Figure 3 a & 3b: At 12 month follow up Figure 4 a & 4b: Functional movements at 3 months. a-extension 110°, b. flexion 90°

Table 1 : Showing the details of the patients

No.	Age (yrs)	Sex	Mech of Injury	Type	Side	Bone grafting	Full wt bear (mths)	ROM	Complications	F/up (mths)	Schatzke score
1	45	M	RTA	33C2	Right	Yes	5	0-130	-	12	Good
2	20	M	RTA	33A2	Right	-	2	1-140	-	9	Excellent
3	70	F	FALL	33A1	Right	Yes	8	5-90	Delayed Union	10	Fair
4	55	F	RTA	33A1	Left	-	5	0-120	-	10	Good
5	86	F	FALL	33A2	Right	-	-	0-30	Periprosthetic#	10	Failure
6	30	M	RTA	33A3	Right	-	3	0-130	-	10	Excellent
7	55	M	RTA	33C1	Right	Yes	4	0-120	-	9	Good
8	48	M	FALL	33A3	Right	Yes	4	0-110	-	8	Good
9	28	M	RTA	33A1	Left	-	4	0-130	-	10	Excellent
10	59	M	RTA	33C1	Right	Yes	7	5-90	Delayed union	9	Fair

from injury to surgery, concomitant injuries, and exact positioning and fixation of the implant.

CONCLUSION

The DF-LCP is a good implant to use for fractures of the distal femur. However, accurate positioning and fixation are required to produce satisfactory results. We recommend use of this implant in Type A and C, osteoporotic fractures. Our early results are encouraging but long term studies are needed to prove definitively acceptable outcomes so that the technique can become part of the in the armamentarium of the orthopaedic trauma surgeon.

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Neglected distal femoral epiphyseal injury

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ABSTRACT

Neglected Distal femoral epiphyseal injury in young adults is a rarely encountered clinical entity. The axial mal-alignment and the functional impairment creates a challenge in management of this injury. The soft tissue contractures, its proximity to neurovascular structures and a complicated osseo-ligamentous anatomy of the knee calls for precise surgical expertise.

We report a case of neglected epiphyseal injury of the distal femur creating a multiplanar deformity- axial and coronal (similar to a Hoffa's type of lesion in adults) and the management strategies adopted based on the concept of distraction epiphysiolysis to achieve a successful result. Such a complex injury treated by epiphysiolysis and secondary osteotomy for restoration of normal biomechanics has not been reported earlier. Only a case of lateral condyle malunited coronal plane fracture has been reported.

We used a knee joint spanning Illizarov femoral frame with wires passing through the epiphyseal fragment of the distal femur in its axis. Percutaneous osteotomy of the distal femoral physeal plate was done to achieve gradual distraction through the physeal plate. Corrective osteotomy, bone grafting and fixation with buttress plate was done 12 weeks after the first surgery. Almost two years after the first surgery the patient presented with normal looking knee with good function.

Key words: Epiphysiolysis, staged reconstruction

INTRODUCTION

Physeal distraction is an accepted technique for limb lengthening or deformity correction. Heuter Volkman stated that shear at the physis promotes growth and compression decreases growth. Distraction epiphysiolysis describes gradual distraction (1mm/day) of the growth plate which creates a fracture at the physis in the layer

between the maturing chondrocytes and the hypertrophic layer¹.

Incidence of distal femur epiphyseal injury in young adults is low^{2,3}, but have a high incidence of complications- varus or valgus malalignment, vascular impairment and peroneal nerve injury^{4,5,6}. The complex pathological soft tissue anatomy pose a great amount of difficulty in achieving anatomical reconstruction.

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CASE REPORT

A boy aged 16 years presented to us with deformity of left knee with shortening of the limb following an alleged

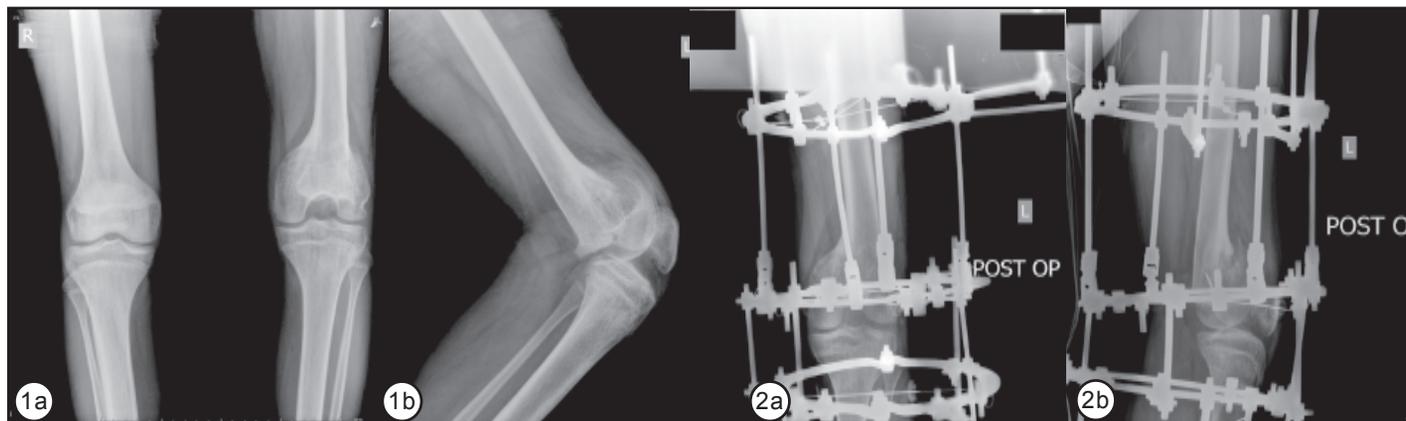


Figure 1a & 1b: Pre-operative X-ray- malunited and completely anteriorly displaced distal femoral condyles.

Figure 2a & 2b: X-ray of knee joint spanning Ilizarov femoral frame with wires passing through the epiphyseal fragment of the distal femur in its axis.

history of a significant injury to his left knee while playing football about 8 months ago. He was treated earlier elsewhere non-operatively soon after the injury with immobilization for about 3 weeks. Later the boy started ambulation and range of motion exercises were begun gradually. He was able to stand and walk independently and had varus deformity of 20 degrees and limb length discrepancy approximately 2 cms. Minimal knee was effusion present with gross wasting of the thigh muscles. Abnormal bony prominence was felt over the anterior aspect of the distal end of the femur. Minimal tenderness was over the joint line, with active flexion 10-90 degrees, fixed flexion deformity of 10 degrees, varus of 20 degrees. There was no distal neurovascular deficit. X-rays of the part revealed malunited and completely anteriorly displaced distal femoral condyles. There was also subluxation of the knee.

During surgery, knee joint spanning Ilizarov femoral frame was applied with wires passing through the epiphyseal fragment of the distal femur in its axis. Percutaneous osteotomy of the distal femoral physeal plate was done to achieve gradual distraction through the physeal plate.

Distraction of the femoral epiphysis was started 5 days after the index surgery at the rate of 1mm/day in the differential manner to correct varus alignment. Continued

distraction was carried out for a period of 3 weeks. At this stage the ilizarov frame was realigned followed by a static phase for 4 weeks.

Monitoring of distraction was done radiologically and after obtaining sufficient realignment of the limb and epiphyseal distraction the Ilizarov frame was removed and an above knee slab was applied.

Follow-up x rays showed good distraction through the physis and knee subluxation reduced.

Corrective osteotomy, bone grafting and fixation with lutress plate was done 12 weeks after the first surgery

Almost two years after the first surgery the patient presented with normal looking knee with no bony tenderness with just 1 cm muscle wasting of the left thigh with no extensor lag. He was able to flex the affected knee to 120 degrees.

DISCUSSION

Distal femur physeal injuries are rare in children^{2,3}, but associated with high rate of complications requiring resurgery- most common being growth disturbance, shortening and neurovascular injury. The close proximity of the popliteal vessel to the posterior surface of the femur

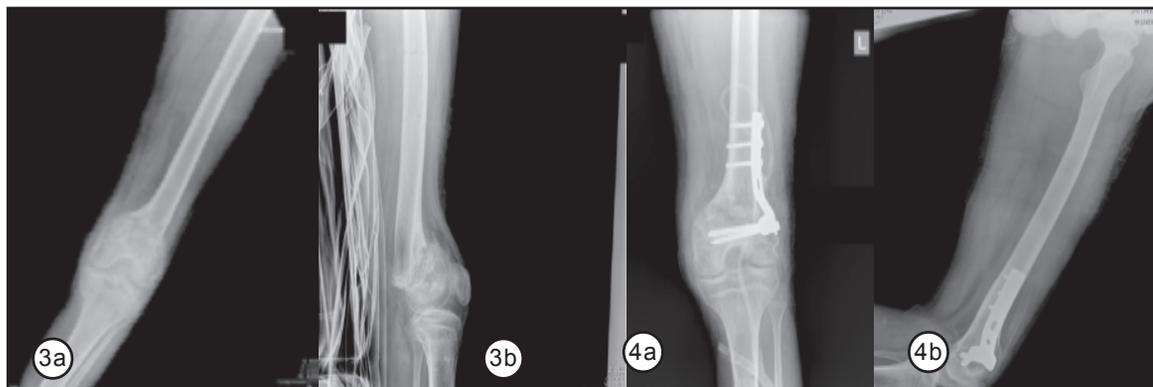


Figure 3a & 3b: After removal of the Illizarov frame
Figure 4a & 4b: Post operative X-Ray after corrective osteotomy, bone grafting and fixation with buttress plate

separated by only a fat pad, make surgical intervention difficult and more so in malunited fractures, where soft tissue adherence is known⁷. The chance of peroneal nerve neuropraxia is also common due to varus tilt and medial rotation.

The distal end of femur contributes to 70% of femur growth and 37% of lower limb length.^{8,9} Salter harris Type II injury is most common in during sport injury. Unlike in adults where there is also ligament injury, in skeletally immature there is more chance of physeal involvement.¹⁰

In the first stage we used Illizarov fixator which helped us in preventing soft tissue

stretching and helped in physeal distraction initially thus following the principles of Distraction epiphyseolysis. Since the patient was nearing skeletal maturity, we attempted this procedure as the probability to cause further growth disturbance is minimal. This has the advantage of preventing a possible neurovascular damage.

The second procedure involving corrective aligning osteotomy and fixation with a lateral plate was done away from the original fracture site.

Historically Supracondylar fractures of femoral bones in adolescents are most frequently caused by cartwheel

accidents¹¹ and now due to valgus stress during sport injury.^{12,13,14,15} The main reason is the anterior or lateral impact forces on a flexed knee. Fractures of the distal femoral end in children may involve the metaphysis, epiphysis and femoral shaft. They often lead to lysis along the growth plate, which is the most fragile part of the bone. The majority of these fractures concern children in the age of 12-14 years.¹⁶ Lower limb fractures are connected with much worse prognosis than upper limb fractures. Shortenings and deformations of the lower limbs are much worse tolerated than the ones in the upper limbs, due to a higher physiological load.

