

Fellowship report

Depuy Johnson and Johnson Indian Orthopaedic Association Foreign Fellowship 2004

I am honoured to submit the report of the Depuy Johnson and Johnson of Indian Orthopaedic Association foreign fellowship 2004. At the outset I would like to thank our past President, Indian Orthopaedic Association, Dr. Praveen Kanabar, Our Hon. Secretary, Indian Orthopaedic Association Dr. H.K.T. Raza, and the Fellowship Secretary Dr. Shantaram Shetty for having selected me for this prestigious fellowship. I would also like to thank Prof. R.H. Govardhan, Past President of Tamilnadu Orthopaedic Association and Mr. Edward, Regional Manager, Depuy Johnson and Johnson Company for helping me to arrange the centre of training.

I started from Chennai on the evening of 15th January 2005 to France via Dubai. On reaching Charles De Gaulle Air port at Paris on 16th January 2005 I was picked up and taken to Bois Guillaume a small town beside Rouen about 170 kms from Paris. Bois Guillaume is of historic value as it was here Joan of Arc lived and was burnt to death. I was received at Hotel Eden by Dr. Jean Luis Briard, renowned joint replacement surgeon attached to Clinique des Cedres a 100 bedded trust hospital.

The training programme started every morning at 7.45 am sharp when Dr. Briard picked me up from my hotel room. The day started with ward rounds which was very informative. I was impressed by the importance given at the center to post operative pain relief which led to earlier rehabilitation of the patients. The way Dr. Briard moved with the patients in the wards and attitude of the patients who were mostly elderly individuals needs special mention. The ward rounds concluded with a visit to the physiotherapy department which was very well equipped. I had the opportunity to observe the patients who had undergone total knee replacement being mobilized very effectively. I was surprised to see the operated patients in the hydrotherapy pool as early as the sixth day.

The operation days (Monday, Wednesday and Friday) were really hectic. Dr. Briard starts to operate by 9.00 am and continues till late evening. I had the opportunity to wash up for every case. It was a treat to watch Dr. Briard operate. I assisted around 15 total knee replacements and 8 unicompartmental

knee replacements. The navigation system was used in a few cases. In addition arthroscopic surgeries of the knee were performed. The method of managing difficulties which arise during total knee replacement surgeries were well demonstrated by Dr. Briard. On a few occasions I had the opportunity to assist Dr. Pascal Vie, another joint replacement surgeon attached to the same institution.

The out patient services (Tuesdays and Thursday s) started at 9.00 am and went on till late night. Total knee replacements with 10-15 years follow up were demonstrated. Complications following total knee replacement were seen and their management discussed. A number of sports injuries to the knee joint were also seen in the out patient services and the appropriate management discussed. The day ended with a planning session for the next day's surgery cases. I also visited the Radiology department where I was shown the latest radiological procedures.

Every evening I was dropped in my hotel room by Dr. Briard. Dr. Briard was kind enough to take me home for dinner on a few occasions after a days work. I can not forget the warm reception offered to me by Mrs. Briard during my visits to their house.

During the weekends I visited my relatives in Paris and and took the opportunity visit many sites of importance like the Eiffel Tower, Notre Dame Cathedral, the Arch of Triumph and Versailles Palace.

After completion of the fellowship programme I returned from Paris on 31st January 2005.

I am grateful to the Indian Orthopaedic Association for awarding me the fellowship and express my gratitude to Depuy Johnson and Johnson Company for their interest in promoting the cause of Orthopaedics.

Over all the training was very educative, informative, and useful. The fellowship visit to France was a very pleasant experience.

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Current concept review

Clinical audit in orthopaedics

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What is clinical audit?

“A systematic approach to quality improvement that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change”. This was introduced formally in the NHS (National Health Service) in the United Kingdom in 1993¹⁻⁵.

In other words – Clinical audit monitors the use of particular interventions, or of the care received by the patients against agreed standards. Any departures from the best practice can then be examined in order to understand and act upon the causes.

Effective clinical audit is helpful for health professionals, health service managers, patients and the public. It supports health professionals in making sure their patients receive the best possible care. It can inform the health service managers about the need for organisational change or new investment to support health professionals in their practice^{6,7,8}.

It helps to ensure the patients are given the best possible care and provides the public with confidence in the quality of the service as a whole.

History of clinical audit

During Crimean War Florence Nightingale and her team of 38 nurses applied strict sanitary routines and standards of cleanliness to the hospital and equipment, and with Florence's gift, kept meticulous records of the mortality rates among the hospital patients. The mortality rates fell from 40% to 2% after the changes were made. They were instrumental in overcoming the resistance of the British doctors and officers to Florence's procedures. Her methodical approach, as well as the emphasis on uniformity and comparability of the results of health care, is recognised as one of the earliest programs of outcomes management².

Ernest Codman became known as the first true medical auditor following his work in 1912 on monitoring surgical outcomes. Codman's “end result idea” was to follow every patient's case history after surgery to identify individual surgeon's errors on specific patients. Although his work is often neglected in the history of health care assessment,

Codman's work anticipated contemporary approaches to quality monitoring and assurance, establishing accountability, and allocating and managing resources efficiently².

Contemporary medicine

Despite the successes of Nightingale in the Crimea and Codman in Massachusetts, clinical audit was slow to catch on. This situation was to remain for the next 130 or so years, with only a minority of healthcare staff embracing the process as a means of evaluating the quality of care delivered to patients.

The National Institute of Clinical Excellence (NICE) in UK, has described the various aspects of the structure, processes, and outcomes of care are selected and systematically evaluated against explicit criteria. Where indicated, changes are implemented at an individual, team, or service level and further monitoring is used to confirm improvement in healthcare delivery².

What is the difference between clinical audit and research?

Audit and research are two different entities. As both share some common features there is a tendency to use them in conjunction. Clinical audit compares current practice to the standard practice. Research determines what constitutes the best practice.

The purpose of the audit is to assess one's performance. Audit tells us whether we are doing the things in the right way. An audit runs in a cycle. The steps in the cycle are setting standards, assessing the current performance, finding out the deficits, implementing the change and reassessing whether the standard is achieved. The statistics and methods are usually simple.

Research generates new idea and tells us about right thing to do. This is peer reviewed. It can be complex, needing full ethical standards and approval. The information generated from the research helps to set the standards of practice.

Clinical audit – a domain of clinical governance

Clinical governance is a framework through which medical organisations are accountable for continuously improving

the quality of their services and safeguarding high standards of care by creating an environment in which excellence in clinical care will flourish. A duty of quality was placed on NHS organisations in the 1999 NHS Act. This introduced corporate accountability for clinical quality and performance. Clinical Governance is a 'whole system' process which has a number of features⁹⁻¹².

- Patient centred care needs which mean that patients are kept well informed and are given the opportunity to participate in their care.
- Good information about the quality of services is available to those providing the services as well as to patients and the public.
- Variations in the process, outcomes and in access to health care are greatly reduced.
- NHS organisations and partners work together to provide quality assured services and drive forward continuous improvement.
- Doctors, nurses and other health professionals work in teams to a consistently high standard and identify ways to provide safer and even better care for their patients.
- Risks and hazards to patients are reduced to as low a level as possible, creating a safety culture throughout the NHS.
- Good practice and research evidence is systematically adopted.

The importance of the philosophy - patient centred, safety conscious, multi-disciplinary in delivery, is emphasised along with the methods to be used such as continuous improvement at a number of organisational levels tackling variation and using evidence.

Doctors in each speciality must take the lead in setting evidence based, achievable standards that can be monitored in their respective speciality. Ideally the monitoring should be performed by an independent clinician and during normal clinical activity. Once the standard of the service is identified, one needs to implement the change required to correct the deficiency in the service. One must be obliged to demonstrate that existing resources are being used as effective as possible. The solutions for the deficiencies must be innovative, cost effective and bring out improved care of the patients¹³.

To cite an example:

How to audit a poorly performing doctor?

It is the duty of a doctor in his clinical practice to demonstrate seven principles for being a good clinician. Good medical practice, good clinical care, teaching and training,

maintaining good relationship with patients, treating colleagues fairly, probity, keeping oneself healthy¹⁴.

To ensure these, a doctor needs to have appropriate attitude, knowledge and skills¹⁵. To enable them to meet their responsibilities for clinical governance they

1. Need to work in teams
2. Be constantly constructively self critical
3. Be committed to continuous professional development
4. Know how to avail themselves of and apply relevant best evidence
5. Meet the responsibility set out in good medical practice.

What are the barriers to clinical governance^{10,16,17} :

1. Poor fabric of building in which to deliver in patient service
2. Too few alternatives to admission of patient
3. Too few treatment options
4. Too little of integration of multidisciplinary follow up

Conditions which can lead to errors happening include high work load, too much complacency or exhaustion, inadequate knowledge, poor design, inadequate supervision, ability or experience to manage conditions, stressful environments among others, overestimating ones own skills etc.

Types of clinical audit¹⁸

Standards-based audit - A cycle which involves defining standards, collecting data to measure current practice against those standards, and implementing any changes deemed necessary.

Adverse occurrence screening and critical incident monitoring - This is often used to peer-review cases which have caused concern or from which there was an unexpected outcome. The multidisciplinary team discusses individual, anonymous cases to reflect upon the way the team functioned and to learn for the future. In the primary care setting, this is described as a 'significant event audit'.

Peer review - An assessment of the quality of care provided by a clinical team with a view to improving clinical care. Individual cases are discussed by peers to determine, with the benefit of hindsight, whether the best care was given. This is similar to the method described above, but might include 'interesting' or 'unusual' cases rather than problematic ones. Unfortunately, recommendations made from these reviews are often not pursued as there is no systematic method to follow.

Patient surveys and focus groups - These are methods used to obtain users' views about the quality of care they have received. Surveys carried out for their own sake are often meaningless, but when they are undertaken to collect data they can be extremely productive.

Perspective of clinical audit in orthopaedic practice

In the last 30 years clinical orthopaedics has seen major advancement in every field. This has come through refinements and improvements in skills, knowledge as well as technology. Because of these changes, we are facing an ocean of change in our training and education.

The true essence of surgical innovation and improvement has come through because of individual surgical experiences and new techniques with little evidence of clinical trials. The orthopaedic surgeon relies on multidisciplinary approach for developing a new technique or method of the treatment. These refinements need to be evidence based and accountable. The surgical learning curve and technical difficulty associated with a new technique is variable from individual to individual and also to country to country. The enormous amount of funding spent in developing new technology in the western world brings inequality in the orthopaedic community especially between the developed and developing world. Thus, the perspective of the clinical audit changes according to the economy or the healthcare budget of the country.

The surgical trials are often expensive and difficult to run¹⁹. Surgical trials present important challenges in design, including the difficulty of blinding, comparing operative and non-operative treatments, the ethical concerns related to surgical placebos, and the effect of learning curves and surgical expertise²⁰.

Without sponsorship and financial support surgical trials are simply impractical. Ethical approval for patient interventions becoming a well established hurdle towards scientific research in current orthopaedic practice¹⁹. To develop a meaningful audit one should be able to get access to literature evidence and then set a standard in the practise for improving patient care.

Role of evidence based orthopaedics in clinical audit

Orthopaedic surgeons want what is best for their patients. Determining best practice, however, is not always straightforward. Clinicians use many sources of information to determine treatment options for their patients. Surgeons rely in large part on their training. As surgeons progress through their careers, practice learned through training is

influenced by their own experience, the advice of colleagues, and their personal learning, including continuing medical education and the use of texts or the surgical literature. One of the more powerful forces in shaping best practice is, and should be, the surgical literature. The literature, however, is often contradictory^{21,22,23}.

Evidence based practice has given direction and magnitude for understanding the solution for a specific question whether in diagnosis, therapeutic or surgical interventions and outcome determination. Most peer reviewed indexed journals in orthopaedics requires an article to be based on the level of evidence. By using best scientific evidence, resources could be freed from what is deemed to be ineffective treatment in order to ensure a more effective service for all on the basis of principles of distributive justice²⁴. The practical implications of such a framework may result in the determinations overtly based on evidence, but covertly used as mechanism of rationing rather than rationalising the health care. The translating best research evidence to treatment for an individual patient continues to remain a challenge. Patient specific evidence is not always clear, and research evidence needs to be integrated with attitudes and values of clinical decision making process²⁵.

The levels of evidences are as follows in descending order

- Level 1a- Systematic review and meta-analysis
- Level 1b – Randomised Controlled Trials (RCTs)
- Level 2 – Cohort study
- Level 3 – Case control study
- Level 4 – Cross sectional study
- Level 5 – Case reports

It is highly desirable to have high quality RCTs for providing an evidence towards changing practice and existing practice. But it is clearly undesirable to undervalue anything that does not come in the form of a RCT²². In truth, lesser forms of evidence provide many insights, hail many breakthroughs and warn of impending disasters in ways which would be simply impossible with RCTs. Lower levels of evidence play an important part in generating hypothesis for RCTs.

Examples of Evidence based orthopaedics :

Example 1:

“Weekly Pin- Site care was as effective as a daily care in patients with external fixation” – Dahl et al (2004).

This study was designed as randomised unblinded controlled trial with outcome measures relating to infection rate and its severity. They found no difference between weekly or daily pin site care groups with an external fixator. The pin site infections are the most common feared complication associated with the use of external fixator. However because there is lack of evidence to guide the management of local skin wound at the pin site, the techniques of pin care remain anecdotal and of personal preference (Temple, 2004 – Cochrane database). This study which compares two different time intervals for pin care provides valuable information regarding no easily measurable differences between daily and weekly pin site care²⁶.

Example 2

“The Sliding hip screw is better than short femoral nails for extracapsular femoral fracture” – Parker MJ (2004).

This is a meta-analysis of 28 trials with operative details and fracture fixation complications as the outcome measures. In patients with extracapsular proximal femoral fractures, the sliding hip screw performs better than the short gamma nail. No advantage is seen with the intramedullary hip screw or the proximal femoral nail compared with the sliding hip screw. Limited evidence supports the use of the short intramedullary nails compared with the blade plate or condylar screw. On the basis of this review, the sliding hip screw remains as the “gold standard” for fixation of intertrochanteric hip fractures²⁷.

The above cited examples does relate to the best practice as evidenced in the literature. Surgeons involved in individual practices in the community has less time to attend to various learning facilities, and thus may resort to the few standard journals which may influence the decision making in different areas of Orthopaedics. A critical appraisal of the available literature is the first step towards developing a clinical audit procedure. One must assess the merit of the study and apply the changes implemented elsewhere in their own practice for improving the quality of patient care²⁸.

How to conduct an audit?⁵

Audit can be conducted essentially in stages as described below:

- Selection of a topic
- Specification of desired performance
- First data collection
- Comparison of performance against standards
- Implementation of the change
- Second data collection

Deciding a topic for the audit :

The topic is decided mainly according to the practice in unit. A corrective action is mandatory when unacceptable levels of performance have been identified or suspected which may define the process of clinical audit. A clinical audit question can range for a variety of diagnostic, therapeutic, and management issues. Having established that an audit can be justified, an additional question must be addressed, i.e. what is the aim of this particular audit?

The clinical issues can be the performance of a particular procedure in terms of outcome, or an existing disease situation. The following few examples could give some directions²⁹⁻³⁴.

Examples :

1. Increased post-operative infections
2. Open tibial fractures – acute management
3. Use of thrombo-prophylaxis in lower limb arthroplasty
4. Interval between admission and operation of a hip fracture
5. Adequacy of fracture fixation
6. Timing of fixation of acute ankle fracture dislocations
7. Mortality and Morbidity audits

The non clinical issues can range from diagnostic protocol to management issues.

Examples :

1. Out patient follow up (Loss of patients attendance and the reason)
2. Data maintenance in the wards (like fluid maintenance chart, accuracy of medical documentations)
3. General hospital medical records and database
4. Balance of patient volume and minimum time spent in physical examination
5. Risk assessment for tumours
6. Time of Residents training
7. Lead protection in operation theatres

Specification of the desired performance

Once aim has been established, we have to define clearly the level of desired performance. Performance is described in terms of criteria and associated standards. The criteria are defined as systematically developed statements that can be used to assess the appropriateness of specific health care decisions, services and outcome¹⁶. It is essential that the criteria are based on good quality research evidence.

The standard has been defined as the percentage of the events that should comply with the criterion³⁵. When standards are set they can be used as targets, which trigger action to improve performance. There may be particular local constraints that make the attainment of high standards difficult, eg. Limited resources or patients who are poorly compliant. Daniels and Sabin developed a framework for the “accountability for reasonableness” in the decision making process. The model would apply to all healthcare decision makers, particularly those who are faced with financial constraints pitched against an exponentially increasing demand³⁶. Sometimes a standard can be set just above current performance in order to serve as a stimulus to improvement.

First data collection

An assessment tool has to be designed in the form of questionnaire. It is desirable to have a questionnaire that is reliable and valid. These assessment can be made either for a specified number for patients or for a particular duration. After completing the list of patients, one must ensure they are representative sample of the population in question. Also, one must ensure that this data is reproducible and extracted by an independent observer. By tabulating the results a reasonable conclusion can be derived about the current performance.

Comparison of performance against standards

An answer to the following sets of questions has to be determined

1. Is there a deviation of the current performance from the available best evidence in the literature?
2. If there is a shortfall, what are the specific issues that need addressing?
3. Single or multiple issues to be addressed?
4. What steps need to be taken to address these issues?
5. Will implementation of the required issues improve the standard of care?

Implementation of changes

Once the audit has made clear why changes in performance are needed, one has to make practical plans to implement the change. The practical issues are related to the following questions

1. Who is responsible for implementing the change?
2. What is the precise change required?
3. How to develop the method to ensure a change does occur ?

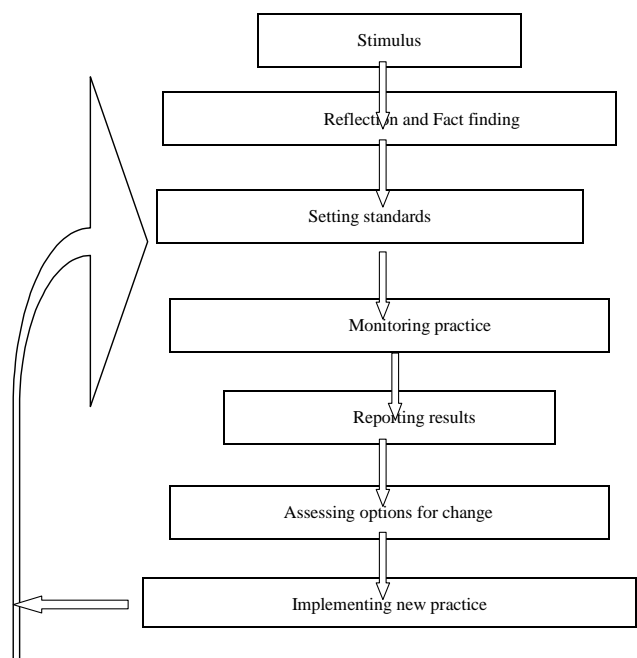
4. When is the time to collect a second set of data after the agreed changes have been implemented?

Different strategies can be adopted to implement the change according to the needs of the target population. A wide range of strategies are available – eg. Feedback, educational strategies etc⁵.

Collection of second data

Once the changes are implemented in the new practice, the performance has to be re evaluated by performing another audit at a stipulated time interval. If the desired improvement has been achieved then it technically completes an audit cycle. This is known as closing the audit loop. Sometimes a re-evaluation may provide information and identify the areas that can be improved further to meet the standards.

Flow chart of audit cycle



Characteristics of a good audit

A good audit constitutes good planning, systematic and adequate collection of the data, participation of all people in the audit process in the unit, and coordination between the individuals involved in the audit and presenting the conclusions of the work to the audit board. An audit board consists of the surgeon, practitioners, nurses, social services and local health authorities and managers. They all should be collectively responsible for delivery of good quality of care to the population in question by reducing health inequalities.

Uses of audit

- Sets a best practice in the hospital
- Improves patient confidence
- Helps patients to change the clinical performance of health professionals
- Formulates guideline or protocol
- Audit acts as link between learning and education
- An opportunity for the doctors to update the literature
- It can reduce unnecessary expenses – eg. Investigations not appropriate to the clinical diagnosis
- Enhances the dignity and respect of a doctor as well as gives self satisfaction
- Can generate a research study
- In the event of legal claims – result of an audit can be supportive
- When applying for a funding allocation – an audit can be stepping stone

Disillusion with the audit process

Conducting audit is a tedious process, needing manpower, funding and time. A busy surgeon has less time to devote towards well managed audit. They sometimes feel threatened by the prospects.

Audit may have methodological weaknesses such as poor criterion, inadequate sampling and failure to complete the cycle. Objective evidence of current performance is also required. Data extraction could be standardised and follow explicit rules, lest biased misinterpretation of the results may lead to implementation of a substandard practice.

Clinical audit in the Indian perspective

There is non uniformity of the standards of the care of patients from state to state, city to city and hospital to hospital. The governmental institutions run low in health budget annually. Only the premier institutes in the country which has autonomous organization and managers to run the health care activities have access to large funds. In the rural hospitals, the state of the art in orthopaedics and trauma surgery is virtually absent. Implementation of modern equipments in the metropolitan cities and their hospitals has led to the difference in public opinion.

Thus, a large pool of patients with financial capabilities looks towards the private sector for better health care.

There are differences between different institutes in the residency training in orthopaedic surgery. There are instances when one assumes that qualification means fully competent for a surgical skill, which is realised by many younger

surgeons. A large volume of the young generation of training doctors migrates to the metropolitan cities in search of more experience or they migrate to the west for greener pastures.

Thus, in an environment where the surgeons have the last say on setting the standard of care, we are probably creating a more non-uniform environment where standards of care may be in question.

There is lack of training and education of guidelines and management protocols for most disease situations. Even if there are guidelines set by the hospitals, there is lack of communication amongst members to do continuous teaching and training for improving the standards in the respective hospital, thus raising hope for the common people who run the democracy. Education and training of the allied medical professionals are inadequate and not everyone in the system takes equal interest in the quality of care. This makes a great divide between the skilled and non skilled personnel.

There is also lack of communication between the rural and urban areas which leads to ignorance in the rural community regarding the standard of practice for different clinical conditions. There is gulf of difference in providing funding between the centrally run and state run institutions.

Above all we have major issues in political and economic agendas which results negative attitudes and a resistance to change amongst the care providers and patients.

How to perform clinical audits against all odds?

Each institution and their respective departments should form a working committee under the able guidance of a motivated surgeon.

In larger institutions where record keeping is adequate, the head of the department or the orthopaedic surgeon concerned should be responsible for the audits pursued in the unit. One should employ a clinical audit coordinator who would be delegated for completing the audits under the supervision of the surgeon. The audit coordinator should be able to liaise with all staffs in the unit for successful completion of the projects. Once the change is implemented one has to meticulously collect the second set of data to show the change and complete the audit cycle.

In the smaller hospitals, one should be able to employ a clinical auditor who is employed by the state to maintain a database for the department and perform regular audit as required even on simple aspects of treatment e.g. fracture management protocols. One could complete an audit cycle with help of the surgeon and the superintendent of the hospital.

Link between audit, learning and education

Audit is a mode of learning. It holds a key part in continuing professional development (CPD). Continuing education is a narrow concept based on lectures, seminars, courses and conferences outside of work place. Nowadays, CPD encompasses continuing education and acquisition of new knowledge and skills in the clinical setting. One has enhanced management and communication skills. One improves in their learning skills, assessment skills and teaching skills. One should be able to effectively use information technology (which India is very advanced in) and attend more intensely to the social, cultural, ethical and psychological influences in a work place. This is not only because work place learning is less expensive, because of less loss of staff time, but primarily because it is probably a more effective way of bringing together research findings and practice, improving professional practice and promoting team development.^{5,20,37}

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The unipolar ASR : viable option in unsalvageable femoral head conditions in the young patient

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Background: The management of unsalvageable femoral head conditions in the young patient has remained an unresolved dilemma. Articular surface replacement of the hip has recently made some headway in terms of providing near-normal hip joint mechanics and function. However, this surgery has been limited to early stages of arthritis only with reasonable maintenance of head-neck congruity and morphology. Femoral neck fractures, osteonecrosis with large segment collapse, advanced arthritis with femoral incongruity, etc are traditional contraindications to the resurfacing technique.

Methods: We present here a report on our series of 20 cases of unsalvageable femoral heads in young patients (age range, 27 to 52yrs), over a twelve month period (Aug 2004 to Jul 2005), treated with the unipolar ASR prosthesis. Fifteen patients (two had bilateral hip pathology) had primary or secondary arthritis (degenerative, post-traumatic, ankylosing spondylitis and post-avascular necrosis) while three had old operated femoral neck fractures. All patients underwent hip replacement surgery using the Unipolar ASR prosthesis.

Results: Clinical and radiological results at 6-month follow up have been very encouraging and warrant further study. At an average of 4 months post-operatively, patients were able to squat, sit on the ground and perform light sporting activities.

Conclusions: The Unipolar ASR prosthesis is an extension of the articular resurfacing technique employing similar principles (large size bearings, metal-on-metal interfaces), and has incorporated the advantages of the uncemented technique. We propose that this technique be more frequently used so as to brighten the prognosis of the young active patient with unsalvageable hip conditions, especially in the Asian scenario.

Key-words: Unsalvageable femoral head; Unipolar ASR prosthesis; Surface replacement.

Introduction

Surface hip replacement, a bone-conserving alternative to total hip replacement, is a significant development in the evolution of hip arthroplasty¹. With a surface replacement, only the surface of the joint and a few millimeters below this are removed. These surfaces are replaced with a thin layer of metal, leaving the rest of the bone intact. The advantages are that the femoral head and neck are retained and thus no femoral stem prosthesis is necessary, and as a consequence, revision to a total hip when required is technically easy¹. As younger patients need surgery for hip arthritis, articular resurfacing surgery seems the ideal treatment, and is suggested in young people with degenerative hip disease, congenital hip dysplasia or Perthes' disease, with avascular necrosis and ankylosing spondylitis as extended indications¹. The greatest limitation is that it cannot be performed in conditions with head-cup size mismatch, or large head defects, or unsalvageable head conditions (collapse, fracture neck, etc.)².

Medium-term results from the McKee-Farrar metal on metal articulation, and short-term and medium-term results from contemporary metal-on-metal hip replacements have been very encouraging³⁻⁵, and form the basis for the new metal-on-metal, large bearing surface replacement prostheses. Articular surface replacement of the hip has made some headway in terms of providing near-normal hip joint mechanics and function. Modern metal-on-metal hip resurfacing was introduced as a less invasive method of joint reconstruction for the younger and more active group. Following the reintroduction of metal-on-metal articulating surfaces for total hip arthroplasty in Europe in 1988, Amstutz et al developed a surface arthroplasty prosthetic system using a metal-on-metal articulation⁶. The first 400 hips treated with metal-on-metal hybrid surface arthroplasties at an average follow-up of three and a half years showed that the majority of the patients returned to a high level of activity, including sports, and 54% had activity scores greater than 7 on the University of California at Los Angeles (UCLA) activity assessment system⁷. Kaplan-Meier survivorship curves demonstrated that the rate of survival of the components at

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Fig 1(a) Pre-op X-Ray of 42 yr old businessman showing secondary hip arthritis following avascular collapse of old operated fracture neck femur (cannulated cancellous screws), (b) Post-op X-Ray showing hip replacement with uncemented 'Corail' stem with Unipolar ASR

four years was 94.4%. No femoral radiolucencies were observed among the hips in which the metaphyseal stem was cemented. The early designs of these surface replacement hips now have 12-year survival figures that are comparable to cemented hip designs in the young⁷.

However, femoral neck fractures, and other unsalvageable femoral head conditions (viz. osteonecrosis with large segment collapse, advanced arthritis with femoral incongruity, etc) have limited this surgery to early stages of arthritis with relatively preserved femoral head congruity and morphology⁸. A modification of the articular resurfacing technique (with the primary objectives of providing long-lasting hips, permitting near-normal movements and using uncemented method of fixation) promises to extend these advantages to younger patients with unsalvageable femoral head conditions.

Materials and methods

Twenty cases of unsalvageable femoral heads in 18 young patients were treated with the unipolar ASR prosthesis, over a twelve month period (Aug 2004 to Jul 2005). There were 12 males and 6 females. The diagnosis was avascular necrosis (with > 1cm. collapse) in 9 patients (one had bilateral unipolar ASR replacement consequent to severe bilateral femoral head destruction). Two patients had severe rheumatoid arthritis (RA). One patient underwent bilateral unipolar ASR prosthesis for near-total bilateral hip ankylosis (ankylosing spondylitis). Six patients had secondary osteoarthritis with femoral head collapse (old healed acetabular fractures in 4, and femoral head collapse following fixed femoral neck fractures in 2 patients). The average age of the patients was 39 (age range, 27 to 52 years). In all cases, the femoral head was severely damaged or absent (unsalvageable, hence excluding the possibility of articular

surface replacement) (Fig. 1a). The criteria used to define the unsalvageable femoral head were femoral head defects > 1cm, limb shortening > 1cm, head-cup size mismatch (seen on pre-op radiological templating), wandering acetabulum (all incidentally contra-indications for the resurfacing technique). Desire of the patient for excessive hip movements was a prerequisite, as are cost constraints.

All patients were fitted with an uncemented 'Corail' femoral stem, attached to the unipolar ASR femoral head prosthesis with a taper sleeve adaptor (Fig. 1b). We used a curved posterolateral skin incision and the anterolateral modified Hardinge approach. Post-operatively, the patients were allowed nil weight bearing (NWB) crutch walking at day 3, partial weight bearing (PWB) at 6 weeks, and full weight bearing (FWB) walking with stick at 3 months ((for the unilateral cases). The 2 patients with bilateral unipolar ASR prosthesis were allowed in-bed mobilization for 6 weeks, then started on PWB walking with crutches, and permitted FWB walking without support after 3 months. Between 3 and 4 months post-operatively, patients were permitted to sit cross-legged, squat and indulge in driving and light sports (golf, table tennis).

Results

We had no cases of infection, DVT, hemorrhage or dislocation. There were two instances of femoral shaft splitting during insertion of the uncemented 'Corail' stem, but these were managed with cerclage wiring (Fig. 2a,b). This did not have any bearing on the end result in these patients.

Patients were evaluated at end of 3 months, 6 months and 12 months post-operatively. Average follow-up was 9 months (range, 6 months to 18 months). We evaluated



Fig 2(a) Pre-op X-Ray of 38 yr old college lecturer showing secondary hip arthritis following old operated AVN of femoral head (broken screw thread and fibular graft visible), (b) Post-op X-Ray showing hip replacement with uncemented 'Corail' stem with Unipolar ASR (with cerclage wiring for split proximal femur while inserting stem)

patients based on a modified scoring system (Table 1) taking into account Harris Hip scores, the return to normal hip functions and advanced hip functions (car driving and light sports). We achieved excellent early results in 16, and good results in 2, with all patients being able to sit cross-legged and squat. A detailed long-term follow-up of these patients is being carried out and will be reported in time.

Discussion

Total hip arthroplasty is less than ideal in young patients with hip arthritis. Surface hip arthroplasty offers a somewhat conservative treatment for this problem. The theoretical advantages are minimal bone resection, normal femoral loading, avoidance of stress shielding, maximum proprioceptive feedback, restoration of normal anatomy (offset, leg length & version), minimal risk of dislocation and easy revision when required^{6, 9-10}. Operative surgery for surface replacement is straightforward, requiring little preoperative planning and immediate weight-bearing postoperatively. Should failure occur, little bone stock loss is incurred and revision to a total hip replacement is as simple as primary hip arthroplasty^{6, 9-10}. There is no significant difference in the length of time needed to perform the surgery and no difference in the length of hospital stay if compared to a similar young group of patients having a more conventional hip replacement. Resurfaced femurs have shown 12-year survival rates close to 97% in the recent reports published, and long-term results are awaited⁷.