CONCLUSION

Although neglected malunited distal femoral epiphyseal injuries are rarely seen, they pose a great challenge to the operating surgeon and meticulous care needs to be taken for post op management. More so in this case it was a neglected injury in malunion. Anatomic reduction is important to minimize the risk of arthritis and growth plate arrest which is a common complication in this type of injury, apart from neurovascular risk. In the position of flexed knee especially beyond 90 degrees the instant center of rotation glides on the posterior condyles and restoring the normal biomechanics and with prevent arthritis and promote normal function. Distraction epiphyseolysis needs to be done in a patient near skeletal maturity and we could use this principle here.

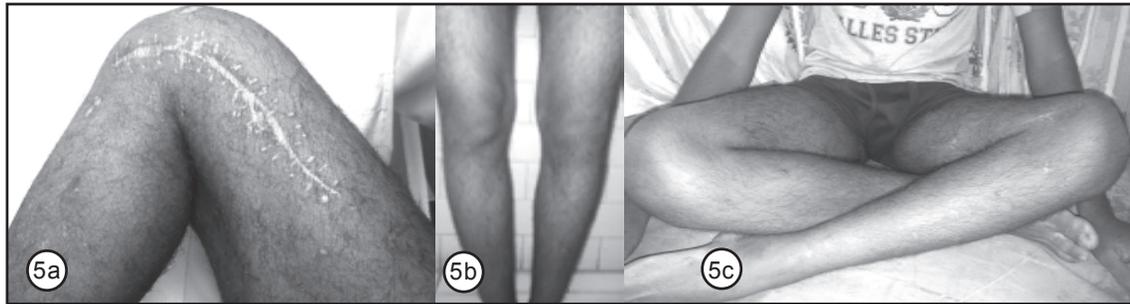


Figure 5a, 5b & 5c: Final functional results showing good knee flexion and extension

Such a complex injury treated by epiphysiolytisis and secondary osteotomy for restoration of normal biomechanics has not been reported earlier. Only a case of lateral condyle malunited coronal plane fracture has been reported.

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Case Report

Pathological fracture of neck of femur in ochronosis

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ABSTRACT

Alkaptonuria is a rare hereditary autosomal recessive metabolic disorder, characterized by accumulation of homogentisic acid in the connective tissues resulting from lack of the enzyme homogentisic acid oxidase, resulting in chronic and long-lasting problems. Ochronosis is the connective tissue manifestation of alkaptonuria. The joint manifestations, especially hip and knee are due to cartilage involvement. The cartilage is pigmented and destroyed. A lady aged 63 years presented with left hip pain and difficulty in walking of 2 weeks duration. The X ray revealed a fracture neck of femur. Intra-operative finding suggested ochronosis. Patients with ochronosis can present in the orthopaedic clinics usually with back ach due to spondylosis or hip and knee pain due to degenerative arthritis. Fracture neck of the femur can be one of the presentations. As the cartilage is involved the fracture neck of femur in ochronosis needs total hip replacement. We present this case for its rarity.

Key words: Ochronosis, pathological fracture neck femur, alkaptonuria

INTRODUCTION

Alkaptonuria, a rare hereditary autosomal recessive metabolic disorder, is characterized by accumulation of homogentisic acid in the connective tissues resulting from lack of the enzyme homogentisic acid oxidase. Ochronosis, dark pigmentation of connective tissues, is the musculoskeletal manifestation of alkaptonuria. The disease results in the accumulation and deposition of homogentisic acid in the cartilage, eyelids, forehead, cheeks, axillae, genital region, buccal mucosa, larynx, tympanic membranes, and tendons. The disease generally presents in adults with arthritis and skin abnormalities; occasionally, involvement of other organs may be seen. The main clinical feature is dark brown colour of urine caused by high urinary output of homogentisic acid. Life-

long accumulation of abnormal metabolites becomes overt in the form of severe spondylosis, peripheral arthropathy, tendon rupture, osteoporosis as well as aortic valve stenosis and skin pigmentation. The features of the disease are associated with affinity of homogentisic acid to the connective tissue and its effect on collagen structure. Most of the time symptomatic treatment is adequate in case of alkaptonuria and ochronosis. In alkaptonuric patients, cartilage, fibro-cartilage and tendons are slowly impregnated by homogentisic acid. This leads to pigment deposition between and on the surface of collagen fibers (ochronosis) which hardens the tissues as in leather tanning, and can render them friable. Ochronotic intervertebral discs show a tendency of calcification and ossification, which produces a characteristic radiological picture³. Ochronotic cartilage is rather often split off in the weight bearing zones of the knee, shoulder and hip. This is followed by osteoarthrotic changes, with a synovial reaction. However pathological fracture of neck of femur² is uncommon association.

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CASE REPORT

In this article, we report the case of a lady aged 63 years who presented to our casualty with pain in left hip on & off since 5 years but increased over the last 15 days with difficulty in walking. There was no history of recent

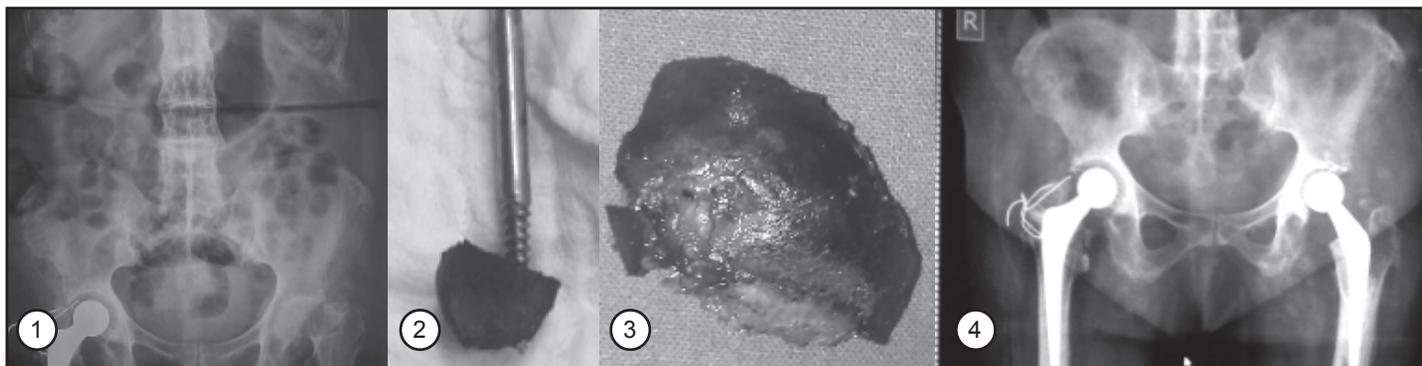


Figure 1: Pre-operative X-ray showing pathological fracture in the neck of femur with arthritic changes left hip, THR on the right side with spondylotic changes in the lumbar spine. **Figure 2 & 3:** Black discolouration of the head of the femur removed during surgery **Figure 4:** Post-operative X-ray, THR on left side also.

trauma or fall. She was a known case of diabetes on regular treatment. Patient had undergone right total hip replacement 5 years back following persistent hip pain. There was no other significant history. On physical examination, there was external rotation of the left hip with pain in the hip movements and localized tenderness. Active SLR was not possible. The X ray examination showed fracture neck femur with degenerative arthritic changes in left hip. Preoperative workup was done and surgery was planned in form of total hip replacement. During surgery, blackish discoloration was first noticed at the insertion of gluteus medius and the soft tissue around the hip including the capsule, labrum, transverse acetabular ligament and ligamentum teres along with femoral head, neck and acetabulum had blackish discoloration^{6,7,8,9}. A cemented total hip replacement was performed in a standard manner using a 47 mm acetabular cup and a size 12 stem and wound closed over a single drain¹⁰. Routine post operative care in the form of ankle, knee and hip exercises from day one, drain removal at 48 hours, followed by standing and partial weight bearing walking with walker commenced. Intravenous antibiotics were given for 72 hours. The wound healed satisfactory and patient discharged on tenth post operative day after suture removal.

Postoperative workup was done in form of 24 hour urine sample darkened in sunlight. Caviar like papules were found around her eyes and the helix cartilage of her ears, and on the dorsum of both hands. There were brown macules on the sclera⁴ (Osler's sign) Histopathological examination of blackish material confirmed diagnosis of ochronosis¹². X ray of the thoracolumbar spine showed typical calcification of the intervertebral disc².

DISCUSSION

This case is unique as the patient presented with persistent hip pain and pathological fracture neck femur. Follow-up results were satisfactory with good range of motion, no pain. Good short term results in terms of VAS score. Diagnosis was made on basis of biopsy sample which confirmed ochronosis. Darkening of urine sample and negative Benedict's test further supported diagnosis.⁶ On further clinical, radiological & biochemical evaluation it was confirmed as classical case of ochronosis.

CONCLUSION

Ochronotic pathological fracture neck femur is a rare entity and can present unusually as hip pain with arthritic changes.

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Case Report

Dislocation of knee

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ABSTRACT

Dislocation of knee has been long considered a rare injury. They are true orthopaedic emergencies and are associated with extensive ligamentous damage and increased potential for vascular complications associated with these injuries. The most of the knee dislocations occur as a result of high velocity trauma and significant soft tissue injury is necessary for a knee dislocation to occur. We report one case of anterior dislocation of knee with anteromedial ligamentous instability.

A man aged 50 years presented with pain, swelling and deformity of left knee. Following physical examination, radiographic assessment, anterior dislocation of knee with anteromedial ligamentous instability was diagnosed. Immediate closed reduction of the dislocation was done. The open reconstruction of the anterior cruciate ligament and repair of the medial collateral ligament was carried out 3 weeks later.

Anterior dislocation of knee needs to be addressed with proper planning and evaluated thoroughly for ligamentous injury and neurovascular injury both clinically and radiographically with early repair of ligamentous disruptions.

Key words: Dislocation of knee, knee ligament disruption

INTRODUCTION

Dislocation of knee is considered a rare injury¹ but the incidence might be higher than recognized because many of the dislocations are spontaneously reduced at the scene of the injury².

Knee dislocations are classified as anterior, posterior, medial, lateral and rotary according to the displacement of the tibia in relation to the femur. Rotary dislocations are designated as anteromedial, anterolateral, posteromedial and posterolateral^{1,3}. They are true orthopaedic emergencies and are associated with extensive ligamentous injuries and associated vascular injuries⁴.

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CASE REPORT

A man aged 50 years presented to our institute with complaints of pain, swelling and deformity of the left knee following a fall from a flight of stairs which was about 6 feet high. There were no external injuries, patella was directed upwards and medially compared to the right patella, there was tenderness over the left knee joint with the quadriceps tendon appearing taut with painful and restricted movement of the left knee joint. Distal neurovascular status was normal, further examination of the knee could not be done as the patient was in severe pain

Radiological investigation revealed anterior dislocation of the knee which was reduced as an emergency under general anaesthesia by closed reduction which was successful and the distal vascularity post reduction was intact. After reduction, the haemarthrosis was aspirated



Figure 1a & 1b: Clinical photograph of the dislocated knee
Figure 2a & 2b: Radiographs of the dislocated knee
Figure 3a & 3b: Clinical photographs showing full range of movement

and the knee was immobilized in full extension. The neurocirculatory status was checked at frequent intervals post reduction also.

The MRI scan of the knee revealed complete disruption of the anterior cruciate ligament with a horizontal tear in the posterior horn of the medial meniscus and a tear in the medial collateral ligament

Through an anterior approach, the anterior cruciate ligament reconstruction was done using a patellar tendon allograft and the torn portion of medial collateral ligament was repaired using non-absorbable sutures. The post-operative period was eventless and the active knee movements was initiated using a restricted hinged knee brace after 3 weeks. Patient was followed up regularly for one year; patient had painless and complete range of motion in the left knee.