The metal-on-metal articulation has been established as a promising alternative in young patients in both older (McKee-Faraar hips) and contemporary studies. In a retrieval study on cobalt-chrome alloy McKee-Farrar (metal-on-metal) matching acetabular and femoral components at revision total hip arthroplasty at an average time of 16 years, the findings showed very low wear and loss of sphericity⁵. Polishing wear (type 1), fine abrasive (type 2), multidirectional dull abrasive (type 3), and unidirectional dull abrasive wear (type 4) of the articulating surfaces were identified. The mean percent area of femoral heads occupied by types 2, 3, and 4 wear was 18%, 5%, and 2%, respectively⁵. More recent analyses of the early series have shown the advantages of metal-on-metal to be better and have led to a renaissance of this articulation. Initially, stainless steel was used because it was easy to manufacture and polish. Current metal-on-metal bearings are based on cobalt-chromium-molybdenum alloys with varying carbon contents. Such bearings are self-polishing. Linear wear rates remain at the level of a few micron a year. An improvement in technology has increased the life span of the metal-on-metal THR-bearing system. This bearing concept probably permits the use of larger head sizes, to reduce the risk of impingement and luxations⁴. The low frictional torque

from the metal on metal bearings is entirely consistent with the clinical experience of historic metal on metal joints having lasted 30 years or more⁹. With metal-on-metal bearings, the volumetric wear has been reduced 20-100 times from those with polyethylene, and there is no penalty for the large ball size⁹. These devices are now conservative on the acetabular as well as femoral side. Hybrid or all-cementless fixation is arguably superior to earlier all-cemented devices. In a series on cementless articular resurfacings by Amstutz et al¹, the results up to 4 years have been complication-free, with an absence of pain and a return to high functional levels, including participation in sports. Although follow-up was short, surface replacement with the large ball size was found extremely stable, and dislocation rare⁶.

Reported complication rates have also been low. There has been no report of dislocation of the resurfaced hip in literature. Dislodgement of the acetabular component has been observed, possibly due to inadequate primary fixation, and which is easily correctable by appropriate component repositioning. Markedly reduced amounts of fat and marrow are seen on trans-esophageal echocardiography after resurfacing compared to conventional stem total hip replacement, thereby limiting thromboembolic complications. A recently published study¹¹ demonstrates the risk of osteonecrotic femoral head collapse following articular resurfacing surgery. In a study of 377 patients who underwent resurfacing arthroplasty, 13 were found to require revision; for fracture of the femoral neck in eight, loosening of a component in three and for other reasons in two. None of these cases had shown histological evidence of osteonecrosis in the femoral bone at the time of the initial implantation. At revision, bone from the remnant femoral head showed changes of patchy osteonecrosis in nearly all cases¹¹. From these established reports, important risk factors that have been identified for femoral component loosening are large femoral head cysts, patient height, female gender, and smaller component size in male patients⁸. Arthritic hips of limbs that are more than 1 cm shorter than the contralateral limb or those that have a comparatively low horizontal femoral offset are biomechanical limitations in the selection of hips for resurfacing¹².

The principles of the 'in-vogue' resurfacing arthroplasty are metal-on-metal articulation, large bearing surfaces and initial sturdy fixation. It only seems logical that an extension of these principles in unsalvageable femoral head conditions would lead to similar exciting results. The unipolar ASR femoral prosthesis is based on this belief. This prosthesis is an extension of the articular surface replacement technique employing similar principles (large anatomical size bearings, metal-on-metal interfaces) with proper use of the uncemented technique of fixation. Hips where the femoral head contains large collapsed areas / defects, femoral head fractures, coxa

Table 1. Grading of results on the basis of modified scale based on Harris Hip Scores, and return to normal and advanced hip functions

Result grading	Harris Hip Score	Return to normal hip functions		Return to advanced hip functions	
		Unaided walking	Car driving	Squatting / cross-legged sitting	Light sports activities
Excellent	> 90	Yes	Yes	Yes	Yes
Good	80 – 90	Yes	No	Yes	No
Poor	< 80	No	No	No	No

vara more than 90 degrees and weakened cystic femoral head/ necks¹³⁻¹⁴ (all primary contra-indications for resurfacing) are amenable to this prosthesis. Anticipated intra-operative limitations, such as inability to revise to smaller components, the risk of neck notching leading to fractures, and great limitation in cup-head size matching, are no longer applicable with the unipolar ASR[®] femoral prosthesis. However, factors such as patient selection, surgical technique, and durable fixation of the components remain critical as reliance is on uncemented fixation. The long-term survival reports of the McKee-Farrar metal-on-metal hip replacement testify to the promising future of this anatomical Unipolar ASR prosthesis. However, long-term studies of this prosthesis are not available at present.

There is another major concern about the extent and duration of the relevant “internal” exposure to Cr and Co ions. It is yet unclear whether the medium-term corrosion rate is high or, on the contrary, it becomes negligible, because of the continuous surface finishing. This exposure should be carefully monitored, in order to clarify the biologic effects of ion dissemination and, consequently, to identify risks concerning long-term toxicity of metals¹⁵.

With time, resurfacing hip replacement is providing fantastic opportunities to the young arthritic to lead a near-normal life. However, the experience and results with the unipolar ASR prosthesis is very limited. Preliminary experience identifies definite early advantages, and simultaneously underscores the importance of obtaining secure initial fixation. This metal on metal hip surface replacement procedure seems to be the answer to the burning issue of hip replacement in the young active population, where the femoral head is non-salvageable. We however need long-term evaluation and are waiting eagerly for medium and long term results to justify our excitement.

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Unicondylar knee arthroplasty in unicompartment osteoarthritis : early results

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Background: Knee Arthritis in most patients begins and remains confined to medial compartment. Unicondylar knee replacement (UKR) can be better alternative in these selected patients.

Methods: Eighty one consecutive unicondylar knee arthroplasties in 60 patients of isolated medial compartment arthritis were done using Allegrato unicondylar knee. Patients were followed up at 6-month interval with average follow up 1.8 yrs. Knee society score was used for comparative evaluation of these patients.

Results: The mean pre operative knee society score of 62 improved to post op. score of 94. No complication reported so far except one case of tibial base plate dislocation requiring re fixation. Our short-term results are good to excellent with 100 % survival at avg. follow up of 1.8 years.

Conclusion: UKA is better alternative with many advantages in selected patients of early symptomatic medial compartment arthritis. However proper patient selection improvised design, exacting surgical technique and experienced team with established center are must for uncompromising results.

Key-words: Unicondylar knee arthroplasty (UKA); Medial compartment arthritis (MCA); Unicondylar knee replacement (UKR).

Introduction

Osteoarthritis of knee is common affection in our country compared to western world. Even in United States, arthritis or rheumatism is a major and foremost cause of disability in adults (2.2 times compared to heart disease) ¹. The ICMR survey conducted in 1984-85 of elderly persons over 60 yrs of age attending geriatric clinics showed 40% suffer from diseases of locomotive system ². There are an estimated around 20 million people in our country suffering from symptomatic knee arthritis that requires some kind of

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treatment-either medical or surgical. The total cost of AORC (arthritis & other rheumatic conditions) in the United States in 1997 was \$86.2 billion (including \$51.1 billion in direct costs and \$35.1 billion in indirect costs), approximately 1% of the U.S. gross domestic product (GDP) ³. In most patients of osteoarthritis knee, involvement begins with medial compartment. In almost 70% of patient's arthritis remain confined to medial compartment till their death. These are a potential group of patients, which can be benefited from more conservative surgery in form of partial replacement surgery, Unicondylar knee arthroplasty when surgery is opted for management of arthritis. It is estimated that out of all the patients who have been advised for total knee replacement almost 30% of them can be well managed with unicondylar knee arthroplasty only.

Materials and methods

Patient selection: This retrospective plus prospective study was conducted to evaluate the results of unicondylar knee arthroplasty in patients of symptomatic medial compartment arthritis operated between July 2002 and February 2006 by a single surgeon at our institute. Eighty eight patients, 27 male and 51 female patients were selected having medial compartment arthritis⁴. One hundred and three unicondylar knee replacement surgeries (53 unilateral and 25 bilateral) were done using Allegrato unicondylar knee. Age of patients ranged from 40 to 78 years with average age of 52.5 years. Patients were selected after thorough clinical and radiological evaluation and only those with medial unicompartmental disease were selected.

Patients were graded according to classification proposed by Romagnoli⁵ for medial compartment arthritis (Table I).

Table I. Classification

Grade	Features	Recommended treatment
1	Joint space narrowing	AscopyHTO//unispace
2	Obliteration of joint space	HTO+A"Scopy/unispace UKA
3	Obliteration+translation+ mild PF involvement	UKA
4	As above _ ACL deficiency	UKA/TKA



Fig. 1 (a,b) X-rays AP and lateral view showing medial compartment osteoarthritis, (c, d) Post-operative X-rays, (e) Clinical photographs showing flexion at knee-joint.

Those patients with bi compartment or tri compartmental involvement, those with cruciate deficiency or with inflammatory arthritis were excluded. Those with more than 15° varus deformity and with flexion deformity more than 10° or passive range of motion less than 80° were also excluded. All patients were subjected to routine radiological investigation along with valgus stress view. Those with fixed varus deformity were also excluded from study⁴.

Pre-operative evaluation: On pre operative evaluation 76 knees were of arthritis grade 2 and 27 knees were of arthritis grade 3. Average pre operative varus deformity was 6 deg (range 4 to 12 deg). The range of movement was between 80 to 95 deg (avg. 85 degrees). Average preoperative walking distance was 1.1 Km (range 0.4 to 1.8 Km). Overall Knee society score preoperatively was from 44 to 72 with average of 62.

Operative technique: All patients were operated under regional anesthesia (spinal and or epidural anesthesia). Minimally invasive surgery was done using medial para patellar incision. Minimal soft tissue release was done.

Tibial cut was perpendicular to metaphyseal axis in frontal plane. Precaution was taken to avoid avulsion or fracture of cruciate ligament or intercondylar eminence. Posterior slope was kept between 0 to 3 deg in saggital plane.

Femoral resurfacing was done at right angle to tibial cut at the edge of medial supracondylar line. With knee in extension a mark was made at the edge of trial tibial component, which marked the superior limit for femoral component to avoid patellofemoral impingement. With this reference, femoral zig was used to make distal femoral condylar cut.



Trial reduction was done and thickness of tibial base plate selected to keep the residual knee alignment in under corrected position so as to avoid lateral compartment overloading. Osteophytes if any were removed from intercondylar notch. Patelloplasty was done when required based on per operative findings. Multiple drill holes were made on femoral side for better cementing and criss cross-superficial cuts made on tibial side for the same.

Pulsatile lavage wash was given to remove bone flecks and expose marrow cavities for cement penetration. Components were fixed using single pack of high viscosity cement. After seating tibial component, femoral component was inserted and knee extended with application of static pressure on implants till cement set solidly. After cementing a thorough pulsatile wash was given again. Anatomic closure was done with knee in 90 deg flexion with use of negative suction drain. Postoperative radiological evaluation was done in anesthesia recovery room.

Average operative time was 1 hour 5 minutes (from skin to skin). Total blood loss both intra operative and post operatively in suction drain was around 300 ml on an average.

Post operatively patients were put to foot pump and static quadriceps exercise on the same day of surgery after recovery of anesthesia. Prophylaxis for deep vein thrombosis was given

in selected very elderly patients or in whom there was a risk factor. Knee range of motion, hamstring stretching and quadriceps strengthening exercise was started as soon as patients were comfortable, usually on 2nd postoperative day. Full weight bearing walking was allowed with use of stick support. Special emphasis was laid on gait training. Almost all patients were discharged by 5th postoperative day (range from 3rd day to 7th day post operatively).

Results

Though routine evaluation was done a regular interval, at 6-month post operative thorough clinical and radiological evaluation was done and findings recorded for comparative evaluation for this study. Knee society score was used to compare the overall functional results. Knee society score improved to an average of 94 (range 90 to 96). Knee flexion increased to an average of 126 deg (range 114 to 142 deg). There was an excellent improvement in walking distance, with average 5.3 km (range 2.8 to 6.5 km). On radiological evaluation the tibiofemoral alignment ranged from 2 degree valgus to 4 deg varus; an average of 2 deg varus (Fig. 1). There was no evidence of osteolysis, loosening or change in position of component fixation on comparative radiological evaluation till date with one exception.

There were no major intraoperative or postoperative complications like fracture of tibial spine or cruciate injury. There is no single patient reported with infection so far. There was only one patient with complication where there was dislocation of tibial base plate at 1 year Follow up. This patient required re- exploration and refixation of base plate. No patient required revision to total knee arthroplasty or bilateral unicondylar knee. Using conversion in TKR as end point or failure results were 100% survivals at average follow up 2.2 years.

Discussion

Since in most patients of knee arthritis have predominantly medial compartment involvement, unicondylar knee replacement can be a better alternative to total knee replacement in selected patients. Advantages of unicondylar knee replacement are small incision, minimal soft tissue resection, shorter operative time, less blood loss, less chances of infection, better bone stock conservation (important consideration for future conversion to total knee replacement), option to convert to bi- unicondylar replacement if there is involvement of opposite compartment, rapid and more predictable recovery, more post operative range of motion

and overall higher patient satisfaction. Though our study is of short term follow up (avg. follow up 2.2 yrs), there are many published results world over that has established the role of unicondylar knee replacement surgery in management of early knee arthritis with predictable long term results (87% to 98% with 6 to 15 year follow up)⁷⁻¹⁴. According to results shown by Ramagnoli, there is 96.9% survival at 9-12 yrs and 90% at 14 years with his experience of 1000 UKA using Allegrato unicondylar knee^{5, 6}. Similar good to excellent results, 90% to 94% survival at 10 years, were documented by using Miller Galante unicondylar knee^{15, 16}.

Though high tibial osteotomy is considered as an alternative management modality in unicompartmental arthritis, the draw backs are, limited indications (in early grade 1/ 2 medial compartment arthritis), no long lasting and reproducible results (80% to 90% at 5years & 50 to 65% at 10 years)¹⁷⁻²². and compromised results of future definitive surgery (results of TKA after HTO are comparable to revision surgery and not with primary TKA). We obtained good to excellent early results of unicondylar knee replacement surgery. However thorough clinical and radiological evaluation for strict patient selection, improvised design, improved surgical technique, an experienced team and a well-established center are pre requisites for achieving uncompromising results.

Unicondylar knee replacement is an attractive option with better predictable results in management of early osteoarthritis knee or symptomatic unicompartmental disease. As no disease modifying drugs are available surgical option has to be resorted at some point of time, UKA is a better alternative to high tibial osteotomy or total knee replacement with many advantages. However proper patient selection, better surgical technique, better design and an established replacement center are pre requisites to achieve reproducible and long lasting results.

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Efficacy and safety of instrumentation in caries spine

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Background: Spinal instrumentation may be used in tuberculosis of spine for prevention or correction of deformity.

Methods: Thirty eight patients of caries spine underwent surgery with spinal instrumentation in the last 3 years. Out of these patients, 30 cases have completed a minimum follow-up of 9 months (Range 9 to 39 months, mean 12.8 months). The regional distribution was 1 in the craniocervical junction, 7 in the subaxial cervical spine, 3 in the cervicothoracic junction, 3 in the thoracic region, 4 in the thoracolumbar junction and 8 in the lumbar region and 1 in the lumbosacral junction. All the cases had anterior lesions except one, which had both anterior and posterior lesions. All of them had decompression, debridement of the lesion and instrumented fusion. Indication of surgery was caries spine with neurodeficit and /or osseous destruction and deformity, which was not responding to conservative treatment of one month.

Results: Results were analyzed keeping in mind the clinical and radiological criteria. The former included recovery of pain, and neural deficit with a feeling of general well being. The latter included correction of deformity and evidence of fusion. There was no case which had wound healing/infection related problems. Complications included one case of implant failure and one case of transient neurological deterioration. Results were excellent in 20, good in 5, fair in one and poor in one patient. Majority of the patients were very satisfied with the surgery and all the patients had full anti-tubercular chemotherapy for one year.

Conclusions: In properly selected patients, spinal instrumentation is justified because of its safety and efficacy in achieving deformity correction and solid fusion.

Key-words: Spinal tuberculosis; Spinal instrumentation; Fusion; Kyphosis; Neurological deficit.

Tuberculosis in the spine is still extremely common in our country and the fact that it is basically a "medical" disease cannot be over-emphasized. The role of spinal instrumenta-

tion in caries spine has been addressed to in the current literature on two issues. The first issue to be considered is about putting in a foreign body in an infected zone. The first clinical and biological study of the same was published a dozen years back and was shown to be experimentally safe with the added newer generation antitubercular medicines¹. Subsequently it was questioned whether it is better to put in posterior hardware only given the fact that the infected zone is basically the anterior structures because posterior element tuberculosis is quite uncommon². Subsequently it has been shown that anterior instrumentation also is very safe so far as the problem of persistent infection relating to the usage of foreign body is concerned^{3, 4, 5}.

Potential advantages of spinal instrumentation are correction of deformity, increased rate of fusion, especially multilevel spinal fusion, early mobilization, wider resection of unhealthy bone without fear of instability and addressing the problem of instability when present.

Materials and Methods

Thirty eight patients of caries spine underwent surgery with spinal instrumentation in the last 3 years at our institute. Out of these patients, 30 cases have completed a minimum follow-up of 9 months (Range 9 to 39 months, mean 12.8 months). Three of them were not available for follow-up and hence have been excluded from the study. So the present study constitutes 27 patients (12 males and 15 females) of caries spine.

Adjunctive spinal instrumentation was used for the following indications.

1. Neurological deficit not responding or worsening with anti-tubercular drugs (or rapidly progressive gross neurology at initial presentation)
2. Bony destruction leading to kyphotic deformity (>40 degrees) +/- Instability.
3. The need for establishing the diagnosis

Generally speaking, gross osseous destruction (especially in more than 2 vertebrae involvement) and kyphosis more than 40 degrees or additional frank instability were the absolute indications of instrumentation.

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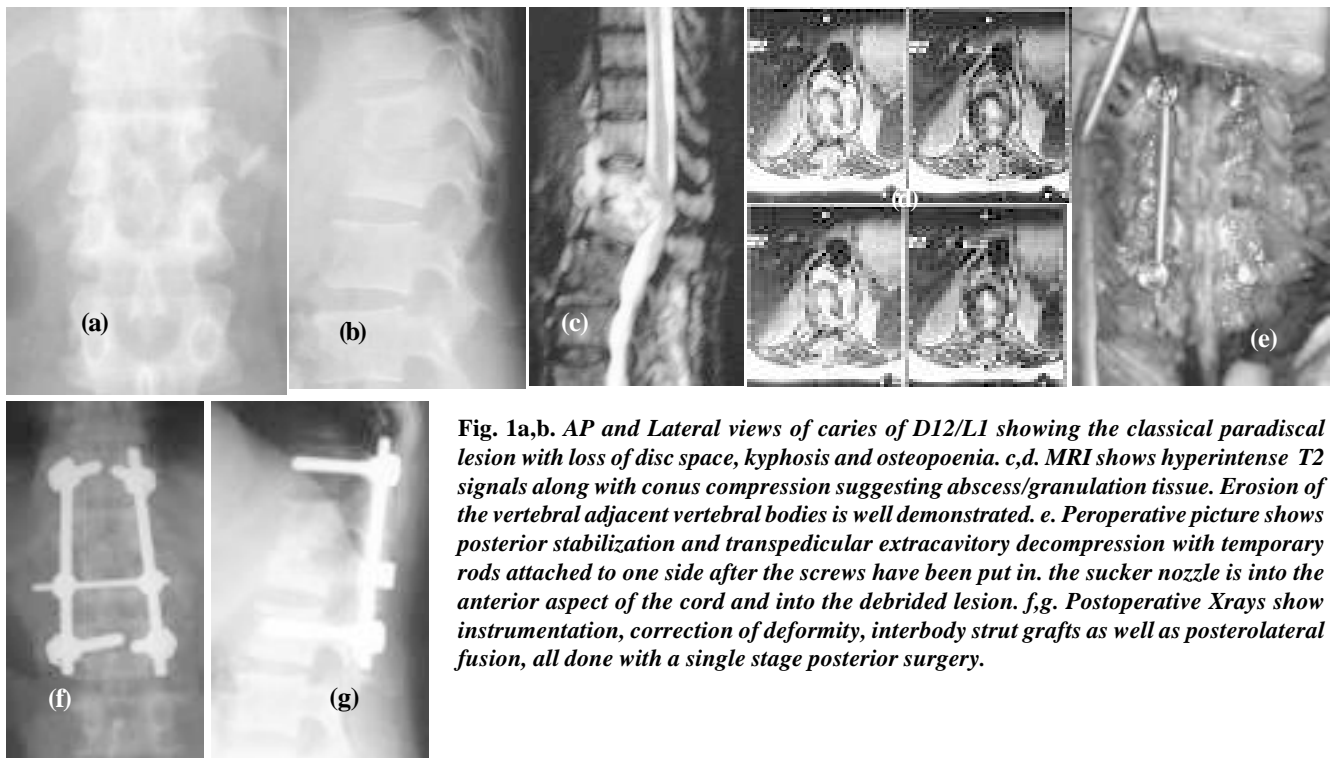


Fig. 1a,b. AP and Lateral views of caries of D12/L1 showing the classical paradiscal lesion with loss of disc space, kyphosis and osteopenia. **c,d.** MRI shows hyperintense T2 signals along with conus compression suggesting abscess/granulation tissue. Erosion of the vertebral adjacent vertebral bodies is well demonstrated. **e.** Peroperative picture shows posterior stabilization and transpedicular extracavitary decompression with temporary rods attached to one side after the screws have been put in. the sucker nozzle is into the anterior aspect of the cord and into the debrided lesion. **f,g.** Postoperative Xrays show instrumentation, correction of deformity, interbody strut grafts as well as posterolateral fusion, all done with a single stage posterior surgery.

The regional distribution was 1 in the craniocervical junction ($C_{0/1/2}$), 7 in the subaxial cervical spine ($C_{3/4/5/6/7}$), 3 in the cervicothoracic junction ($T_1/T_2/T_3$), 3 in the thoracic region (T_4 to T_{10}), 4 in the thoracolumbar junction ($T_{11/12}/L_1/L_2$) and 8 in the lumbar region ($L_{3/4/5}$) and one in the lumbosacral junction (L_5/S_1). All the cases had anterior lesions except one, which had both anterior and posterior lesions.

All of them had decompression, debridement of the lesion (except the 2 cases in the craniocervical region where posterior stabilization and fusion alone was done) and instrumented fusion. The types of surgeries were:

- Anterior decompression/debridement + fusion with anterior instrumentation – i.e. *anterior alone surgery* – 6 pts. (All were patients of sub axial cervical spine affection and 2 of the cervicothoracic junction)
- Anterior decompression/debridement + fusion with posterior instrumentation and fusion – i.e. *anterior and posterior surgery* – 7 pts. (2 in thoracic and 3 in thoracolumbar areas)
- Posterior transpedicular decompression/debridement with posterior instrumentation and fusion – i.e. *posterior alone surgery* – 14 pts. (3 in thoracic, 2 in thoracolumbar, all lumbar, lumbosacral and craniocervical areas though in the latter it was posterior stabilization and fusion alone without transpedicular decompression)

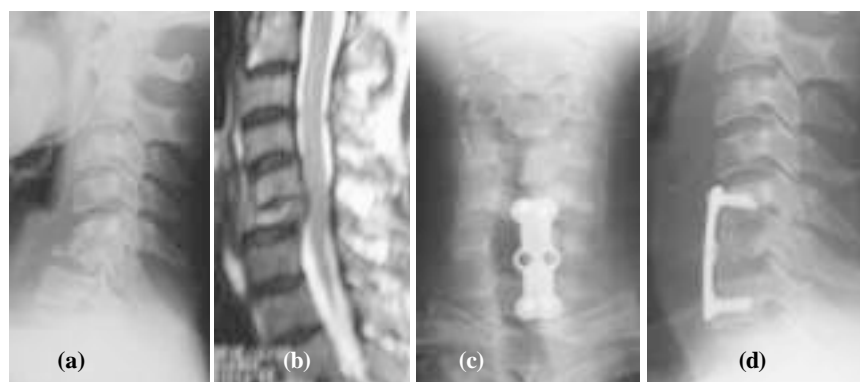
The average duration of surgery / blood loss in these groups were 220 mins/400cc, 430 mins/750cc and 310 mins/600cc respectively. All patients had a single general anesthesia. For anterior surgery, the approach in the cervical spine was a standard anterior approach, for the cervicothoracic spine, it was manubrial splitting, for the thoracic and thoracolumbar spine, it was a transthoracic (+/- trans-diaphragmatic), for the lumbar spine it was a retroperitoneal and for the lumbosacral spine, it was a suprapubic approach. For posterior surgery, it was a midline posterior approach.

Instrumentations used include Hartshil rectangle with sub laminar wiring in 7, plate/screw fixation in 6, hartshil with plate/screw in 1 and transpedicular instrumentation in the remaining 13.

Postoperative protocol used was similar in all cases with category b patients going to the ITU initially. All patients had drain removal on the second day and were made to sit up. Chest and limb physiotherapy was started and when the neurology permitted, they were out of bed from that day onwards. Stitch removal was usually on the 10th day and the average postoperative hospitalization was 11.4 days.

Patients were followed up at the end of 1, 3, 6 and 12 months and then on once every year. All patients had a full antitubercular chemotherapy (4 drugs for 3 months, 2 drugs

Fig 2a. Preoperative X-ray, b. MRI of a patient with Caries C6 with kyphosis, instability and neurodeficit, not responding to conservative treatment. c,d. and postoperative X-ray – note the correction of kyphosis and the stable construct after C6 corpectomy, strut bone grafting from the iliac crest.



for 9 months) and intolerance leading to modulation of the drug regime/dosage had to be done in 10 out of the 27 patients (37%). The average follow-up time is 12.8 months (range 9 months to 3 years 3 months). All patients had regional X-rays and blood ESR, CRP estimation at 3 months, 6 months and one year followed by once every year.

Results

Results were analyzed according to clinico-serological criteria of disease control, neurological recovery/functional improvement, and pain control. Radiological analysis was done according to percentage of deformity correction and evidence of fusion. Following was the protocol used by us in assessing our results.

Excellent: Complete normalization of ESR/CRP, full neurological recovery, restoration of preoperative functional status including return to work, pain status < 3 on the Visual Analogue Score (VAS), and complete radiological fusion with > 80% correction of deformity

Good: Complete normalization of ESR/CRP, full neurological recovery, restoration of preoperative functional status including return to work, pain status < 5 on the VAS, complete radiological fusion with >70% correction of deformity.

Fair: Complete normalization of ESR/CRP, incomplete neurological recovery with useful motor power (>3/5), ambulant, pain status < 5 on VAS, radiological fusion with < 60% correction of deformity.

Poor: Any one or more of the following - Persistently raised ESR/CRP, discharging sinus, incomplete neurological recovery with useless motor power (<3/5), non-ambulant, pain status > 5 on VAS, radiological nonunion, persistent deformity of > 50% of original, implant failure.

Results were excellent in 20, good in 5, fair in one and poor in one patient. Majority of the patients were very

satisfied with the surgery and all the patients had full anti-tubercular chemotherapy for one year. The only poor result was a patient who had C_{4/5} caries with quadriplegia not responding to ATD with complete destruction of C₅, deformity of 70 degrees and cord compression. Anterior decompression with corpectomy C₅, C₄ to C₆ and iliac crest bone grafting was done along with fixation from C₄ to C₆ with locking plates and screws. There was an implant failure with screws coming out at C₄ for which a revision front and back surgery had to be performed with refixation and fusion anteriorly from C₃ to C₆ and posteriorly from C₃ to C₇.

The fair result was another patient who had caries D₇ with paraplegia for 4 months prior to surgery, not responding to ATD, gross kyphosis of 60 degrees and with myelomalacic changes in the cord along with compression. He was offered a front and back surgery with anterior debridement, decompression, fusion and posterior fixation and fusion. He had complete radiological fusion with good deformity correction but had incomplete neurological recovery with motor power in the lower limbs of Grade 3/5, and was ambulant on a walker. There was not a single case with infection/wound healing problems/discharging sinus.

Discussion

The issue is to be considered is the efficacy and the absolute/relative indications for the use of instrumentation in operative treatment of caries spine. There still remains considerable debate regarding the use of some form of instrumentation in all patients undergoing decompressive surgery. Instrumentation definitely allows radical decompression without the fear of destabilizing the spine but in single level disease, without much of kyphotic deformity and in adult patients, possibly it is not required, as it has been shown conclusively that only 3-5% of patients treated conservatively progress to kyphosis beyond 60 degrees⁶. Hence we believe that the classification system

proposed by Mehta and Bhojraj⁷ is rational and should be followed. Only those patients who have destabilizing anterior decompressive surgery especially in the context of pre-existing kyphosis be fixed anteriorly (cervical/cervicodorsal spine) or posteriorly (thoracic/thoracolumbar/lumbar spine). Those patients in whom the entire surgery can be done posteriorly should be done with bilateral transpedicular/extracavitary decompression/debridement and instrumentation and fusion. Transpedicular instrumentation is safe and efficacious in correcting deformity and maintaining stability^{8,9,10,11}. Combined front and back surgeries have been reported^{12, 13,14} and compared¹⁵ but should be considered with strict indications of more than 2 level affections, predominantly anterior compression producing neurodeficit, kyphosis over 40 degrees or in a growing child for mandatory posterior fusion.

For fusion, we have used autologous iliac crest strut/chip grafts as required but allograft fibula¹⁶ and cages can be safely used.

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Role of fluoroscopic guided fine needle aspiration biopsy in spinal pathologies

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Background: The presence of vertebral lesion, whether symptomatic or not presents a diagnostic challenge. Open biopsy of spine is associated with considerable clinical morbidity. Hence it was decided to evaluate the efficacy of fluoroscopic guided fine needle aspiration biopsy (FGFNAB) in providing a definitive diagnosis in pathologies of the spine and to determine the degree of co-relation between the histopathological diagnosis and the presumptive clinicoradiological diagnosis.

Methods: A prospective study of 103 patients in whom a presumptive diagnosis was made by available imaging techniques (including magnetic resonance imaging) was undertaken. All patients underwent histopathological /cytological examination for confirmation of the presumptive diagnosis, using material obtained through FGFNAB.

Results: A definitive diagnosis was established, through FGFNAB, in 76 (73.8%) patients. Non concordant diagnosis was seen in 13(12%) of patients. In 27 (26.2%) patients the results of FGFNAB were inconclusive.

Conclusion: FGFNAB is a minimally invasive, technically easy, quick and cost-effective procedure. It can be done on an outpatient basis, under local anaesthesia and often eliminates the need for an open biopsy. FGFNAB can clinch the diagnosis early and helps institute definitive therapy. Hence we strongly recommend FGFNAB as a basic investigation in all pathological lesions of the spine.

Key-words: Spinal Pathology; Fluoroscopy; Fine needle biopsy.

Introduction

The presence of a vertebral lesion, whether symptomatic or not, presents a diagnostic challenge and is always a cause of concern to the treating clinician. Despite the formidable armamentarium of radiological investigations now available, it is still difficult in many cases to arrive at a definitive diagnosis. Since definitive therapy depends upon the histopathology of the lesion, a tissue diagnosis is invariably necessary¹.

Biopsy of bone is resorted to when histological/cytological or bacteriological evidence of disease is required before appropriate treatment can be planned. In skeletal pathology, the radiological features are nonspecific and only a differential diagnosis can be given. A combined approach, utilizing the strengths of the clinical, radiological and pathological evidence together, is the best way of reaching to a correct diagnosis².

Open biopsy of the spine, was associated with considerable clinical morbidity in a large questionnaire survey of surgeons. The procedure was thought to have worsened the prognosis in 8.5 % of cases put to open biopsy³.

We undertook a prospective study to evaluate the efficacy of fluoroscopic guided fine needle aspiration biopsy (FGFNAB) in providing a definitive diagnosis in pathologies of the spine and to determine the degree of co-relation between the histopathological diagnosis and the presumptive clinicoradiological diagnosis.

Materials & Methods

From July 2002 to December 2003, a prospective study was carried out in 103 patients, who were taken up for FGFNAB of the cervical, dorsal, lumbar and sacral spine pathologies. Informed consent of the patients was obtained.

Patients having a lesion at any level of spine, confirmed by imaging techniques, were taken up. Exclusion criteria included lesions less than 5mm in size or too close to the canal, lesions of anterior cervical spine, patients with deranged bleeding parameters, and uncooperative patient.