DISCUSSION

Dislocation of the knee is considered a rare injury. It is most commonly caused as a result of knee hyperextension beyond 30 degrees with or without varus/valgus stress⁶. It can occur following a wide variety of mechanisms, but most commonly following high energy traumatic events^{8,9}. They are known to cause extensive ligamentous and neurovascular complication⁴.

Frequently orthopaedic surgeons are concentrating on the obvious skeletal injuries and ignoring the subtle signs of knee injury, a critical but often overlooked diagnostic step is to perform a good examination under anesthesia after skeletal stabilization to unmask significant ligamentous knee instability⁷.

Diagnosis of knee dislocation with ligamentous injury are made through the history and clinical examination of the patient but are confirmed through X-ray examination. The anterior dislocation of the knee is the most common type of dislocation and it is usually associated with arterial injury⁴ and occurs as a result of hyperextension of the knee⁶. The position classification system is useful for guiding the surgeon regarding the potential reduction maneuvers needed to reduce the dislocation.

The anatomic classification system is based upon what structures are torn and is useful in guiding the surgeon regarding treatment options, according to which best treatment is immediate closed reduction of the dislocation followed by ligament repair.

The decision to perform arthroscopic versus open reduction in a complex knee injury depends on the timing of the surgery and the nature of the injury itself

If reconstruction is done within the first few weeks, the capsular tissue may be torn, where open technique is preferred over arthroscopy to avoid risk of extravasation of fluid into the compartments which may increase the risk of compartment syndrome.

CONCLUSION

Anterior dislocation of knee is rare but is the most common dislocation of the knee joint and is commonly associated with extensive ligamentous injury and vascular injury. Emergency closed reduction of the dislocation depending on the type of dislocation with repeat vascular examination is mandatory to rule out any unsuspected intimal tear which may cause delayed ischemia hours or days after the reduction, followed by early ligament reconstruction and repair within 3 weeks results in satisfactory knee with minimal post operative complications.

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Case Report

Distal ulna-radial synostosis(DURS) procedure in the treatment of diaphyseal defect of radius in a child

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ABSTRACT

presents with club hand like deformities coupled with loss of functions of the hand and forearm. We report a case of a boy aged 10 years who presented with severely disturbed hand functions and grotesque looking left forearm with radial club hand like deformity due to osteomyelitis following fracture of the forearm. We planned for distal resection of ulna at the level of distal stump of remaining radius and synostosing the remaining proximal ulna to the distal radial stump. Follow up at the end of two years a very good functioning forearm and hand with negligible shortening of the forearm with a well aligned wrist and hand on forearm.

Key Words: Radial defects, Single bone forearm reconstruction techniques

INTRODUCTION

Diaphyseal defects due to osteomyelitis of the bones of forearm in children presents to the clinician with a challenging situation to restore the limb function. Often the radial defects present as club hand like deformities coupled with loss of functions of the hand and forearm. Single bone forearm reconstruction techniques are often followed to obtain centralization of the wrist on forearm which ensures optimal hand functions and also minimal disturbance to the growth of the limb. In these situations it is often the ulna which is suitable for centralization owing to the loss of distal radial physis. We followed the technique of synostosing the distal shaft of the ulna to the remaining distal radial stump which contained a viable radial physis.^{1,2} This technique automatically centralizes the wrist and also a viable distal radial physis

maintains the growth of the forearm thus ensuring the dual benefit of function and growth being unhindered.

CASE REPORT

A boy aged 10 years presented to us with deformities of left forearm sustained as a result of healed osteomyelitis of the radius. His hand functions were severely disturbed and grotesque looking left forearm with radial club hand like deformity. Child had open fracture of the forearm bones which were treated by native methods and subsequently he developed infection in the forearm bones. He was later treated in a local hospital by surgery on his left infected forearm. Subsequently child developed discharging sinuses which healed after a prolonged treatment with antibiotics and splintage.

Clinical examination of the left forearm revealed gross radial deviation of the hand with ulnar bowing of the forearm. Radial side shortening was also noted to be more than ulnar side. Ulnar head prominent over the wrist owing to disturbed growth of the distal radial physis

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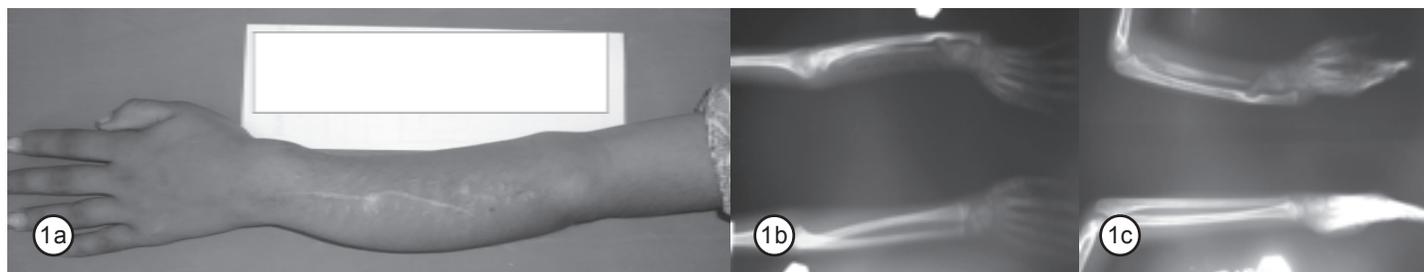


Figure 1a: Pre-operative photograph showing the deformity
Figure 1b & 1c: Pre-operative radiographs of the affected forearm with normal limb x rays to show the difference in growth patterns

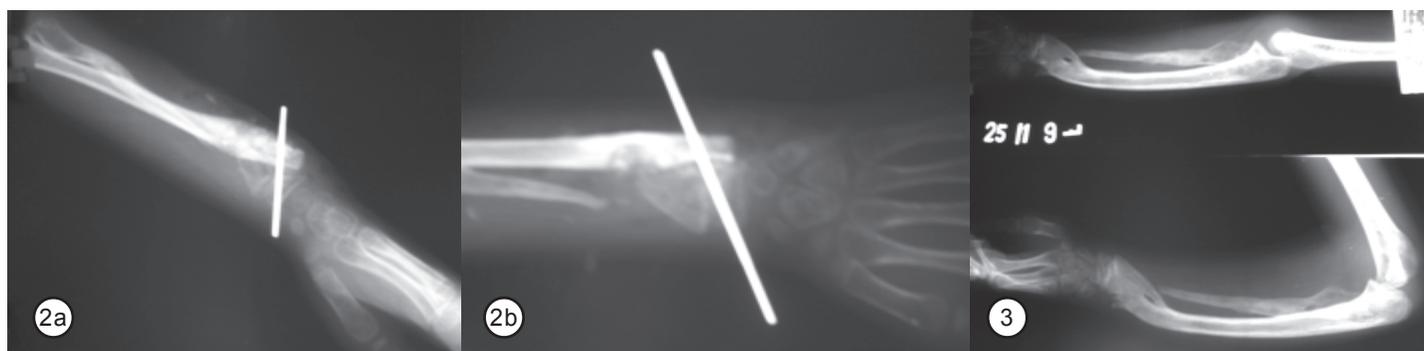


Figure 2a, 2b: Post-operative radiographs showing resection of distal ulnar stump and synostosing the distal radio-ulnar articulation
Figure 3: Radiographs at the end of 2 years showing complete consolidation of the synostosis

and normal growth of the distal ulna. Multiple healed puckered scars on the forearm observed revealing the evidence of healed infection. No neurovascular deficits were noted in the limb or in hand. Hand functions of gripping the objects and making fist were extremely difficult due to abnormal position of the wrist. However there were no neurological injuries noted in the hand.

Radiographs of the forearm with wrist and elbow showed significant loss of radial diaphysis with evidence of non-union of the distal radial shaft. The non-union ends showing significant tapering ends with the distal radial stump abutting on the distal ulna. Continued growth of the distal ulna mismatching the disturbed growth of the distal radial epiphysis resulting in distal radio-ulnar joint mal-alignment. Wrist joint and hand skeleton were noted to be normal. However the decreased radio-density of the distal radial epiphysis was a concern.

Further radio-nuclear studies were done to note the activity of the infection and also about the viable functions

of the distal radial epiphysis. This study proved a good activity in the distal radial epiphysis and also no activity at the non-union site indicating the absence of infection and any skeletal activity at that region.

Blood investigations were also done and were found to be normal without any evidence of acute or chronic septic foci elsewhere.

Radiographs of the forearm with wrist and elbow. Normal limb x rays are included to show the difference in growth patterns of distal ulna and radius and also note the deformities of the wrist and significant loss of distal diaphysis of the radius.

METHODS

Deformity correction was planned in the following manner. As the distal radial epiphysis showed functional activity and the wrist was naturally centralized on the distal radius, we planned for distal resection of ulna at

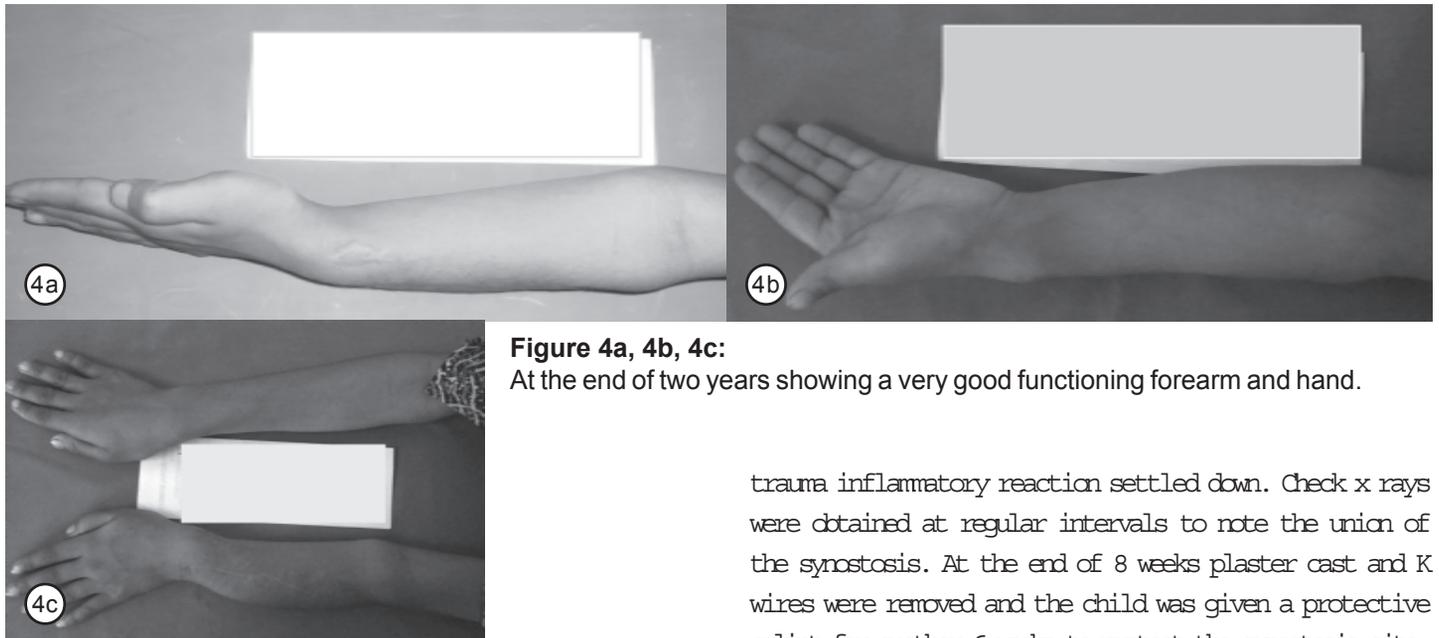


Figure 4a, 4b, 4c:

At the end of two years showing a very good functioning forearm and hand.

the level of distal stump of remaining radius and synostosing the remaining proximal ulna to this distal radial stump. This achieved two important pre-requisites of surgery, deformity correction and also not disturbing the distal radial physis and the wrist. This ensures us the normal growth of the forearm with improved hand and wrist functions.