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History, positive findings of examination of the spine and neurological assessment were recorded meticulously. Complete haemogram, Montoux test, radiographs of the affected spine, serum phosphorus, serum calcium, and serum alkaline phosphatase were done in all cases. Computer tomography or magnetic resonance imaging of the spine was done as and when indicated. Specific investigations like ELISA (Enzyme linked immunoabsorbant assay) for tuberculosis, Serum electrophoresis, Bence Jones proteins in urine, PSA (prostatic specific antigen) were undertaken, if clinically indicated. These investigations helped us reach to a presumptive diagnosis in all the cases.

Equipment: Touhy epidural needle (Fig 1) -17G was used with outer core diameter of 1.47mm and needle length- 8.89cm

Approach: Patient was put in lateral or prone position. Needle was introduced through postero-lateral approach⁴.

- In cervical spine only posterior elements (facet joint, lamina, and spinous process) can be approached safely as there are few, if any, important vascular or neurogenic structures within this region.
- D₂ to D₉ Thoracic Vertebrae : 04 cms from the midline at an angle of 35 degrees to the horizontal.
- D₁₀ to L₅ Vertebrae: 6.5 cm from the midline at an angle of 35 degrees to the horizontal.
- Sacral Spine: 02 cms from the midline at an angle of 90 degrees to the horizontal.

Procedure: Biopsy was done in the operation theatre under local anaesthesia with all aseptic precautions. After confirming the site of the lesion under the image intensifier, epidural needle was inserted according to the above-mentioned technique. The stylet remained in place while inserting the needle into the tissue, to prevent clogging of the needle. Needle was checked for its position under image intensifier in both antero-posterior and lateral views. Stylet was then removed; aspirates were obtained through the epidural needle by attaching a 20cc syringe, to the needle hub and gently withdrawing and advancing the needle several millimeters at the pathologic site while maintaining negative suction. If there was no return of aspirate material, a small amount of saline was injected and then aspirated.

Needle was inserted for a maximum of three times at the pathological site in one sitting and if adequate material was not obtained the procedure was aborted, and it was repeated after 24 hours. We used the needle to obtain two cores of tissue to have a representative sample in almost every case as recommended by Phadke et al⁵. If the patient complained of radicular pain during advancement of the needle, it was

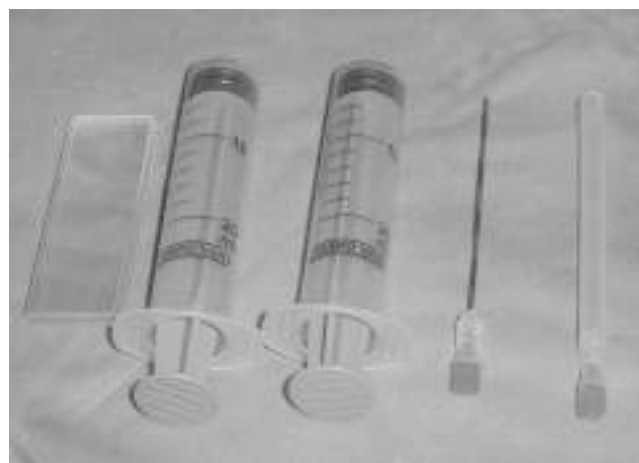


Fig. 1 . Touhy's Needle with Syringe

immediately withdrawn and repositioned in a caudal or cranial direction in order to avoid the nerve root.

During the procedure the same pathologist was available every time in the operation theatre. Needle along with the syringe was handed over to him immediately for cytological / histopathological examination. In all cases air dried and wet smears were prepared and stained smears were also prepared by the papanicolaou method. For interpretation of the result, Phadke et al⁵ criteria's were followed by the pathologist to reach to a definitive diagnosis.

The patients were closely monitored for at least 2 hours after the procedure. Neurological assessment was done during this period to rule out any iatrogenic nerve injury. No additional limitation of activity was enforced after the procedure.

Results

Age of patients ranged from 06 to 90 years; 41 of them were in the age group of 41 to 60 years. One hundred and one cases presented with the chief complaint of back pain with or without weakness. Of the two cases presenting without back pain, one had a mass in the paravertebral region and the other had a kyphotic deformity with weakness. Neurological deficit was observed in 80 patients. Forty five biopsies were done at the thoracic level, followed by the lumbar spine in 36, dorso lumbar junction 13, sacral spine 4, cervical spine 3 and lumbosacral junction in 2 cases.

Pus, fluid, tissue pieces, bone bits, blood clots, necrotic material, granulation tissue and sero-sanguinous fluid were the contents of the aspirates from the site of lesion. On clinico radiological assessment we could reach to a presumptive diagnosis in 80 cases while 23 cases remained undiagnosed on clinicroadiological assessment.

The 80 clinico-radiologically diagnosed cases, which were subjected for FGFNAB showed concordant diagnosis in 50 cases (that is the diagnosis was same both clinico-radiologically and histopathologically). Nonconcordant diagnosis was seen in 13 cases and in 17 cases no diagnosis could be made histopathologically. The distribution of 13 nonconcordant cases is as shown in Table I.

Table I. Distribution of nonconcordant cases.

Presumptive Clinicoradiological Diagnosis	Number of Patients	Definitive diagnosis by FNAB	Number of Patients
Tuberculosis	13	Metastasis	05
		Pyogenic	08
Total	13		13

In the 23 non-conclusive clinicoradiological cases which were also subjected for FGFNAB, a definitive diagnosis could be reached histologically in 13 cases however 10 cases still remained inconclusive (Table II). Hence a definitive diagnosis with FGFNAB could be made in 76 patients. There were 27 inconclusive biopsies out of 103.

Table II. FGFNAB results in 23 cases where clinico radiological assessment was inconclusive.

Presumptive Clinicoradiological Diagnosis	Number of Patients	Definitive diagnosis by FGFNAB	Number of Patients
Inconclusive	23	Tuberculosis	05
		Dermoid cyst	01
		Metastasis	04
		Multiple Myeloma	01
		Plasmacytoma	01
		Aneurysmal bone cyst	01
		Still Inconclusive	10
Total	23		23

Discussion

We preferred the Touhy's epidural needle because of its beveled tip and curved portion at its end, which allows minimal tissue trauma during insertion and also helps in taking biopsy from the osteolytic bones. It has a thin-wall design, which provides maximum lumen with minimum trauma to the patient. Another reasons to choose this needle were its easy availability as it is regularly used by anesthetists for epidural analgesia and also that the needle is economical compared to other suggested varieties of needles by Desantos et al⁶, Debnam and Staple⁷, and Stoker and Kissin⁸.

Subjecting a patient to anti tubercular treatment on a presumptive diagnosis without tissue diagnosis not only

exposes him to the side effects of toxic drugs but also adds on to the financial burden and is considered a social stigma in our society. Similarly a presumptive diagnosis of metastasis to the spine if treated without tissue diagnosis would have an adverse psychological impact, on being labeled as a case of cancer. Therefore, FGFNAB is a necessity before subjecting the patients to any definitive therapy.

In our study no complications like vertebral compressions, neurologic complications or infections, have been reported at the time of biopsy or post biopsy, suggesting that the procedure is very safe in experienced hands.

In 50 patients FGFNAB, gave a concordant diagnosis with the clinicoradiological diagnosis. Thus FGFNAB proved to be a complimentary adjunct to clinicoradiological assessment. Phadke et al⁵ opined in his study that correlating FGFNAB with the clinical and radiologic findings, a definitive diagnosis could be made in most cases.

The value of FGFNAB of the spine can be judged by the observation that in 13 patients FGFNAB gave a non-concordant diagnosis with the clinicoradiological diagnosis. This is a very high number and certainly proves beyond doubt that FGFNAB should be made a gold standard for the diagnosis of the lesions of the spine. FGFNAB proved to be a base line investigation in 13 out of 23 cases (which could not be diagnosed clinicoradiologically) to give a definitive diagnosis. In our study, the failure was in 27 cases; these cases were taken up for open procedures

Stoker and Kissin⁷ stated that the overall accuracy of FGFNAB varies from 68% to 96%. Debnam & Staple⁶ in 1975 reported a success of 82% working with the Ackerman needle (12 gauge), Shalot et al² in 1982 reported 96% working with Jamshidi needle (8-10 gauge), and Stoker et al⁷ 88.1% working with Jamshidi needle (8-10 gauge). Our success rate was 73.8%, with the Touhy's (17 gauge) epidural needle. This variation in success rates is attributed to the difference in needle type used. In all the 3 studies who have reported better success rates compared to ours, have used wider bore needles with a trephine cutting edge, but the procedure was invasive and done under local anaesthesia and sedation. It was cumbersome, costly, and needed expertise in undertaking this procedure. They had used the needles to achieve specimen adequacy. On the other hand, we have used the 17 gauge Touhy's needle essentially to achieve a percutaneous route, making it cost-effective and noninvasive leading us to undertake FGFNAB as an outdoor procedure.

When compared with the success rates of Fyfe et al⁹, 71%, working with trephine needles and Moore et al¹⁰, 60%, working with Ackerman needle, our results were better.

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Lumbar disc excision through fenestration

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Background: Lumbar disc herniation often causes sciatica. Many different techniques have been advocated with the aim of least possible damage to other structures while dealing with prolapsed disc surgically in the properly selected and indicated cases.

Methods: Twenty six patients with clinical symptoms and signs of prolapsed lumbar intervertebral disc having radiological correlation by MRI study were subjected to disc excision by interlaminar fenestration method.

Results: The assessment at follow-up showed excellent results in 17 patients, good in 6 patients, fair in 2 patients and poor in 1 patient. The mean preoperative and postoperative Visual Analogue Scores were 9.34 ± 0.84 and 2.19 ± 0.84 on scale of 0-10 respectively. These were statistically significant (p value < 0.001 , paired t test). No significant complications were recorded.

Conclusion: Procedures of interlaminar fenestration and open disc excision under direct vision offers sufficient adequate exposure for lumbar disc excision with a smaller incision, lesser morbidity, shorter convalescence, early return to work and comparable overall results in the centers where recent laser and endoscopy facilities are not available.

Key-words: Prolapsed intervertebral disc; Sciatica; Fenestration; Discectomy.

Introduction

In orthopedic practice patients having lesions of lumbosacral region causing low backache with sciatica are not

uncommon since the beginning of recorded history. The first disc prolapse operation falsely accredited to Mixter and Barr had been conducted by Oppenheim and Krause in Berlin but interpreted it as an enchondroma of spinal disc^{1,2}. Mixter and Barr's classical paper "Rupture of intervertebral disc with involvement of spinal canal" opened an era of systematic diagnosis and operative treatment of lumbar disc prolapse. Their operative approach was an extensive laminectomy.³

Shortly afterwards hemilaminectomy became the favourite procedure in cases with unilateral symptoms. Love described extradural removal of herniated disc and devised interlaminar fenestration for treatment of lumbar disc prolapse.⁴ Refinement of fenestration technique was described by Williams who coined the term "Conservative surgical approach to the virgin herniated disc" which required the use of operating microscope to facilitate better visualization of dural sac, nerve roots and other interspinal structures including disc⁵. The advantages of fenestration and interlaminar approach has been demonstrated^{6,7,8}. Mishra et al compared laminectomy and fenestration for disc excision and concluded the superiority of later approach in respect to early postoperative mobilization, early return to work and low incidence of postoperative backache as it is less extensive⁹. It is very safe, effective and reliable surgical technique for treating properly selected patients with herniated disc. This approach is free from spinal instability and membrane formation resulting from laminectomy¹⁰.

The recent techniques like percutaneous lumbar disc decompression (PLDD), percutaneous endoscopic lumbar discectomy (PELD) and Young endoscopic spine system (YESS) need lots of expertise, experience and expensive equipments which are not available at every center.^{11,12} Hence disc excision through fenestration is the procedure which can be performed by majority of orthopaedic surgeons even in small peripheral centers.

Materials and methods

Twenty-six patients with signs and symptoms of prolapsed lumbar intervertebral disc who failed to respond to conservative treatment of minimum 6 weeks duration were studied prospectively. Patients with PIVD who were having

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neurological deficits and intractable pain not relieved by adequate conservative trial and patients with bladder and bowel involvement (cauda-equina syndrome) were assessed preoperatively regarding informative history through general and neurological examination and were subjected to magnetic resonance imaging scan (MRI). The results of imaging were correlated with physical findings and symptomatology of the patients. All clinico-radiologically proven cases were subjected to surgery.

All patients were operated in knee-chest position under general anaesthesia. In 12 cases lower 3rd part of upper lamina or upper 3rd of lower lamina was cut to enlarge a fenestration for clear view. Adherent part of the disc was not removed. Meticulous hemostasis was achieved with bipolar coagulation and surgical. In cases of inadvertent dural tears, accessible ones were sutured with non-absorbable sutures while inaccessible ones were sealed by fibrin glue and epidural fat was placed over the nerve root to prevent postoperative adhesions. Incision was closed in layers without negative suction drains.

Postoperatively patients were allowed up on first postoperative day. Gradual walking was encouraged, prolonged stooping and flexion was avoided. Lifting, bending and stooping prohibited for 6 weeks. Patients who were heavy laborers or long distance drivers were off work until 12 weeks and then advised to modify their duties. All patients were advised a regular postoperative back exercise program after 3 weeks.

Statistical analysis was performed with statistical software (version 12.0 for windows, Chicago, Illinois) and data were evaluated by paired student t test. Significance was accepted at p-value < 0.01.

Results

Out of 26 patients 18 were males and 8 were females. The average age was 38.22 years ranging from 25-50 years. Thirteen patients were sedentary workers. Relevant examination findings of patients were as per table I. The most common level of involvement was L₅-S₁ followed by L₄-L₅. Central or posterocentral position of the prolapsed disc was most common followed by paracentral, posterolateral and lateral in that order. Fifteen patients had left sided symptoms while eleven had right sided. The average duration of preoperative back pain was 14.6 months and that of preoperative leg pain was 10 months. The average duration of conservative management was less than 6 months in 17 patients and rest had more than six months. Intraoperatively

eleven patients had massive disc prolapse. Average postoperative hospital stay was 4.8 days.

In our study we assessed pain according to VAS scale¹³. The preoperative mean±SD VAS score was 9.34±0.84 which improved to 2.19±0.84 postoperatively. A paired student t-test showed that the above changes were statistically significant (p<0.001), which shows a significant reduction in patient's perception of pain.

Table 1. Clinical profile of patients

Side Involved	Number of patients
Left	15
Right	11
Examination findings	
Diminished strength of EHL	21
Diminished deep tendon reflexes	21
Level involved	
L ₂ -L ₃	1
L ₄ -L ₅	9
L ₅ -S ₁	16

The follow up data was analyzed using modified Macnab criteria¹⁴ and patient based outcome studies using SF-36¹⁵.

Based on modified Macnab criteria 17 patients showed excellent, 6 good and 2 fair results. One poor result was due to persistent root pain. Based on SF-36 questionnaire for comparing quality of life preoperatively Vs postoperative on eight domains, all the eight domains showed statistically significant findings (p<0.001). Except for bodily pain, general health, physical function and social function, all other domains showed positive improvements with transformed scores postoperatively.

Seventeen patients in our study returned to work in less than one month after surgery. Eighteen patients returned to change their original work while 8 patients had to their nature of work.

There was inadvertent dural tear in three patients. In two cases dural rent repair was done under vision, while in the 3rd case tissue sealant glue was used. All three patients recovered uneventfully. Two patients had temporary retention of urine after the surgery which relieved by single catheterization. Three patients complained postoperative headache, relieved by intravenous saline hydration and analgesics. Transient back pain was complained by four patients postoperatively, relieved by analgesics. No other major complications like DVT, pulmonary embolism, nerve root injury, retroperitoneal injury or wound infection occurred in our study.

Discussion

Prolapsed intervertebral disc occurs in about 5-10% of all backache patients and is a common cause of sciatica. Even a small herniated disc in the presence of a narrow spinal canal can be responsible for the compression of cauda equina and its roots. The standard treatment of lumbar disc prolapse has been surgical excision of the disc, though the methods of discectomy vary. The traditional view has been that wide laminectomy produces increased morbidity compared to less extensive procedures like inter-laminar fenestration¹⁶.

Most cases of sciatica due to intervertebral disc lesions were in fact partial cauda equina lesions, mostly unilateral and characterized by muscular weakness, wasting, reflex abnormalities and sensory impairment referable to compression of one or more nerve roots. The radiating pain in leg did not differ appreciably in L₄-L₅ and L₅-S₁ disc lesions. In both groups the pain radiated along the posterior aspect of thigh and calf. Quite frequently these patients complained of tingling and numbness along sciatic nerve distribution. Out of 26 cases in our study 21 were having neurological deficit, out of which 5 had cauda equina compression and bladder involvement.