Procedure was performed with the patient under general anaesthesia. A dorsal based incision was chosen as this would avoid the radial neurovascular bundle which would be at risk if volar approach were to be used. Also the distal ulna could be easily reached by this approach. The distal ulna was osteotomized at the pre-determined level. The level was further confirmed by IITV images. The distal stump of ulna was completely removed with its periosteal covering to avoid any further regeneration. The remaining proximal stump of the ulna was further shelved into the remaining distal radial stump and further was stabilized with a transverse 1.5mm K wire to hold it securely. Tourniquet was released at this stage and vascularity return was noted and wound closed over suction drain after achieving haemostasis. K wire was buried in the subcutaneous plane for further removal. Forearm removable plaster splint was given. Post-operative care included to prevent limb oedema and a moulded plaster cast was applied after the surgical

trauma inflammatory reaction settled down. Check x rays were obtained at regular intervals to note the union of the synostosis. At the end of 8 weeks plaster cast and K wires were removed and the child was given a protective splint for another 6 weeks to protect the synostosis site. Physiotherapy to ensure elbow and shoulder motions were instituted.

Further follow-up at the end of 6 weeks, 6months and at the end of one year and two years was carried out. Limb functions of the child were noted to be highly satisfactory and also the growth of the limb equaled the normal. No recurrence of the deformity or infection noted at the end of 02 years follow-up. Radiographs at the end of the follow-up showed solid fusion of the distal ulna and a viable distal radial epiphysis with a well centralized wrist.

Clinical photographs at the end of two years follow-up showing a very good functioning forearm and hand. Also note the negligible shortening of the forearm with a well aligned wrist and hand on forearm.

Post-operative radiographs showing resection of distal ulnar stump and synostosing the distal radio-ulnar articulation. Note that the wrist is well centered and the non-union site is not probed much owing to the scar tissue which would contain the neurovascular structures.

Radiographs at the end of 2 years follow-up showing complete consolidation of the synostosis. Note a viable distal radial stump with normal appearing radial epiphysis. No radiological evidence of infection noted.

DISCUSSION

Extensive diaphyseal defects of the forearm³ and leg bones due to osteomyelitis in children is a known complication but rarely encountered. This constitutes a considerable clinical challenge in that the functions of the limb are very grossly jeopardized. Reconstruction of these defects by various means such as autologous/allografts, vascularized grafts, bone regenerate formation by Ilizarov methods are well known.^{4,5} The results of such a procedure vary according to the location of the defect and the nature of the infection. It is advisable to carry out excision of the sequestered bone in children only after sufficient involucrum has been formed to protect the host bone from the infectious process of destruction.^{5,6} Removal of the sequestra before the involucrum formation will not only remove a good amount of bone but also weakens the local conditions to combat infection resulting in diaphyseal bone loss. The resulting infected non-union is very resistant to treatment unless the host conditions are stimulated to participate in bone forming process. This can be achieved by methods that are biological in nature which re-establishes the host vascularity and thus combat the infection process.

Deformities resulting in dysfunction of the involved limb make the limb useless as well as ugly. Adaptation to such deformities in children are most wanted and leads to physical disabilities resulting in social unacceptability.

The results of above mentioned procedures in treating such deformities are always guarded and fraught with complications.⁷ Scar tissue, infection and sensitive neuro-vascular status places the limb in a precarious situation. Coupled with this the soft tissue envelope such as the muscles and tendons also will align to the deformed

position complicating the situation. But once the host tissue is given the conditions to re-establish its vascularity the entire process could reverse back to normalcy creating a friendly atmosphere for tissue forming process.^{1,8} Viable tissues and willingness to accept the procedure by the patient is also of a paramount importance.

Reconstruction of forearm mainly revolves around placing the wrist in central position so that the wrist joint could function effectively with respect to forearm and hand.

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Case Report

A rare case of alkaptonuria-Achillis tendon rupture

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ABSTRACT

A lady aged 37 years presented with pain in posterior aspect of left ankle and inability to plantarflex the ankle. Clinical examination and ultrasound revealed achillis tendon thickened and torn. The patient was posted for surgery for tendon repair which revealed complete tear of achillis tendon at insertion site and blackish discoloration of the tendon. A detailed history revealed blackish discoloration of urine on standing since childhood. From these alkaptonuria was suspected and further investigation confirmed the diagnosis. Ochronotic achillis tendon tear is a rare entity and can present with spontaneous Achilles tendon tear as the initial sign. The excision of ochronotic tissue with lengthening of tendon by z plasty was done. In case of spontaneous achillis tendon tear one has to keep in mind the unusual diagnosis of alkaptonuria.

Key Words: Alkaptonuria; Ochronosis; Achilles tendon rupture

INTRODUCTION

Alkaptonuria is a rare metabolic disorder due to an autosomal recessive mutation of homogentisate oxidase gene, located on the chromosome 3q21-q23. This defect results in deficiency of homogentisate 1,2-dioxygenase and accumulation of homogentisate in fibrous and cartilaginous tissues. This leads to degenerative musculo-skeletal deformities in the third or fourth decade of life. The characteristic feature of these patients is excretion of homogentisic acid in the urine. (homogentisic aciduria). The incidence of alkaptonuria is rare, which affects one in one million.

CASE REPORT

A lady aged 37 years presented to the out patient department with chief complaint of inability to plantar

flex the left ankle and pain over the posterior aspect of left ankle for a period of one week following a trivial trauma. On local examination revealed tenderness at tendo achillis insertion site with a gap, Thompsons test was positive. Ultrasound revealed the tear of achillis tendon with thickening .

The patient was posted for tendo Achillis repair; a posterior medial S shaped incision was made and the tendo achillis was exposed, where it was found to be avulsed at the insertion site with blackish discoloration of the tendon which was extending up to musculotendinous junction. The discolored part of the tendon was resected upto the musculo tendinous junction and tendon lengthening was done using z plasty, following which the limb was immobilized in an above knee plaster cast with knee in flexion and ankle in plantar flexion. The resected portion was sent for histopathological examination.

A diagnosis of alkaptonuria was suspected and a detailed history revealed that the patient had the symptoms of

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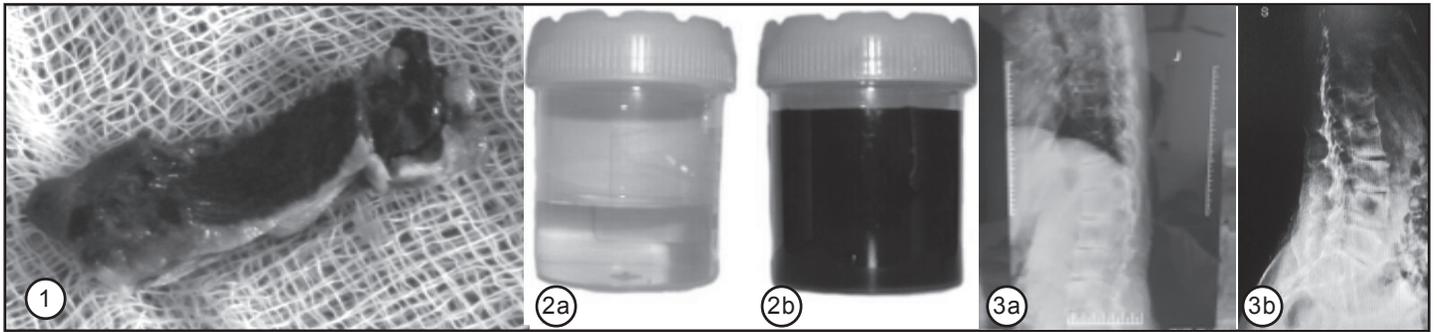


Figure 1: Blackish discoloration of the cut end of tendon **Figure 2a & 2b:** Ammonical silver nitrate test
Figure 3a & 3b : Narrowing of the disc space was followed by disc calcification and fusion of the disc

joint pain and on and off back pain. There was also history of darkening of the urine on standing.

The following test were performed:

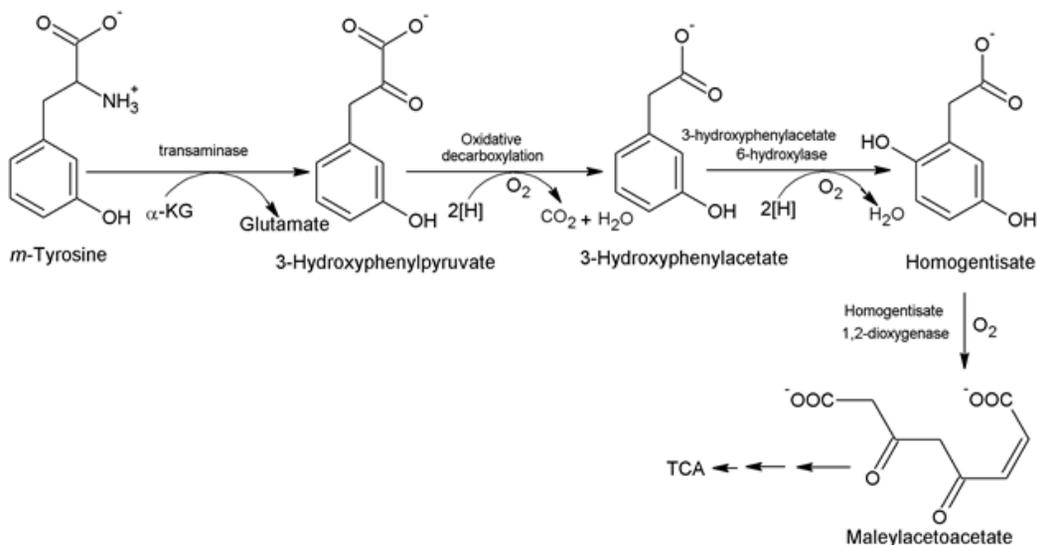
1. The urine turned dark on standing in atmospheric air for few hours.
2. The urine Benedict's test: The urine turned black on adding Benedict's reagent; then on heating slowly, a greenish yellow precipitate was formed which also turned black after few hours of standing.
3. The ammonical silver nitrate test: appearance of a ring of black precipitate was observed.
4. The ferric chloride test : appearance of a transient green colour on addition of ferric chloride to urine sample was observed.

The radiographs of the spine showed degenerative changes with decreased disc space and end plate sclerosis, degenerated intervertebral discs with calcification throughout cervical, thoracic & lumbar vertebra; generalised osteopenia was also seen with no involvement of the facet joints and sacroiliac joint. (Figure 1a & 1b)

ECHO showed-thickened mitral leaflets, mitral valve prolapse, mild mitral stenosis with regurgitation. The ejection fraction was 60%

There were no involvement of sclera or ear cartilage.

Based on forementioned features a diagnosis of alkaptonuria was made.



DISCUSSION

Alkaptonuria is a benign, rare inherited condition affecting 1 in 250,000 to 1 million people worldwide. This disorder usually appears early in life and skeletal deformities can occur after third decade of life.

The homogentisic acid oxidase gene provides instruction for making an enzyme called homogentisic oxidase. This enzyme helps break down homogentisate into maleyl acetoacetate. This results in derangement of metabolism of phenylalanine and tyrosine, which are building blocks of proteins. The mutations in HGD gene impair the enzyme's role in this process. As a result, homogentisate accumulates in the body.

Upon contact with air, homogentisate is oxidized to form pigment like polymeric material responsible for the black colour of urine. Although blood homogentisate levels are kept very low through rapid kidney clearance, over a period of time, homogentisate is deposited in cartilage throughout the body and is converted to the pigment-like polymer through an enzyme-mediated reaction that occurs chiefly in collagenous tissues. As the polymer accumulates within cartilage, a process that takes many years, the normally transparent tissues become slate blue, an effect ordinarily not seen until adulthood.

The basic defect in alkaptonuria is deficient homogentisate 1,2-dioxygenase activity. Nitisinone inhibits 4-hydroxyphenylpyruvic acid dioxygenase.

The earliest sign of the disorder is the tendency for diapers to stain black. In spine the symptoms in the lumbar and thoracic spine preceded those in the cervical spine. Narrowing of the disc space was followed by disc calcification and fusion of the disc. Pigmentation of the sclera and ear cartilage occurred only after the age of 30 years and is extremely variable in severity, some have tendon-related findings with thickened Achilles tendons and muscle tears after minimal trauma. Cardiac involvement includes aortic dilatation or cardiac-valve involvement i.e., aortic- or mitral-valve calcification or regurgitation on echocardiography.

Urinary and plasma homogentisate levels can be quantitatively measured using spectrophotometric and chromatographic method.

Therapeutic approach includes mega dose of vitamin C for the degradation of homogentisic acid. Antiresorptive drugs such as alendronate and ibandronic acid are not proven to benefit in ochronotic spine with osteopenia. The aim of treatment is to halt the gradual destruction of cartilage, arthritis, lumbosacral ankylosis, limitation of motion, and deterioration of bone. Recently, a new drug has been identified which inhibits 4-hydroxyphenylpyruvate dioxygenase which is the enzyme that produces homogentisic acid. This drug is Nitisinone (NTBC) whose chemical name is 2-(2-nitro-4-trifluoromethylbenzoyl) 1,3-cyclohexanedione and is sold under the brand name Orfadin. Nitisinone, at a dose of 1 mg/kg/day is safe and effective in tyrosinemia type 1 but has not yet been approved for use in alkaptonuria.

CONCLUSION

Ochronotic achilles tendon tear is a rare entity and can present with spontaneous Achilles tendon tear as the initial sign. Here excision of ochronotic tissue with lengthening of tendon by Z plasty done. In case of spontaneous achilles tendon tear one has to keep in mind the unusual diagnosis of Alkaptonuria.

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Case Report

Management of anterior fracture dislocation of shoulder by open reduction and internal fixation - a report of two cases

Ashwinikumar Mannur

ABSTRACT :

Two cases of Neer's four part fracture of proximal humerus associated with anterior dislocation of capital articular fragment in anterior direction managed by open reduction and internal fixation through deltopectoral approach using T plate in one case and Cobra plate in another case are reported. Results were good in first case and excellent in second case.

Key words: Fracture dislocation of shoulder.

INTRODUCTION

Fractures of proximal humerus associated with dislocation of large capital articular fragment usually in anterior direction account for about 42 percent of all three part and four part fractures of proximal humerus³. In young adults and middle aged individuals dislocation of head of humerus is common and fracture dislocation of shoulder is secondary to high velocity trauma like motor vehicle accidents. Open reduction and internal fixation of fracture dislocations of shoulder is the treatment of choice in active young adults and middle aged persons. We report two cases of fracture dislocation of shoulder one in an elderly and the other in a young man treated by open reduction and internal fixation.

CASE REPORTS

The first case was a man aged 62 years, painter cum attender by profession was hit by abus when he was crossing the street and sustained injury to his left shoulder. X rays showed comminuted fracture of proximal humerus with anterior dislocation of capital articular fragment.

The second case was that of a man aged 38 years old male adult marketing executive, fell from a speeding motor bike when he was riding pillion and sustained injury to his right shoulder. The X-rays revealed four part fracture of proximal humerus with anterior dislocation of capital articular fragment with extension of fracture in to upper third of humeral shaft. A CTscan with 3D reconstruction was done, which showed four part fracture dislocation of proximal humerus with fracture extending in to proximal third of shaft of humerus.

In both cases open reduction and internal fixation was carried out through anterior deltopectoral approach. First case was operated one week after the injury and the

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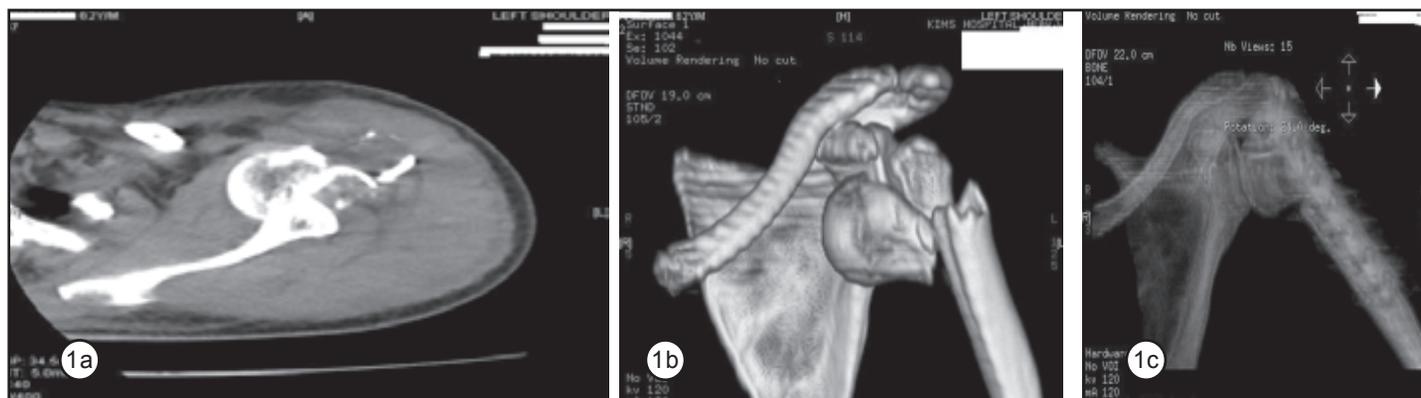


Figure 1a : Pre-operative CT scan; **Figure 1b:** Pre-operative 3D CT scan; **Figure 1c :** Post-operative CT scan (**Case 1**)

second case was operated 3 days after the injury. Patients were operated under general anaesthesia in supine position with affected shoulder elevated on a sand bag placed under interscapular region.

Anterior deltoid fibers were reflected down from their clavicular origin by using electrocautery to expose the greater tuberosity of humerus completely. Subscapularis insertion was cut from the lesser tuberosity and shoulder capsule was opened to release the capital articular fragment, which was buttonholed in the subcoracoid position. Capital articular fragment was reduced back from its dislocated position with help of a Hohman's retractor. All the proximal humeral fragments were assembled using long head of biceps as a guide and provisionally fixed using K wires under C arm guidance. 6.5 and 4mm cannulated cancellous were used for definitive fixation of all the fragments.

In the first case, a T buttress plate was used to fix, head and neck fragment to shaft of humerus. In the second case, interfragmentary screw was used to fix the shaft fragment to oblique proximal humeral fragment and a long cobra plate was used to fix the head and neck segment to humeral shaft fragment.

Proximal humerus thus assembled and fixed was reduced in to glenoid fossa. Capsule and subscapularis were repaired using 1-0 vicryl and anterior deltoid fibres were reattached to clavicle. A suction drain was kept. Skin was sutured with 2-0 Sutu pack suture.

Post operatively arm was placed in an arm pouch and gentle passive motion was begun on second post operative day. After six weeks post operatively, vigorous active physiotherapy with Codman's pendulum exercises followed by pulley exercises was started. This was followed by resistive elastic band exercises and dumbbell exercises to regain muscle strength and mass.

RESULTS

In the first case there was superficial wound infection which cleared with appropriate antibiotic i.e. piperacillin-tazobactam after culture sensitivity and in the second case a small area of skin necrosis which healed with usual wound care.

Both cases were followed up at regular intervals for two years and evaluation of results was done using Constant score^{1 2}, which assigns points for pain, muscle strength and activities of daily living. Muscle strength is measured with use of a one kilogram weight in patients hand and shoulder in abduction or if 90 degrees of abduction could not be reached, then in maximum active abduction as described by Constant.

Constant score is graded as poor (0-55 points), moderate (56 -70points), good (71to85 points),excellent (86-100 points).

Results were good (Constant score79 points at end of one year& 82 at end of second year) in the first case and

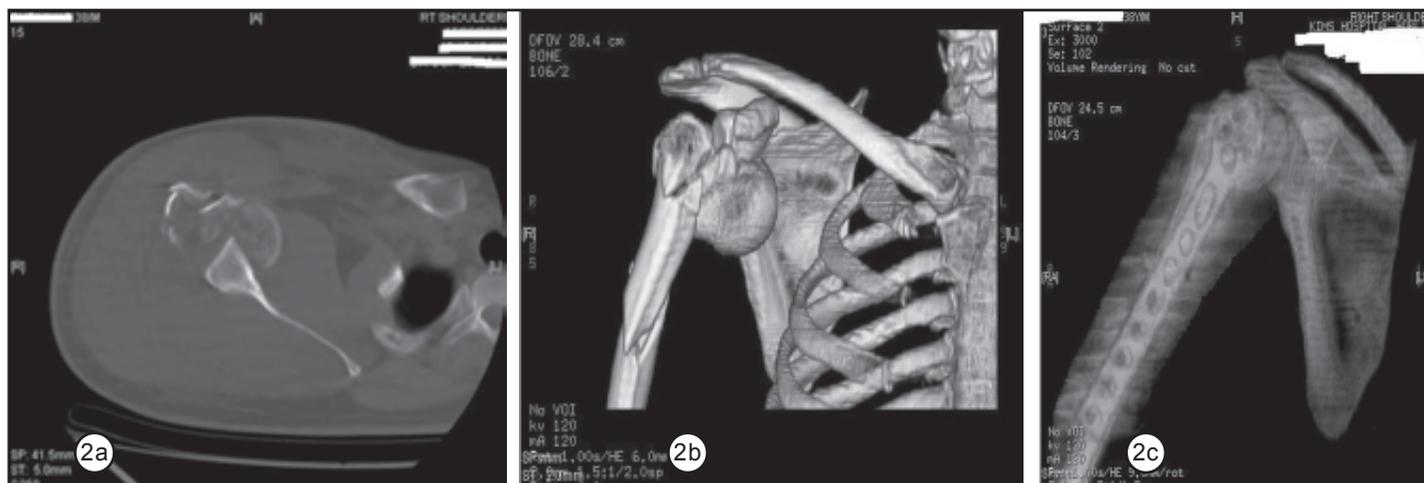


Figure 2a : Pre-operative CT scan; **Figure 2b :** Pre-operative 3D CT scan; **Figure 2c :** Post-operative CT scan (Case 2)

excellent in the second case (Constant score 89 points at end of one year and 93 points at end of second year)

DISCUSSION

Fractures of proximal humerus associated with dislocation of large capital articular fragment usually in anterior direction account for about 42 percent of all three part and four part fractures of proximal humerus³. Neer has reported in his series of 117 cases of three part and four part fractures of proximal humerus, 17 cases in which articular fragment was displaced in anterior direction in total number of 50 cases of three part fractures of proximal humerus, and 31 cases in which articular fragment was displaced anteriorly in 56 cases of four part fractures of proximal humerus.³

Codman⁴ first observed four fracture part pattern of proximal humerus in to humeral head (with articular surface) superior to anatomical neck, greater tuberosity, lesser tuberosity and humeral shaft.