Love devised inter-laminar fenestration⁴. Refinement of fenestration technique was described by William who used an operating microscope to facilitate better visualization of dural sac, nerve roots and other inter-spinal structures including the prolapsed disc⁵.

Results of this study, state that the lumbar discectomy performed with a limited disc excision by fenestration is a safe, effective and reliable method for treating selected patients with herniated lumbar discs. No patients in this study deteriorated after surgery. The length of a patient's recovery period after surgery appeared to be strongly influenced by environmental factors and patient's motivation. In majority of patients with good results, the preoperative sciatic symptoms improved within first three days after surgery.

The approach herein differs from microdiscectomy only in extent of exposure. The disc removal per se in both is limited. Incision into the annulus fibrosus was necessary only when a protruded disc herniation was identified. Additional exposure in fenestration has the advantage of correcting lateral recess stenosis. Surgeon must be prepared to perform foraminotomy or undercutting of upper or lower lamina in addition to lumbar discectomy if the nerve root remains tight after disc excision.

The incidence of complications in our study involving 26 operations such as dural tears, postoperative retention of urine, headache, and backache is low. Other complications reported¹⁸⁻²⁰ did not occur in our study i.e. wound infection, discitis, increased neurological deficit, nerve root injury, pulmonary embolism, retroperitoneal injury or vascular injury etc.

The straight forward test to measure pain is probably simply asking patient to quantify it on Visual analog scale (VAS)¹⁸. This has been used in previous studies for effective monitoring of changes in pain and functional capacity after spinal surgery. On the VAS patient indicates pain intensity on a typical day by marking a line from 0-10 corresponding to pain level. In our study the preoperative mean \pm SD VAS score was 9.34 ± 0.84 and postoperative mean \pm SD VAS score was 2.19 ± 0.84 on a scale of 10. A paired t-test showed that the above changes were statistically significant ($p < 0.001$), which demonstrated a significant reduction in the patient's perception of pain and improved functional capacity after surgery.

We conclude that the procedure of fenestration and open disc excision under direct vision offers the complete visualization of nerve root and complete removal of the offending disc along with loose fragments. In comparison to microdiscectomy, disc excision by fenestration has yielded almost comparable results, except for slight more lifting of paraspinal muscles, though they fall back well in their place with meticulous closure. Further microdiscectomy is the procedure which needs greater know-how and expertise in instrumentation and techniques and is less cost effective. In the peripheral institutions fenestration with disc excision is quite a reasonable method to surgically treat the indicated cases of prolapsed disc and this procedure can be well performed even by an average spinal surgeon with adequate experience in the field of disc surgery.

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Ununited fracture neck of femur treated with closed reduction and internal fixation with cancellous screw and fibular strut graft

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Background: Ununited fracture neck of femur in young adults has been tackled in various ways.

Methods: Twenty five patients of ununited fracture neck of femur in age group 21-55 years were treated by closed reduction, cancellous screw fixation and fibular strut graft and followed up for 2-6 years. Time gap between injury and operation was 6 weeks to 58 weeks. Five cases were previously fixed with various fixation devices.

Results: Osseous union was achieved in 24 cases with average time of 18.16 weeks. Main complication encountered in follow-up was avascular necrosis of femoral head, others were joint stiffness and shortening. Functional end results were good to excellent in 24 cases.

Conclusion: Closed reduction with internal fixation by cancellous screw and fibular strut grafting is easy and useful procedure.

Key-words: Ununited fracture neck of femur; Closed reduction; Internal fixation; Fibular strut graft.

Introduction

In developing countries like India, ununited femoral neck fracture is a common due to deficient medical facilities, ignorance on the part of patient due to illiteracy and poverty. Femoral neck fracture if not treated within 90 days is called nonunion¹ whereas fracture untreated beyond 3 weeks² and 6 weeks³ have been called as ununited fractures. Various procedures such as osteotomies, muscle pedicle grafts, bone graft, hip replacement arthroplasty etc. are advocated in the literature for ununited fracture of femoral neck in adult but results are still unpredictable¹⁻¹¹.

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Henderson⁴ proved that ununited fracture neck of femur can be reduced by closed technique without jeopardising precarious blood supply of femoral head as in open reduction. Cancellous screw provides a reasonable good fixation and occupies less space in femoral neck. Bone graft is a good measure to deal with problem of ununited fracture of femoral neck. Fibular graft is easy to obtain, does not leave behind any functional or cosmetic problem at donor site and it provides mechanical and biological fixation. It gets incorporated into surrounding bone. It also prevents subchondral collapse if avascular necrosis is already taking place.

Material and methods

Criteria for selection of patients : Twenty five patients between 21-55 years who were either not treated for 6 weeks following injury or were treated by various internal fixation methods and failed to unite within a reasonable period of time, with viable femoral head as seen on plain roentgenogram were selected for this procedure.

Pre-operatively patients were systemically examined and evaluated radio- graphically regarding viability of femoral head, overriding of trochanter, quality of bone, details of femoral neck etc. and shortening. CT or MRI was not done. If trochanter was high riding and shortening was more than 1 cm, we used pre-operative skeletal traction to equalize the limb length and to aid in closed reduction during surgery.

Operative procedure : Under regional anaesthesia or general anaesthesia the procedure was carried out on standard orthopedic fracture table in supine position.

Under C-arm image intensifier control, the fracture was reduced by closed gentle manipulation technique and limb was tied in internal rotation which also provided easy access for fibula. We were not very keen to obtain 100% reduction which is very difficult also, rather we accepted reduction having good neck length and minimum rotation and maximum contact of fracture fragments which was checked in anteroposterior and lateral views.

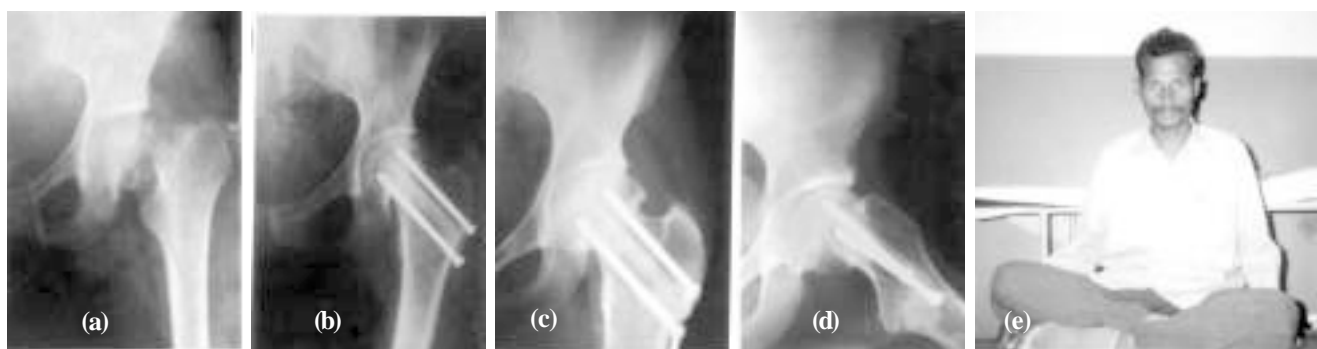


Fig. 1. (a) Radiograph showing a united femoral neck fracture, (b) immediate post-operative after fibular grafting and screw fixation, (c, d) union after 6 months, (e) Clinical results

After reduction, fracture was fixed with two cancellous screw (6.5mm thick, 16mm threaded) leaving behind a space between two screws for fibular strut graft. D.C.S. triple reamer was used to make channel for the fibular graft. About 4" long fibular shaft obtained from middle 1/3 of ipsilateral leg (under tourniquet control, using posterolateral approach, leaving behind periosteum). Graft thus obtained was prepared by chiselling and petalling with the help of osteotome. Interosseous border was blunted and one end tapered. The graft was then inserted through previously made tunnel and hammered into place. After wound closure limb was immobilised into hip spica cast. The sutures were removed through window after 2 weeks.

Follow-up

- Quadriceps exercise and toe movement from the start
- At 2 weeks, suture were removed
- At 6 weeks, spica changed
- Spica cast continued till radiological sign of union were found
- Then spica cast removed and mobilisation exercise started

Then after one month of quadriceps strengthening and mobilisation exercise, patient was allowed partial weight bearing with crutches. When sound bony union achieved as also ensured by skiagram full weight bearing allowed.

Criteria for evaluation of results

For evaluation of functional end results, we have used criteria laid down by Mishra⁵ which is as follows :

- (1) Excellent :
 - Able to walk without support
 - Able to sit in the chair
 - 50-60% of painless movement

- (2) Good :

- Able to walk without support
- Able to sit in the chair
- 40% movement possible with minimum pain

- (3) Fair :

- Able to walk with crutches
- Not able to sit in chair with hip flexed
- 30% of movement possible and painful

Failure was defined when union was absent.

Results

Patients were followed up to 2-6 years. Union was achieved in 24 cases (Fig. 1, 2) in an average time of 18 weeks (range 12-32 weeks) (Table I). Functional end results⁵ were excellent in 21, good in 3, and poor in one patient.

The main complication was avascular necrosis of femoral head (5 cases; Fig. 2d). Among these 5 new cases of AVN one patient developed frank arthritis, had hinged abduction (range of abduction $\approx 20^\circ$), 90° flexion and walking without support with minimal pain while walking. He may require a total replacement arthroplasty later on. Other two patients with AVN had more than 40% of range of movement with minimum pain. They have not developed arthritis yet; they were treated initially with abduction and extension exercise and stick in opposite hand till the pain disappeared. Now they are walking without support and able to sit in chair.

Remaining 2 patients with AVN are having more than 60% range of movement without pain, able to sit in chair and now walking without support. These two patients were also treated with abduction and extension exercise and stick in opposite hand initially.

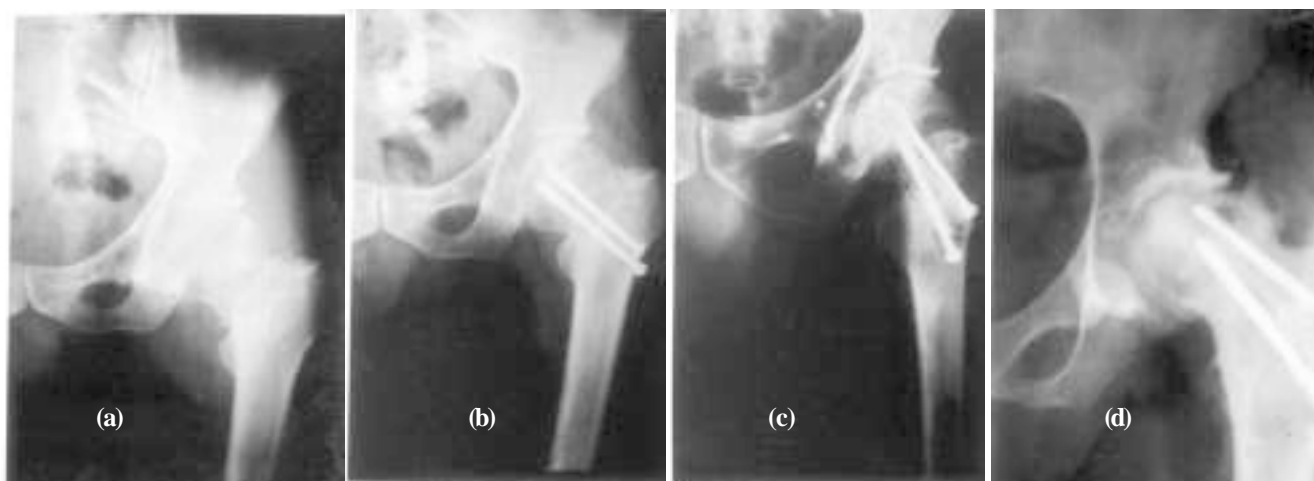


Fig. 2. Radiograph showing (a) ununited femoral neck fracture, (b, c) follow up at 6 months showing union, (d) showing avascular necrosis and collapse at 2 years.

Other main complications were knee and hip joint stiffness (2 cases) and shortening-1" in 4 cases.

Table I. Union time

Union time (weeks)	No. of Cases
12-16 weeks	9
17-20 weeks	8
21-24 weeks	4
25-28 weeks	2
28-32 weeks	1
Total	24

Discussion

Treatment of femoral neck fracture still remains an “unsolved problem”, specially for young, active adults where preservation of femoral head is desired. For active young adult, replacement arthroplasty is not indicated because of long, active productive life ahead, while arthrodesis is not performed because of Indian customs of squatting and sitting cross legged. The problem is further compounded when treatment is delayed and avascular necrotic changes occur in femoral head.

Baksi⁶ with muscle pedicle bone graft obtained union rate of 82%, non union 9%, for 6% of cases re-operations were required while failure rate was 3%. Muscle pedicle bone graft procedure are technically more demanding and such expertise and facilities are not available everywhere.

Goel et al⁷ reported 66 cases of nonunion neck femur treated with McMurray’s osteotomy. They have treated 28

cases in plaster while 38 cases with Wain-Wright plate fixation. Among the plaster group union was 71.4% while in plate group union was 52.6%, incidence of AVN was 18.2%. Ballmer⁸ reported a series of 17 cases treated by Pauwel’s osteotomy. Union rate in Ballmer series was 88%, however, revision of osteotomy was required in 3 cases and incidence of AVN was 30%. All osteotomies create one more fracture which may fail to unite and salvage surgeries like, THR is difficult afterwards.

With open reduction and fibular strut grafting as reported by Nagi et al⁹ and Mishra et al⁵ union rate was 96% and rate of AVN was nil. While in our series rate of union is 96% and rate of AVN is 20%.

We were not very keen to obtain 100% reduction because it is difficult in old cases by closed means with which we are dealing. We have not done open reduction because open reduction is extensive procedure, increases tissue trauma and surgical complication, further disturbs already compromised vascularity, space available for manipulation of fragments under direct vision is extremely limited¹⁰, end results are similar to closed reduction⁴.

There are biomechanical and biological factor responsible for non union of fracture neck of femur^{12,13}. Osteosynthesis is an ideal way to deal with fracture which needs immobilization. Cancellous screw provides reasonably good fixation and occupies less space in neck. Being a simple implant they are easy to insert and readily available. We are quite satisfied with 6.5mm, 16mm threaded, non-cannulated cancellous screws as they also provided good compression at fracture site.

To counter biological factor we need bone graft. We preferred free fibular cortical graft because, it provides mechanical support and fixation, have satisfactory osteoconductive and inductive potential, prevents subchondral fracture and collapse of head, later gets incorporated into surrounding bone so implant loosening does not occur (Fig. 2d), is very easy to obtain, there is no donor site morbidity, is also established method to deal with AVN of femoral head, vascular fibular graft is technically demanding operation.

To conclude, closed reduction with internal fixation by cancellous screw and fibular strut grafting is easy and useful procedure can be done by an average orthopaedic surgeon, can be done at district level with good results and acceptable rate of complication in comparison to various osteotomies and muscle pedicle bone graft procedure^{1, 6-8, 10, 11}.

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Fibular grafting with cannulated hip screw fixation in late femoral neck fracture in young adults

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Background: We reviewed the operative results of fibular bone graft with cannulated hip screw fixation in femoral neck fracture in young adults.

Method: Sixteen young adults with femoral neck fracture were treated by fibular bone graft with cannulated hip screw fixation. All the fractures were more than 3 weeks old.

Results: Results were assessed in 15 patients while one patient died due to complications not related to surgery. Union occurred in all 15 patients. One patient had intra-operative complication in the form of screw cut out with graft in the joint space. The average follow up was 24.4 months. Out of 15 patients assessed clinically 11 showed good results, 3 had fair while 1 had poor result.

Conclusion: We conclude that this is a simple and cost effective procedure for late femoral neck fracture in young adults with good results.

Key words: Late fracture neck femur; Young adults; Fibular graft; Cannulated hip screw.

Introduction

Intracapsular femoral neck fracture has always presented great challenges to orthopaedic surgeons and still continues to be a burning problem, thus it is often called as *The Unsolved Fracture*¹. It is probably the fracture for which there exists the largest number of methods for osteosynthesis. Femoral neck fracture in young adults differs in many respects from the same fracture in older age group. Firstly, it is relatively uncommon injury, secondly, there is considerable difference in the severity of trauma and thirdly, these fractures occur through relatively normal strong bone in young adults². Only a few published reports have dealt with femoral neck fractures in young adults and even fewer with late cases^{3,4}.