Neer⁵ classified proximal humerus fractures depending on these four parts and also association of fracture with dislocation of capital articular fragment.

Cause of fracture dislocation of shoulder in elderly individuals is osteoporosis and even a minor fall results in grossly comminuted fractures.

In young adults and middle aged individuals dislocation of head of humerus is common and fracture dislocation of shoulder is secondary to high velocity trauma like motor vehicle accidents.

In old individuals treatment of choice for fracture dislocation of shoulder is stemmed hemiarthroplasty^{6,7,8}.

Open reduction and internal fixation of fracture dislocations of shoulder is the treatment of choice in active young adults and middle aged persons⁹. Deltopectoral approach is the preferred approach in open reduction and internal fixation of fracture dislocations of shoulder¹⁰ and implants used include blade plate^{11,12}, buttress T plate¹³, cloverleaf plate¹⁴, screw tension band¹⁵, tension band¹⁶, Semitubular plate¹⁷, Enders nails and tension band^{18,19}, Periarticular locking plate²⁰ etc. The reported prevalence of avascular necrosis of the humeral head following a four part fracture of the proximal humerus has ranged from 21%²¹ to 75%²². This high of prevalence of avascular necrosis of the humeral head is attributable to the injury pattern and its effect on the arterial blood supply of humeral head.

Arcuate artery is the main blood supplier to humeral head and arises as an ascending branch of anterior humeral circumflex artery. Arcuate artery supplies majority of humeral head and gives branches to greater and lesser tuberosity. Anastomosis exist between branches of arcuate artery, posterior humeral circumflex

artery and vessels from rotator cuff.^{23 24 25} Injuries to anterior humeral circumflex artery and its introsseous anastomosis can cause avascular necrosis even in absence of displacement of head. Further additional devascularisation of the head through surgical exposure and implant insertion increases the risk of avascular necrosis. Thus preservation of vessels at time of surgery is critical to prevent avascular necrosis of humeral head. Even if anterior circumflex artery is disrupted, protection of soft tissue attachments especially those containing the posteromedial vessels may preserve some flow to the humeral head. This fact may explain why results of open reduction and internal fixation may be better in case of three part and four part fractures associated with dislocation of large capital articular fragment dislocated in an anterior direction¹³. Even, in spite of the fact that, application of a plate requires more exposure as compared to that of circlage wires, theoretically increasing the risk of development of avascular necrosis of humeral head, application of plate lateral to the bicipital groove reduces the risk of injury to the anterior humeral circumflex artery¹³.

Open reduction and internal fixation of fracture dislocation of proximal humerus is a biologic approach albeit avascular necrosis of humeral head is the most common complication, but still shoulder can function satisfactorily even in face of avascular necrosis of humeral head¹³. Gerber et al reported that results for patients with avascular necrosis of head of humerus with anatomical and near anatomical reduction of proximal humeral fracture and without malunion are as good as for those for patients treated with hemiarthroplasty^{26 27}. With stable fixation, revascularization of humeral head is possible.

Although segmental collapse of the humeral head may occur, the functional results may be as good as those of primary arthroplasty.

Postoperative physiotherapy is the most critical step apart from primary fracture management and includes Codman's pendulum exercises followed by passive elevation of shoulder and rotations of shoulder with stick, pulley exercises, resistance band exercises and ultimately

dumbbell exercises to regain glenohumeral joint mobility and muscle strength which alleviate pain ultimately²⁸.

Two cases of four part fracture dislocation of proximal humeri managed by open reduction and internal fixation done in a supine position in a simple setup without use of beach chair position, with satisfactory results are reported, reemphasizing concept that open reduction and internal fixation of four part fractures associated with dislocation of humeral head, in stable, anatomical or nearly anatomical position may lead to revascularization of humeral head and may prevent late segmental collapse of humeral head. Results are good and excellent, highlighting the importance of careful operative technique, near anatomical reduction and vigorous postoperative physiotherapy carried later.

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Case Report

Broken guide wire protruding into the hip joint- a novel method of removal

Rajesh S Bhat, Harsharaj, Edward L. Nazareth, Jacob Chacko

ABSTRACT:

Broken implants, especially broken wires at difficult sites, may pose a challenge for the treating orthopedic surgeon. We describe a method for extraction of a broken guidewires from the neck of femur. We report two cases of broken guide wire removed successfully using arthroscopic instruments. The broken guidewires were removed successfully using novel bone endoscopy technique.

KEY WORDS: Broken guide wire, hip joint, bone endoscopy.

INTRODUCTION

A broken wire within a bone usually does not warrant removal. Rarely a wire may break inside the bone and protrude into the neighbouring joint, necessitating its removal in order to avoid damage to articular cartilage and consequent early degenerative arthritis. Several techniques have been described for the removal of a broken intramedullary nail. Bone endoscopy (actually medulloscopy) has been used for removal of a broken intramedullary nail, assisted closed reduction of long bone fractures, intramedullary loss of reamer, cement removal in revision hip arthroplasty, curettage in simple bone cyst, and direct visual confirmation of cannulated screw placement in slipped capital femoral epiphysis. Here, we describe a novel method for removal of broken guidewires from the hip joint. C-arm assisted method for removing a broken guidewire has not been described before in the English-language literature.

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CASE REPORT

Case 1: An young adult aged 25 years reported to us with history of road traffic accident about an year ago and had sustained subtrochanteric fracture femur on the right side, treated with proximal femoral nailing elsewhere. The previous x rays were not available. When the patient came to our out patient department, he was complaining of right sided hip pain. The pain was increasing on movements of the lower limb and walking, running etc. The X- ray of pelvis with both hips and right hip lateral were taken which showed united subtrochanteric fracture of right femur with proximal nail insitu and a broken guidewire in the head of femur which was protruding in to the hip joint.

After removing the proximal femoral nail implants, a guide was passed under C arm in the direction of the broken guide wire. Using the trippole reamer of the DHS instrments, the track was drilled. Then 30 degree scope was passed through the aperture and broken guide wire was noted and then the grasper was passed and broken wire was held which is confirmed by C arm imaging, it

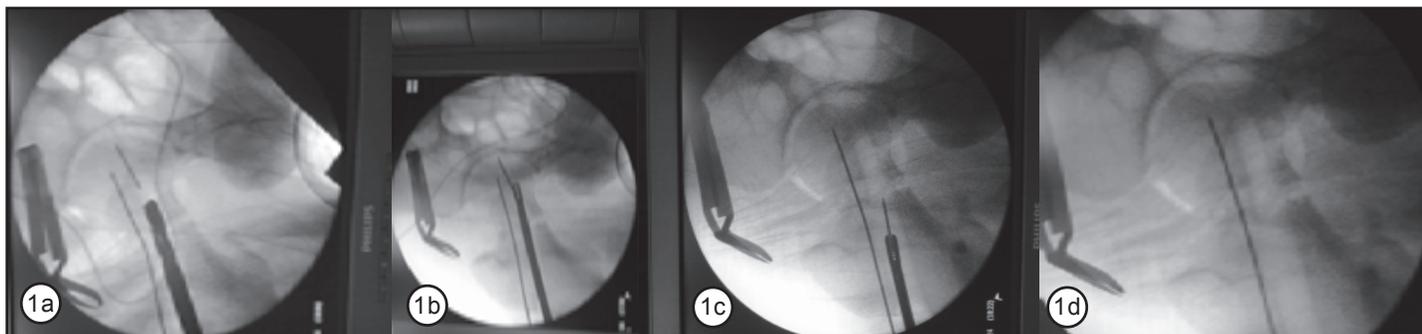


Figure 1a: Track drilling using the tripple reamer of the DHS instrments; **Figure 1b & 1c:** Grasper holding the guide wire and retrieval; **Figure 1d:** Broken guide wire removed.

was then removed. Post operative period was uneventfull. On follow up hip pain was not present.

Case 2: An young man aged around 21 years was posted for cannulated cancellous screw fixation for fracture neck of femur in the same day of the injury. During the surgery after passing the guide wire drilling, the guide wire broke. Then we removed the broken guide wire using bone endoscopy technique as described in the case report above. Later dynamic hip screw was put to him as the endoscopy hole was ideal for barrel screw of dynamic hip screw fixation. Post operative period uneventfull. After 3 months fracture united well. And patient returned to previous occupation.

DISCUSSION

A broken Kirschner wire/guidewire/drill bit usually does not require removal except in exceptional circumstances, like breakage with protrusion into the joint, intra-articular migration, or compression over neurovascular structures. Removal from difficult situations such as when there is intrasosseous breakage of the wire with protrusion into the joint can pose a dilemma, considering the magnitude of iatrogenic damage caused by an arthrotomy, especially in the hip joint. We considered various options for the extraction of the offending wire, including hip arthroscopic extraction, hip arthroscopic push down into the femoral head, and bone endoscopy-assisted extraction. An arthroscopic extraction of the wire would have required sufficient distraction of the joint and could

have been difficult to catch hold of the small protruding wire-tip using graspers. We also considered the hip arthroscopic push down of the wire into the femoral head to be a suitable option, but engagement of threaded end of the guidewire in the subchondral bone would have posed an obstacle. Considering the magnitude of damage caused by surgical dislocation of the hip, we thought it would be imprudent to use this method for the guidewire removal.

The term 'bone endoscopy' is a misnomer, in this technique we used arthroscopic instruments (30 degree scope and arthroscopic grasper). In the bone only one aperture is there unlike a joint or abdomen where multiple opening can be done for introducing instruments and scope simultaneously. We passed the light source first, localised the broken wire then using arthroscopic grasper removed under C arm guidance for confirmation.

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Case Report

Irreducible dorsal dislocation of interphalangeal joint of hallux

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ABSTRACT

Dorsal dislocation of the hallucal interphalangeal joint with sesamoid bone interposition is a rare injury. Hallucal interphalangeal dislocation is ordinarily reducible via closed manipulation; but sesamoid interposition often renders this unsuccessful, and necessitates open reduction. We report here a case of a Miki Type 2 irreducible interphalangeal dislocation. Closed reduction was attempted, following the failure of which, open reduction was performed. The offending sesamoid was excised, and K-wiring of the affected hallucal interphalangeal joint was done. Successful reduction was confirmed with radiograph. At the latest follow up no residual functional disability was seen in the patient.

Keywords: hallux; interphalangeal joint; dislocation; sesamoid bone.

INTRODUCTION

Dislocation of the hallucal interphalangeal joint is an uncommon injury; with dislocation of the hallucal metatarsophalangeal joint being more common owing to its longer lever arm and greater mobility¹. Interphalangeal dislocation of the great toe is with presence of a sesamoid bone within the dislocated joint often mandates open reduction, due to the joint being rendered irreducible via closed methods^{1,9-11,14}. Being a rare injury, only 41 cases have been reported till 2002⁸, with only a few cases reported hence. A clinical incidence

of 13% was quoted by Davies MB et al⁶. Irreducible hallucal interphalangeal dislocations have been classified by Miki et al¹¹ into two types. Our patient presented with a Type 2 dislocation.

CASE REPORT

Our patient had a hyperextension injury at home, following which she presented with pain localized to the right great toe. Any attempted movement of the great toe (especially flexion at the interphalangeal joint), and applying pressure upon the great toe while walking, exacerbated the pain. On examination, the toe was seen to be swollen, with puckered skin and extension deformity at the hallucal interphalangeal joint. Tenderness was elicited locally and the range of movement was limited.

Subsequent radiographs taken revealed a dorsal dislocation of the hallucal interphalangeal joint of the left toe. A bony mass was seen in relation to the articular surfaces of the proximal and distal phalanges, which, at the time of surgery, was revealed to be a sesamoid bone.

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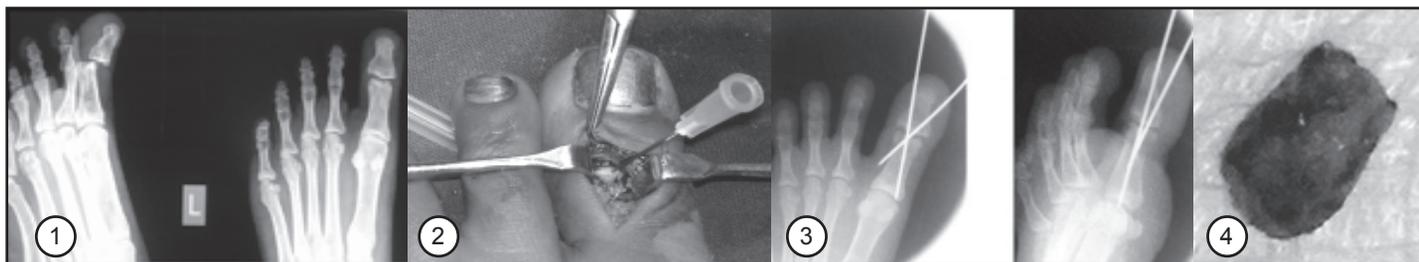


Figure 1: Pre-operative lateral and antero-posterior radiograph showing the interposed sesamoid bone in the proximal hallux interphalangeal joint of the left foot; **Figure 2:** Intraoperative view of the interposed sesamoid bone marked with the needle; **Figure 3:** a) Antero posterior and, b) Oblique intra-operative photographs showing good reduction after ORIF; **Figure 4:** Excised sesamoid bone.

Closed reduction was attempted with application of axial traction along the affected toe, but proved futile. Open reduction and internal fixation was then planned. It was done under spinal anesthesia. A dorso-lateral incision was made and the edges of the incision retracted. The tendon of the extensor hallucis longus tendon was exposed and subsequently retracted. The capsule of the hallux interphalangeal joint was exposed and incised. The interposed sesamoid bone was removed, and the joint was stabilized with the help of K-wires, and the wound closed in layers.

DISCUSSION

Sesamoid interposition causing irreducible dislocation of the proximal hallux interphalangeal joint is a rare type of injury, and is a known cause for diagnostic confusion. Studies by Bizarro et al², Masaki T.³, Yanklowitz and Jaworek⁵, and Valinsky et al⁴ have stated that the radiographic and anatomic incidence of hallux interphalangeal sesamoid are different, with the former (4.3-93%) being lower than the latter (50.6-95.5%). Such dislocations, normally reducible via closed manipulation, are rendered irreducible due to the bony block offered by the sesamoid bone. Miki et al¹¹ described anatomic details of the irreducible dislocation of the interphalangeal joint of great toe.

According to this, there are two types of irreducible dislocations depending upon the position of the displaced volar plate, including the sesamoid. In the type I dislocation, the sesamoid is entrapped within the joint,

and radiography reveals wider joint space, good alignment of phalanges, and intra-articular displacement of the sesamoid. In type II dislocation, the sesamoid bone is located over the proximal phalangeal head and radiographs reveal narrower joint space or overlapping of phalanges and hyperextension of the distal phalanx. The patient in present case report had type II dislocation.

Though seemingly benign, interphalangeal sesamoid bones have far reaching implications, and can often result in changes to the biomechanical function of the interphalangeal and metatarsophalangeal joints of the great toe⁷. Associated with these biomechanical changes are several, potentially debilitating clinical pathologies that range from hyperkeratotic plantar lesion to the rare irreducible interphalangeal joint dislocation⁸.

The mechanism of dislocation of hallux interphalangeal joint is known to be a combination of axial loading with hyperextension force¹⁴. Closed manipulation can reduce such dislocations satisfactorily. But frequently open reduction is needed¹⁴. Various approaches have been described to access the affected joint; namely the dorsal, plantar, medial, and dorso-lateral approaches^{9, 11, 12, 15, 16}. A dorsal approach affords easy exposure¹. Some authors have advocated excision¹⁵ of sesamoid bone while others preserved it¹⁰. Recently, percutaneous approach in reduction of an incarcerated sesamoid in the interphalangeal joint has been described¹³. Post reduction stabilization by means of bulky dressing¹, splinting¹¹, Kirschner wire⁹ and a short leg cast¹¹ have been described.

CONCLUSION

Although removal of sesamoid might have a negative effect on the biomechanics of the hallux, in most cases a complete recovery is made⁶. We have excised the sesamoid bone through dorsal approach and stabilized the reduction with a Kirschner wire and found the management satisfactory in the present case as no post-operative complication or disability was observed.

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Case Report

Soft tissue cover and extensor mechanism reconstruction using gastrocnemius flap in complex knee defect

Latheesh Latheef; Terence Derryl L Dsouza; Rakesh Sera

ABSTRACT

Reporting a case of traumatic infected loss of extensor mechanism of right knee due to a defect of about 2cm of the patellar tendon treated with debridement and medial gastrocnemius flap for covering the defect as well as for reconstructing the patellar tendon. Patient was immobilized post operatively in a above knee slab for 4 weeks and then gradually mobilized. At 2 months follow up patient had a good range of movement at the affected knee with flexion ranging from 10-80° and complete resolution of infection.

Gastrocnemius flap has been widely used to reconstruct extensor mechanism defects following radical tumour debridement surgeries or knee arthroplasty. However the usefulness of this technique to cover traumatic/infected extensor mechanism defects is under reported. This report is to highlight the importance of this technique in post traumatic infected cases of patellar tendon loss resulting in a good post operative outcome.

Key Words: Extensor mechanism defect; Gastrocnemius flap

INTRODUCTION

Chronic non healing wounds over the anterior aspect of the knee joint exposing the bones and associated loss of extensor mechanism is a challenging problem to the treating orthopedic surgeon¹.

In these circumstances the surgeon is confronted with two problems: first, providing adequate soft tissue cover to prevent osteomyelitis of the underlying bone and the second, reconstruction of the extensor apparatus. Soft tissue cover is achieved by using local muscle flaps² and

extensor apparatus is reconstructed using different techniques including use of allografts, synthetic grafts or autologous tissues with their advantages and disadvantages.^{3, 4}

The current case report describes a technique of simultaneous repair of soft tissue loss at the knee region and repair of the defect of patellar tendon using a musculotendinous unit of gastrocnemius muscle. This single stage surgical procedure has the dual advantage of providing functional reconstruction of the extensor apparatus and providing adequate soft tissue cover simultaneously.

CASE REPORT

A man aged 37 years presented to our out-patient department with a discharging wound along with restriction of movement at right knee for the previous two months duration. Four months ago the patient had

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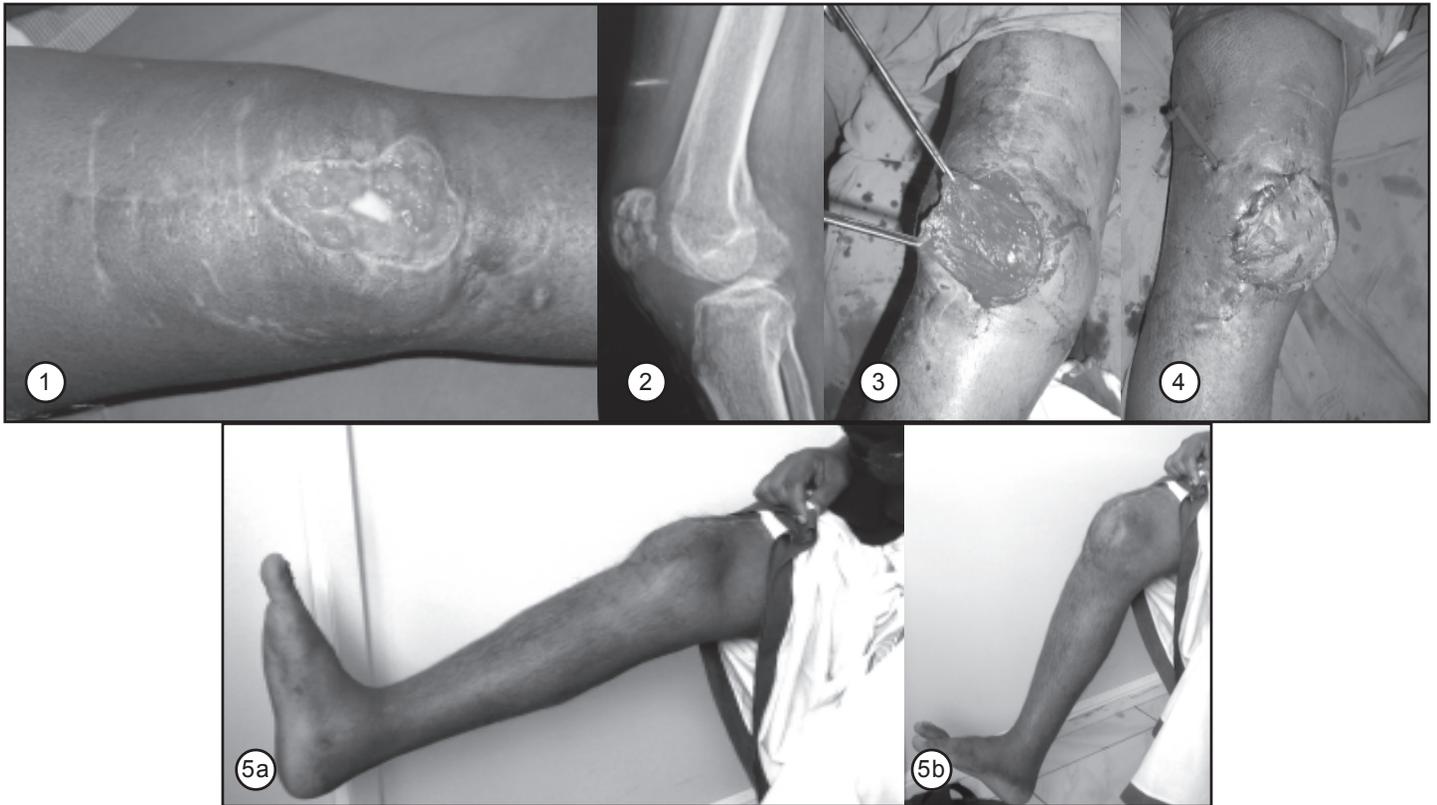


Figure 1: Pre-operative photograph showing the a discharging wound

Figure 2: Pre-operative X-ray showing uniting fracture patella

Figure 3: Medial head of gastrocnemius, isolated and levered across the wound

Figure 4: Muscle pedicle then covered using a split thickness skin graft

Figure 5a & 5b: At 2 months follow up patient had a good range of movement at the affected knee

suffered a closed fracture of the right patella following a road traffic accident. He had undergone primary fixation using tension band wiring. Post operatively patient had developed infection at the surgical site for which wound debridement and implant removal was done.