In under developed countries because of poverty, ignorance and lack of facilities these fractures are often seen only after a delay or improper treatment. These cases are associated with a high incidence of non-union and avascular necrosis.

Fibular bone graft with cannulated hip screw fixation is a recognized method of treatment for late femoral neck fractures even with early stages of avascular necrosis. The cannulated hip screw provides reasonably good fixation and placement of fibular graft has many advantages as it acts as biological implant, prevents subchondral collapse, act as channel for revascularisation and because of its trifine shape adds to the stability of fracture reduction.

The main aim of our study was to salvage the natural femoral head and to provide stable, mobile and painless hip to the patient.

Material and methods

Between April 2001 to September 2003, 16 patients with late femoral neck fractures (>3 weeks) were operated at our institution. There were 10 male and 6 female patients with mean age at surgery as 36.8 (21-50) years. The interval from injury until surgery was 3 to 8 (av 5.5) weeks. All patients were contacted for clinical and radiological follow-up and had standard radiographs of pelvis with both hip AP view in internal rotation and lateral hip radiographs.

After necessary preoperative investigations all patients were operated under spinal/epidural or combined anaesthesia using the traction table. Acceptable reduction was achieved in all the patients by traction and closed manipulation under image intensifier. Two surgical teams were formed, while one team harvested the ipsilateral fibular graft using standard posterolateral approach from the middle third of the leg and drill holes were made on the two surfaces leaving the interosseous border intact. The second team exposed the hip through lateral approach. Three guide wires introduced from the base of the trochanteric flare passing through the fracture site under image guidance. Over the central guide wire the medullary canal was reamed using 8 mm part of triple

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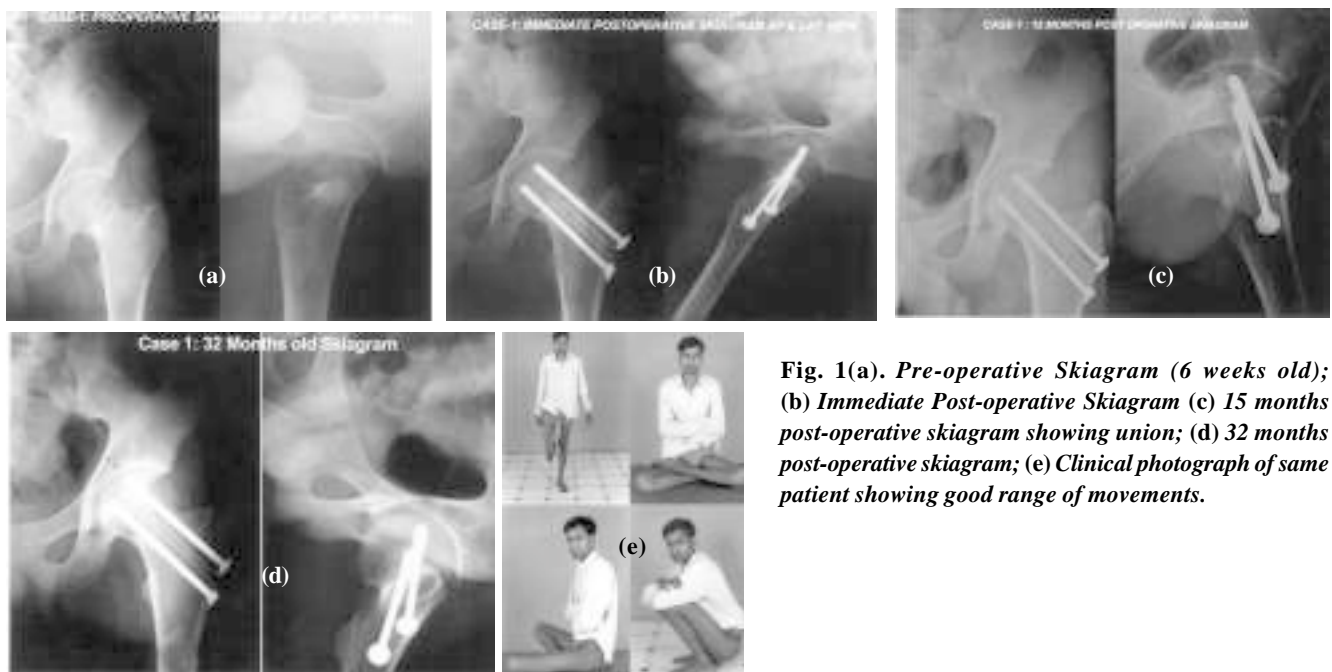


Fig. 1(a). Pre-operative Skiagram (6 weeks old); (b) Immediate Post-operative Skiagram (c) 15 months post-operative skiagram showing union; (d) 32 months post-operative skiagram; (e) Clinical photograph of same patient showing good range of movements.

reamer while cannulated hip screws were introduced over the remaining two guide wires after drilling and tapping. Fibular graft was gently hammered in to the reamed area and after final impaction of the graft both the screws were tightened to provide compression at the fracture site. Closure was done in layers over a suction drain.

After stitch removal our patients were followed at monthly interval for initial three months and thereafter at bi monthly interval. All patients were kept non-weight bearing for an average period of 10 weeks (range 8-12 weeks) but mobilisation was started on the 3rd postoperative day depending on pain tolerance of the patient by using 4-post walker. Partial weight bearing with walker and then with a stick was started after 8 to 17 (average 12.5) weeks while full weight bearing was started after 12 to 21 (average 16.5) weeks depending on the clinical and radiological evidence of union.

Result

All the patients showed union with in six months with an average union time of 3.86 months (Table I). The average follow up of our patients was 24.4 (range 20-32) months. Functional evaluation was done by Larson's Method⁵, which showed good results in 11, fair in 3 and poor results in one patient. According to Larson's Method of functional evaluation out of 15 patients assessed 14 patients were pain free and had flexion-extension range 90°-120°, adduction-abduction range 60°-80° and external-internal rotation range 60°-80° (Fig. 1). Postoperative shortening was seen in 6

patients ranging from 0.5-1.5 cm. During the postoperative period 2 patients had superficial infection that was managed conservatively while one patient had intraoperative complication in the form of graft in the joint space with cut out of the screw and had pain and limited range of motion in all directions (Fig. 2). We had not observed avascular changes in the femoral head in any of our patients till our follow up.

Discussion

In most of the published reports the free fibular graft was used either to treat non-union of the femoral neck fracture or to treat early stage of avascular necrosis. Henderson⁶ at Mayo clinic treated 77 cases of femoral neck fracture by open reduction and free fibular grafting followed by hip spica for 3 months. Dooley and Hooper evaluated retrospectively 26 patients of non-union treated with fibular bone graft with or without valgus subtrochanteric osteotomy, 24 of these cases united⁷. They concluded that an osteotomy did not improve the union rate but rather added a possible further site for complications. Inclan and Patrick^{8,9} used free fibular graft in conjunction with Smith-Petersen nail for treating femoral neck fracture. They reported non-union and avascular necrosis at the rate of 10-15%. Nagi et al reported a series of 26 cases (10 fresh and 16 old) treated by open reduction and one cancellous screw with free fibular graft followed by single hip spica to all his patients^{1,10}. Slater et al reported a single case study of femoral neck fracture treated by closed reduction and fibular grafting with two cannulated hip screw fixation¹¹. In our series



Fig. 2. Intra-operative complication : graft in joint space.

of 16 patients, we achieved closed acceptable reduction under image intensifier and put fibular graft with two cannulated hip screws providing reasonably secure fixation. We had not applied hip spica postoperatively; rather we achieved ambulatory status much earlier. In none of our cases complications related to donor site morbidity¹² were reported and the complications that occurred were preventable by good technical judgement. Recently described reconstructive procedures like total hip replacement and surface replacement arthroplasty have a high incidence of failure in younger age group and also life expectancy of patients with late femoral neck fracture is much longer than that of the prosthetic implant. Further more joint preserving surgery improves the quality of life in short and medium term while still leaving the possibility of total hip replacement at an older age.

We conclude that treatment of late femoral neck fracture in young adults is a valuable, simple and cost effective option of salvaging the natural femoral head while simultaneously

providing stable, painless and mobile hip leaving the option of reconstructive procedures open at an older age.

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Fibular osteosynthesis in neglected femoral neck fractures

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Background: Neglected fractures of femoral neck present a problem in management.

Method: Twenty five cases of neglected femoral neck fracture in young and middle age were treated by closed reduction and internal fixation by three peripherally placed cannulated cancellous screws, with centrally placed free fibular bone graft.

Results: Union occurred in all the 25 cases, one case had avascular necrosis. There was no residual disability at donor site. Twenty four cases had excellent and one case had satisfactory result.

Conclusion: Free fibular bone graft with multiple cancellous screws gives good results in treatment of neglected intracapsular fracture neck femur.

Key-words: Neglected femoral neck fracture; Fibular osteosynthesis; Free fibular bone graft

Introduction

Fractures of the femoral neck have always been a great challenge to orthopaedic surgeons. Innumerable methods of treatment are available, but none of them gives uniformly good results¹⁻⁶. The problem is further aggravated by presentation of large percentage of cases after a significant delay, a problem peculiar in developing countries like ours. Established methods of treatment for neglected fracture elsewhere do not hold good for femoral neck fracture because of its complexity in anatomy and biomechanical circumstances. The recent advances in the treatment have remarkably changed the outcome but the optimum results are still not achieved and hence none of the method has been universally accepted as standard method of treatment⁶.

The present work was undertaken to study the role of free fibular bone graft with multiple cancellous screws in treatment of neglected intracapsular fracture neck femur.

Material and methods

Twenty five cases of ununited fracture neck femur between Jan 1998 to Dec 2001 were studied. The duration of injury was 3 weeks to 24 weeks, average being 10 weeks and majority of patient were between 22-60 years of age. Mean age being 48 years.

The patients were kept on bilateral A/K skin traction preoperatively till the two limbs were equal or the injured limb was slightly longer. Patients were taught quadriceps drill on day one.

Operative technique

The surgery was done, under general or regional anaesthesia on fracture table under C arm image intensifier. Close reduction was done with the usual method, position of the fragments was confirmed in AP and lateral views by image intensifier. Fracture was fixed by peripherally placed 3 cannulated cancellous screws in usual manner taking care that at least 1.5×1.5cm of lateral cortex was intact in the middle for fibular graft. A guide wire was placed in almost center of femoral head and neck under the control of image intensifier, length of the guide wire helped to assess the required length of the fibular graft, pre calculated length of fibula was removed by Gigli saw from the middle of ipsilateral leg. Intrososseous border of fibula was chiseled off to have almost rounded fibula. 9.0mm hole was drilled around the centrally placed guide wire by the drill bit used for lag screw of DHS. Multiple drill holes using 2.5mm drill bit were made in the whole length of fibular graft already removed. The graft so prepared was hammered over the guide wire upto the subchondral part of the femoral head under C-arm control. Wounds are closed in layer over suction drain.

Post operatively no external splintage was given. Isometric quadriceps exercise were started preferably on the first post operative day as per pain tolerance and cooperation of patient. Knee bending exercises were started on 2nd or 3rd post operative day. Crutch walking was allowed after 6 weeks. Patient were followed at 6 weeks interval and examined clinically and radiologically. Full unsupported weight bearing was not allowed till radiological consolidation of fracture. The average follow up period has been 2 years.



Fig. 1. (a) Radiograph showing ununited femoral neck fracture; (b) Immediate post operative X-ray; (c) At 8 months followup showing union

Results

Union occurred in all the 25 cases within 12-24 weeks, average being 16 weeks (Fig. 1, 2). Old fractures with absorption of neck took longer than relatively fresh fractures. There was no residual disability at donor site, except transient lateral popliteal nerve involvement in one case. Avascular necrosis was observed in one case, which had persistent pain and restriction of movements at the affected hip. Rest all the patients had full range of movements at hip and knee and were able to resume routine activities. Infection, superficial or deep, did not occur in any case. Results were graded on excellent in 24 cases and satisfactory in one case.

Discussion

Neglected fractures of the femoral neck >3 weeks old pose a challenging problem in management in regards to rate of union and complication like avascular necrosis. Many methods of treatment⁵ such as osteotomy displacement/angulation, replacement arthroplasty (Hemi/total)^{4,6} & osteosynthesis using vascularized corticocancellous graft (Meyer’s procedure)⁷ or fibular osteosynthesis⁸⁻¹² have been advocated. Osteotomies whether displacement/angulation changed the normal anatomy as well as biomechanics of the hip, result in residual shortening and make future replacement procedure if needed difficult a part from added risk of nonunion at the osteotomy site.

Replacement arthroplasties whether hemi or total involve replacement of natural head by prosthetic head and the best results after arthroplasty, whether hemi or total, can’t be compared to the united femoral neck fracture in anatomical or near anatomical position. Successful osteosynthesis overcomes all these problems. Many methods of osteosynthesis using vascularized corticocancellous graft i.e. muscle pedicle or fibular grafting have been advocated. Muscle pedicle grafting needs open reduction which further

jeopardizes vascularity of femoral head and is associated with high incidence of avascular necrosis and hence, has lost its popularity.

Henderson⁷ treated nonunion of the femoral neck fracture by open reduction and free fibular grafting with POP hip spica for 3 months. Nagi et al^{10,11} reviewed young patient treated by ORIF with one cancellous screw with free fibular graft and supplemented it with external immobilization using Thomas knee splint or a foam gutter splint or POP hip spica and reported encouraging results.

In modification of Nagi’s technique, authors have successfully treated 25 cases of neglected fracture neck femur by closed reduction and internal fixation by three peripherally placed cannulated cancellous screws and centrally placed free fibular graft. The three cancellous screws provide rigid fixations to the fracture, parallel lag screws permits collapse at fracture site still retaining the fixation and thus bringing in union. Bone dust resulting from drilling by 9mm drill bit works as internal bone graft. Fibular strut supports osteoporosed,



Fig. 2. (a) Radiograph showing ununited femoral neck fracture; (b) Follow-up X-ray showing union.

poorly vascular or avascular femoral head, assist in fixation as well as have osteoinductive potential.

Rigid fixation thus achieved does not necessitate any external immobilization. Close reduction doesn't disturb the retinacular vessels and hence do not add to poor blood supply, so vital for fracture healing.

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Management of trochanteric fractures

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Background: Trochanteric fractures unite invariably with conservative treatment. However the high rate of complications associated with this method makes stable reduction and rigid internal fixation the treatment of choice.

Methods: Eighty fresh trochanteric fractures were subjected to internal fixation, 50 with the DHS and 30 with the DCS. Indirect reduction or open reduction with internal fixation using prophylactic antibiotics was done. Patients were followed up clinico-redirectologically for 2 years.

Results: Satisfactory fixation was achieved in 93.3% of the DCS group and 92% of the DHS group. Union was seen at 12 weeks and 16 weeks depending on the quality of reduction and fixation. Technical problems and complications were slightly higher in the DHS group.

Conclusion: Although there were no significant difference in the number of good reductions and the time to bony union between the 2 groups, as regards handling and complication, the DCS was found a more versatile implant compared to the DHS.

Key-words: Trochanteric fractures; Internal fixation; DHS; DCS.

Introduction

Trochanteric fractures of the femur are rising in incidence. By definition, intertrochanteric fractures include any fracture from the extra capsular part of the neck of the femur to a point 5cm distal to the lesser trochanter¹. These fractures occur predominantly in people over 60 years old and are 3-4 times more common in women than men². Although these fractures unite invariably with conservative treatment, the high rate of complications associated with this method makes stable reduction and rigid internal fixation the method of choice.

Internal fixation of trochanteric fractures is a life saving measure in the elderly³.

Intrinsic factors such as osteoporosis and comminution are beyond the control of the surgeon, extrinsic factors like choice of the reduction of the fracture, the type of implant used and technique of its application are within his control².