The examination revealed an infected wound over anterior aspect of right knee measuring 6cmx4cm exposing the underlying patella and a patellar tendon defect measuring 2cms. The range of motion at right knee was 0-10 degrees.

Under spinal anesthesia patient was positioned in supine position. Tourniquet was applied and the right lower limb was prepared and draped. Thorough wound debridement was performed leaving behind a soft tissue defect of 7cmx5cm and a patellar tendon defect measuring 2 cm.

Mid-line incision given about 10cm over the calf to expose the medial head of gastrocnemius. Medial head was isolated and divided at its musculotendinous junction and levered across the wound over the patella under a skin tunnel. The aponeurotic undersurface of the gastrocnemius was sutured to the remnants of the patellar tendon and rest of the muscle utilised for soft tissue coverage of the wound. Muscle pedicle then covered using a split thickness skin graft harvested from the contralateral thigh.

Patient was immobilized post operatively in a above knee slab for 4 weeks and then gradually mobilized with a ROM brace. At 2 months follow up patient had a good range of movement at the affected knee with flexion ranging from 10-80° and complete resolution of infection.

DISCUSSION

Complex defects over the anterior aspect of the knee exposing the patella with extensor tendon loss pose a reconstructive challenge. The problem can be tackled by the classical method of tendon reconstruction using autologous tendons, allografts, or synthetic grafts followed by soft tissue cover using gastrocnemius flap⁵ in a staged manner. The exposed bone and infection further compounds the problem.

We present the outcome of single staged reconstruction of extensor mechanism and soft tissue loss. Here the medial gastrocnemius muscle is transposed to cover the anterior surface of knee, the middle third of musculotendinous unit with a fairly thick aponeurosis on its deep aspect to overlay the joint. This conveniently enables the surgeon to replace the defect in the patellar tendon simultaneously providing adequate soft tissue coverage for the wound. This procedure also reduces the infection rate and delayed healing seen during usage of non vascularized graft material for tendon reconstruction.⁶ Physiologic healing with well vascularized tissue promotes early mobilization with better functional outcomes similar to previous reports.^{7, 8}

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Case Report

Total knee replacement in a patient with peripheral vascular disease

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ABSTRACT

Patients with osteoarthritis of the knee requiring total knee replacement often have other comorbidities. It is important to assess the vascularity of the limb, as many patients have associated atherosclerotic peripheral vascular disease. Such patients require special attention during intraoperative and postoperative period to prevent major complications.

We present a man of 65 years with osteoarthritis of the knee with associated diabetes mellitus, hypertension, ischaemic heart disease and atherosclerotic peripheral vascular disease with absent peripheral pulses who was managed with total knee replacement. A thorough search of literature was done to know the importance of vascular consultation, use of tourniquet, assessment of vascularity of the limb in the postoperative period and steps to avoid complication like a vascular catastrophe. Patient was managed accordingly and had an uneventful recovery with good result.

All patients with absent peripheral pulses should undergo doppler scan, an angiography and a vascular surgeon's opinion before surgery. Tourniquet should be avoided during surgery, a meticulous surgical technique should be followed and patients should be monitored closely in the post operative period for signs of ischemia and emergency revascularization procedures should be done if necessary.

INTRODUCTION

Patients undergoing total knee replacement often have other co-morbidities and peripheral vascular disease is one among them. Many asymptomatic patients might be missed of this problem, if a thorough preoperative examination is not carried out. Arterial injuries are rare complications of total knee arthroplasty (incidence 0.03-0.17)¹⁻⁶, but can have devastating implications including amputation of the limb and mortality. Because of the relative poor vascularity of the surrounding structures, arterial injury can compromise wound healing in an already disadvantaged limb and can lead to deep

infection. In an ischemic limb, further injury or deep infection can necessitate amputation¹⁰. The rate of amputation in such a scenario can be as high as 25 percent³. Identifying patients at risk and preoperative and postoperative evaluation of vascularity, and avoidance of tourniquet can decrease the rate of complications to a large extent⁹.

CASE REPORT

A man aged 65 years presented with osteoarthritis of both knees was planned for total knee replacement. Patient was found to have diabetes, hypertension and ischemic heart disease on preoperative evaluation. On thorough physical examination, patient also having absence of distal pulses in both limbs, although there

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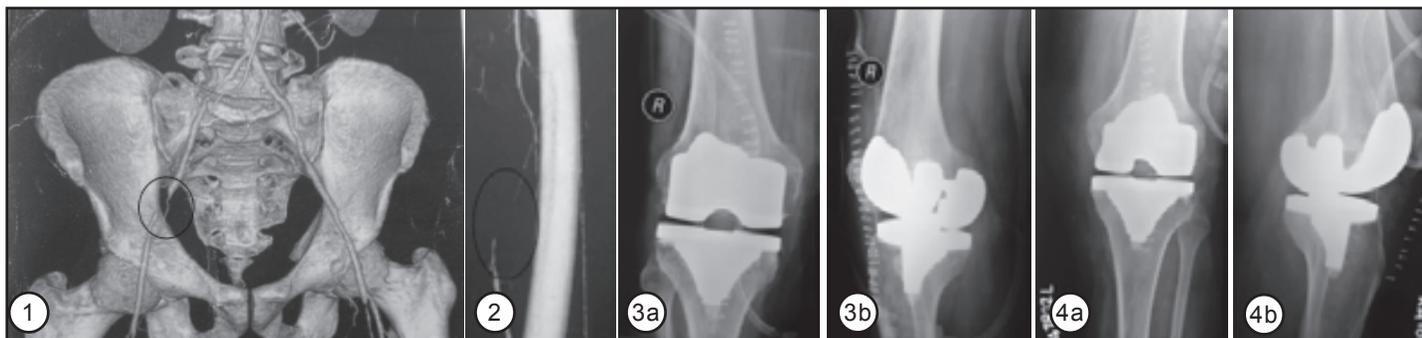


Figure 1: CT Angiogram showing a block in the right external iliac artery with collateral flow; **Figure 2:** CT Angiogram showing a block in the left superficial femoral artery; **Figure 3a and 3b:** Post operative Xrays of the right Knee; **Figure 4a and 4b:** Post operative Xrays of the left Knee

were no established signs of limb ischemia. An arterial doppler was obtained, which showed monophasic flow throughout in right lower limb suggestive of proximal disease and occlusion of superficial femoral artery in the left lower limb with a collateral flow. A CT angiogram showed multilevel occlusions with collateral flow. A vascular consult was done and clearance for surgery was obtained with a risk of postoperative ischemia requiring emergency revascularization procedures. Patients underwent staged bilateral total knee replacement. Tourniquet was avoided and a meticulous surgical technique was followed respecting the soft tissues preventing further vascular insult. Patient was assessed intraoperatively for the amount of blood loss and postoperative for signs of ischemia. Pain, sensation and movement of the toes, distal capillary filling, color and warmth of limb, spontaneous bleeding on pin prick and pulse oximeter measurements were assessed. Patient had an uneventful recovery without any postoperative complications.

DISCUSSION

Absent or asymmetrical pedal pulses; intermittent claudication, previous arterial ulcers or vascular surgeries are risk factors for postoperative arterial injury in patients undergoing total knee replacement^{3,4,6}. It is more important to detect asymptomatic or minimally symptomatic peripheral vascular disease as arterial insufficiency is one of the most important risk factor in

TKR. Pattern of pain associated with peripheral vascular disease can often overlap with that of osteoarthritis especially with that of a severe grade and an intermittent claudication and rest pain can be attributed to osteoarthritis itself. Therefore, a thorough preoperative assessment of the vascularity of the limb is of paramount importance^{4,8}.

Examination should include assessment of the discoloration of the skin, absence of hair and nail changes. Pedal pulses should be palpated and always be compared with the opposite side⁸. The popliteal fossa should be palpated for fullness or a mass³. Although baker's cysts are quite common in patients with osteoarthritis, a pulsatile mass or presence of a bruit should alert the surgeon towards the rare possibility of popliteal aneurysms, which can have devastating results if ignored. The reported rates of amputations in such cases vary from 20 - 50 percent⁴. All suspected cases of peripheral vascular disease should undergo a color Doppler and patients with abnormal findings should be subjected to an angiogram. Vascular consultation should be obtained for all cases and a clearance for surgery should be taken. Total knee replacement in such cases should be done only in centers where facility for vascular surgery is available and in coordination with them.

Ankle brachial index (ABI) is an important measure of limb ischemia. If the ABI is greater than 0.5, patients

can safely undergo a total knee replacement without the need for further investigation, but with the risk of postoperative ischemia. Those with an ABI of less than 0.5 should undergo an arterial bypass either before or immediately after the surgery⁵. The mechanism of injury can be either a direct or an indirect injury to the vessels. Indirect injury with thrombus formation is the usual mechanism of injury in an already compromised vessel and most of them are associated with the use of a tourniquet^{4,6}.

Postoperatively patients should be assessed for signs of ischemia. Pallor, temperature, capillary refill, spontaneous bleeding on pin prick, excessive pain, paraesthesia, paralysis and distal pulses should be looked for^{3,11}. It might be difficult to interpret many of these signs in a postoperative scenario, especially in patients under regional anaesthesia. A doppler study should be done and ABI should be measured. Emergency vascular consultation should be obtained in patients with abnormal findings^{3,11}. Angiography and revascularization should be done wherever indicated at the earliest⁵. Prognosis is likely to be poor in patients with delay in diagnosis or management¹². Even in high volume orthopedic hospitals there may be delay in diagnosis of arterial injuries. Calligaro Et al reported a delay of 1-5 days in detection of postoperative vascular injuries in 44 per of patients¹³.

CONCLUSION

All patients planned for total knee replacement, with absent peripheral pulses should undergo doppler scan, an angiography and a vascular surgeon consultation before surgery. Tourniquet should be avoided during surgery, a meticulous surgical technique should be followed and patients should be monitored closely in the post operative period for signs of ischemia and emergency revascularization procedures should be done if necessary. Failure to detect patients at risk preoperatively or delay in diagnosis of a vascular injury in the

postoperative period can have devastating results including amputation and mortality.

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