Various classifications of these fractures have been proposed; most of them include a subtrochanteric fracture as one or the other of its types. Implants used for fixation of these fractures include: pin-plate assemblies e.g. S-P nail plate; adjustable angle device e.g. McKee and McLaughlin nail plates; fixed angle devices e.g. Jewel nail plate; sliding compression screw assemblies e.g. DHS, DCS; intramedullary nails e.g. Ender nails, the gamma nail. DHS permits good impaction of fracture site with compression effect in trochanteric fracture of the femur. AO dynamic condylar screw (DCS) are designed for internal fixation of fractures of the distal and of the high subtrochanteric regions. It has been suggested that using a 95° implant may be stronger biomechanically than the 130° implants because it allows additional screw fixation to the proximal fragment. DCS is an appropriate device for reverse oblique intertrochanteric fracture with subtrochanteric extension.

In this study, we have attempted to prospectively analyze the operative results of the DHS and DCS used in the treatment of intertrochanteric fracture of the femur.

Material and Methods

Between 1998 to 2000, 80 patients with trochanteric fractures were treated. Of these, 50 were fixed with the DHS and 30 with the DCS. The patients included 29 males and 51 females ranging in age between 21 years and 84 years (average 52.5 years). Forty eight fractures affected the right side and 32 affected the left. According to Boyd & Griffin classification 3 cases were type I, 53 cases type II, 10 cases type III and 8 cases type IV. Under general or spinal anaesthesia, over a fracture table and under image intensifier control, the fractures were reduced by closed manipulative reduction, failing which open reduction was resorted to. Implants were introduced following standard techniques and instrumentation for all types of fractures.

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Fig. 1. (a) Reverse obliquity fracture; (b) fixed with DCS.; (c) united fracture after DCS removal



Third generation cephalosporins were used pre-operatively and continued post-operatively for another 10 days. Patients were encouraged to move their operated limbs from the first post-operative day. Partial weight bearing with axillary crutches was started by the second week. Full weight bearing was allowed only when the x-ray showed bony union.

Results

There was no significant difference in the different types of fracture in both the groups. Post-operative X-rays showed that there was no significant difference in the total number of good reductions between the two groups. A greater number of anatomical reductions were achieved in the stable fractures in both groups.

Satisfactory fixation was achieved in 28 patients (93.3%) in the DCS group (Fig 1) and 46 patients (92%) in the DHS group. Union was achieved at an average of 12 weeks for those fractures where reduction was stable and fixation satisfactory. In unstable fractures with unsatisfactory fixation the average time of bony union was 16 weeks.

Post-operative infection was insignificant in both the groups. There was only one case of superficial infection in the DHS group, which was controlled with antibiotics. Nail penetration was found in one case of the DCS group and nail cutting through the cortex of femoral neck in one case and head in one case of the DHS groups. Five cases in DHS groups and 2 cases in DCS groups had shortening ranging 1 to 3 cm All these cases had unstable fractures and unsatisfactory fixations.

Four cases in DHS groups and 2 cases in DCS group had coxa vara which was immediate post-operative where satisfactory reduction could not be achieved. Two cases in DHS groups and one case in DCS group complained of hip pain. Four cases in DHS groups and 2 cases in DCS group had restriction of terminal range of hip movements (ranging

from 10° to 25°). Four cases in DHS group and 2 cases in DCS group had difficulty in sitting cross legged.

There were no failure of union, deep infection and no requirement for repeat surgery in both the groups. The final results were recorded as excellent, good, fair and poor using criteria modified after Kyle⁴ suitable for Indians. (Table I,II). It was found that excellent results were seen in 92% in DHS group and in 93.3% in DCS group.

Table I. Evaluation of outcome of patients (after Kyle⁴)

Criteria	DHS	DCS	Total	%
Pain	2	1	3	3.7
Limp	3	2	5	6.3
Shortening				
None	46	28	74	92.5
0-1 cm	2	1	3	3.7
1-3 cm	3	1	4	5
> 3 cm	-	-	-	-
Total	5	2	7	8.8
Coxa vara				
None	46	28	74	92.5
0-10°	2	1	3	3.7
10-20°	2	1	3	3.7
20°	-	-	-	-
Total	4	2	6.6	7.5

Table II. Functional restriction.

Function	DHS	DCS	Total	%
Sitting cross legged possible	46	28	74	92.5
Not possible	4	2	6	7.5
Squatting possible	50	30	80	100
Not possible	-	-	-	-
Walking without support	50	30	80	100
With support	-	-	-	-

Discussion

Dynamic hip screw is considered gold standard for management of tochanteric fractures. There is added advantage of controlled collapse of the fracture. For some

years we treated these fractures with the DHS exclusively, seeing many good results. The not so good fixations we encountered were in the form of loss of reduction and cut-through of the screw through the femoral head or neck.

Another undesirable aspect of this implant is that it requires a very long incision for the insertion of the side plate/barrel plate since it had to travel upwards and medially to make contact with the lateral femoral cortex.

We have been fixing trochanteric and subtrochanteric fractures with the AO 95° dynamic condylar screw. This implant does not require an incision longer than its own length since the barrel plate traverses and almost horizontal line on its way to the lateral cortex of the femur. Also, its use combines the ease of insertion of the sliding screw plate with the mechanical effectiveness of the angle blade-plate. Another advantage is that, we could add two more cancellous screws through the fracture improving fixation and effectively controlling rotation.

The ideal of controlled collapsed rests on the principle of the collapsing forces being perpendicular to the fracture line. A device that traverses in alignment with these compressing forces does excellently. The DHS therefore is an ideal implant for type I & II fractures. In reverse obliquity trochanteric fractures, the fracture line does not conform to this ideal. Here the screw of the DHS is almost parallel to the fracture line and perpendicular to the compressing forces. This would in most cases lead to medial migration of the

distal fragment and loss of reduction. We agree that the 95° DCS performs significantly better than did sliding hip screws⁵. Infection, nonunion, implant breakage and loosening are reported complications⁶⁻⁸. We have not seen implant failure or other causes for re-operation.

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Supracondylar fractures in children—closed reduction vs open reduction

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Back ground: Supracondylar fracture is the most common fracture around the elbow in children of the age group 5-10 yrs. The issue of open reduction in such fractures is always a matter of debate as even closed reduction gives satisfactory results. However the present study of 50 cases aims to highlight the benefits of open reduction over closed reduction in such cases.

Methods: Patients were divided into two groups, 25 cases (group I) were treated by ORIF using K-wires while 25 cases (group II) were treated by closed reduction and P.O.P. splint in pronation. Group I patients were treated under G/A by two mini incisions medial and lateral and fragments fixed with K-wires. Post-operatively P.O.P. back splint was given. In both groups, the back splint was discarded after three weeks and active exercises encouraged.

Results: Minor complications as superficial infections and pin tract infection were observed in group I patients. However variation of carrying angle (cubitus varus) was more in group II. Limitation of movement was more in group II due to mal-rotation and anterior ledge formation, not seen with open reduction group.

Conclusion: We conclude from above series that ORIF of supracondylar fracture is better than closed reduction as incidence of malunion is less and range of motion near normal as compared to closed reduction.

Key-words: Supracondylar fracture, cubitus varus, anterior ledge.

near the distal end of bone, at transformation zone, where shape changes from tubular to flat, and fracture line crosses just proximal to the articular surface. This local anatomy makes it difficult to achieve satisfactory reduction and more so to maintain it. Children are specifically predisposed to this fracture due to various factors, mainly ligamentous laxity and anatomical structure.

The fracture has an impressive pedigree of devastating complications ascribed to it, including arterial occlusion – leading to VIC, nerve injury – median nerve most common, severe deformity, permanent disability, compartment syndrome, myositis ossificans and amputation. It should be considered as a surgical urgency. Various treatment modalities available are close reduction and POP cast, traction, open reduction and internal fixation and close reduction and percutaneous pinning. Each method has its own advantages and disadvantages. As stated by Siris¹ main objectives of treatment for supracondylar fracture in children are prevention of Volkmann's contracture, avoidance of deformities, and restoration of normal function. In past open reduction was generally reserved for complicated cases or performed only after failure of several attempts at closed reduction, as it was believed to produce poor results attributed to the additional surgical insult. The aim of the study was to compare the results of CR & POP cast with primary ORIF in management of supracondylar fractures of humerus.

Introduction

Supracondylar fracture of humerus in children is one of the most common fractures seen in pediatric orthopedic clinic setting worldwide. It accounts for 65.4% of upper extremity fractures in 5-10 year age group in children, fall on outstretched hand being the commonest cause. It is a fracture

Material and methods

Present study consisted of 50 cases of Gartland's type III supracondylar fracture in children admitted to our department from 2001-2004. Patient age ranged from 2 to 12 years with average age of 7.33 years, 82% boys. Thirty one patients attended emergency same day, 11 came next day, 5 within 2 days and rest 3 came in 2-7 days after injury. Patients were divided into two groups, 25 cases (group I) were treated by ORIF using K-wires while 25 cases in group II were treated by closed reduction and P.O.P. splint in pronation. There were three cases of compound fracture in group-I. Five patients in group-I and two in group-II had taken previous

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Fig 1(a). Pre-reduction X-ray showing supracondylar fracture, **(b)** X-ray after reduction, and **(c)** post-reduction X-ray showing union.

treatment in the form of massage and splintage from local bone setters. Our only criterion was that any patient with neurovascular compromise must be treated in group-I, except these patients were randomly allotted groups. So in group-I five patients had weak radial pulse and seven had some neurological complication because of fracture, which was partial in nature and recovered in three weeks. Patients were divided into two groups.

Group I cases were operated under G/A and tourniquet control. With medial and lateral mini incisions open reduction was done. The quality of reduction was assessed by inspection of medial and lateral supracondylar ridge alignment. Two crossed K-wires were put from below the epicondyles across the fracture line into proximal fragment obliquely so as to engage the opposite cortex of the proximal fragment. Elbow alignment was checked by comparing with the opposite side in full extension, this step is important in cases with supracondylar ridge comminution. K-wires were left percutaneous and cut and bend just proud of the skin to facilitate subsequent removal without anesthesia. Capillary return was checked. POP splint was applied in 90° flexion and mid prone position.

The child was discharged after 24-48 hours on oral antibiotics. Patients were reviewed after three weeks when stitches were removed and POP splint discarded. Active exercises were started at three weeks. K-wires were removed between 4-6 weeks in group I.

Group II cases were treated by CR and POP splint under general anaesthesia with elbow flexed to more than 90° degree and full pronation of the forearm. After manipulation radial pulse was checked and if absent, the degree of flexion was reduced to recover the pulse. An acceptable reduction of the coronal, sagittal and rotational alignment was attempted. All cases in this group were taken to O.T. with prior consent for surgery if check X-ray done in O.T. showed unsatisfactory reduction. Criteria used for satisfactory reduction was Baumann's angle within 5°–8° and humero-capitellar angle within 10° of the contra-lateral side. Cases with unsatisfactory

reduction were taken for open reduction and internal fixation immediately. These patients were excluded from study as they did not fit into primary ORIF group. In group II cases child was discharged next day. POP splint was discarded after three weeks and active movements were started.

All patients were reviewed at 3 wks, 6 wks, 9 wks, 3 months, 6 months and 9 months. Assessment at final visits included clinical measurement of carrying angle of both the elbows and range of motion using goniometer. Results were graded as per criteria of Mitchell and Adams (1961) as shown in table I. The results were compared at minimum follow up of six months.

Table I. Criteria of Mitchell and Adams (1961)

Results	Criteria
Excellent	Normal shape & movements apart from 5° changes in carrying angle and 10° limitation of flexion.
Good	Reduction of the carrying angle from 5°–10° but not beyond cubitus rectus and restriction of flexion by 10°–20°.
Unsatisfactory	Alteration of carrying angle by more than 10° with obvious varus deformity and restriction of flexion more than 20°

Results

Commonest age group was 5-10 years. Left side was involved in 29 patients. Three fractures in group I and none in group II were open. All the fractures in group I were extension type while two were of flexion type in group II. Average duration of hospital stay in group I was 2.8 days compared to 1.8 days for group II. Commonest complication observed in group I was pin tract infection (10 cases) followed by superficial infection (5), transient ulnar nerve palsy (1) and deep wound infection (1). Pin tract infection resolved with oral antibiotics and did not require premature pin removal. Superficial infection was managed by local antibiotic dressings. Mal-union (Fig. 1) was the commonest complication (Table II) in group II (9 compared with 4 in group-I) followed by myositis ossificans (1). Extent of elbow flexion was near normal in 16 cases of group I and 11 cases in group

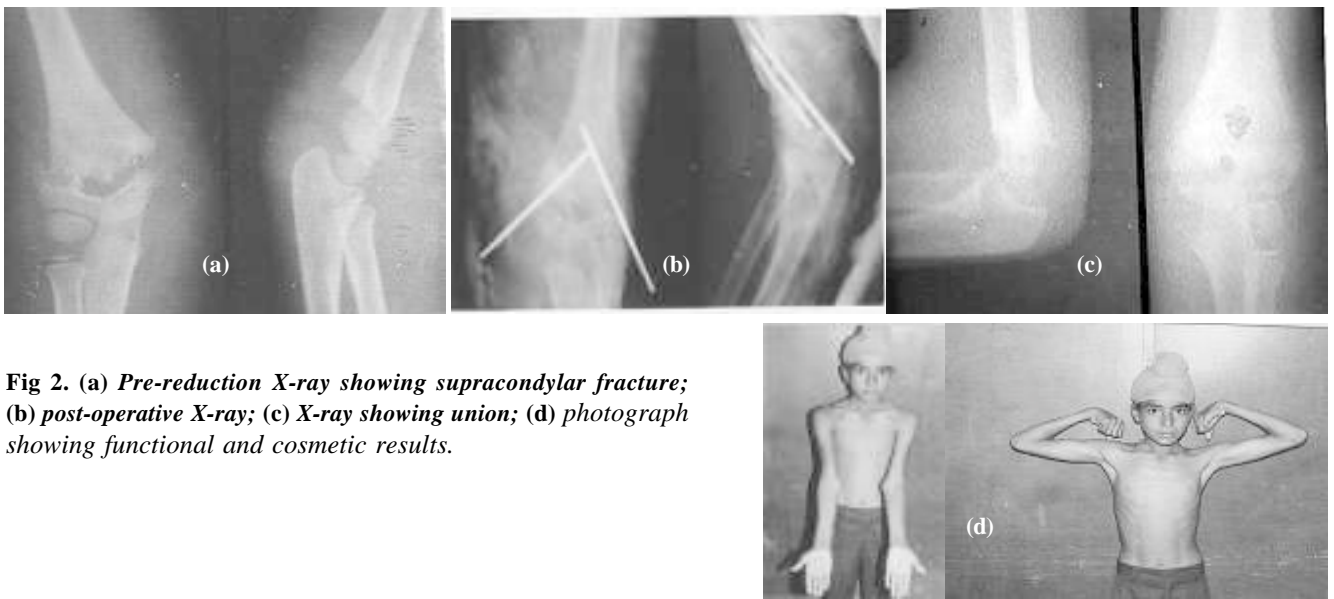


Fig 2. (a) Pre-reduction X-ray showing supracondylar fracture; (b) post-operative X-ray; (c) X-ray showing union; (d) photograph showing functional and cosmetic results.

II. Extension lag was recorded in 5 cases in group-I and 6 cases in group-II. But it was significant only in one case of group-I, where full extension of elbow was not possible and it hindered in carrying angle determination. Results were significantly better in group I (Fig. 2) (Table III).

Table II. Carrying angle in both groups

Carrying angle in degrees	Group I No.	Group II No.
Negative carrying angle	4	9
Zero degrees	3	3
0-10°	9	10
11-15°	8	3
Could not be determined	1	—

Table III. Results as per criteria of Mitchell and Adams (1961)

Grading	Group I	Group II
Excellent	9	9
Good	11	5
Unsatisfactory	5	11

Discussion

Though supracondylar fracture of humerus is the commonest injury around elbow in children, a single, perfect and ideal method of treatment for this fracture is yet to emerge. Treatment modality should be such so as to satisfy both functional as well as cosmetic results.

Closed reduction and casting for type-III fracture is still practiced in developing countries due to limited facilities. Its merits include no need for metal insertion², least costly and less time consuming. Main demerits are high incidence of multiple attempts³, failure in grossly displaced fractures and

loss of reduction after successful closed reduction. The main difficulty of closed reduction & POP splint is the need to hyperflex the elbow beyond 120° to maintain reduction, which is not always possible due to loss of radial pulse on hyperflexion. Failure to do so increases the risk of losing reduction, due to loss of supporting effect of the triceps muscle. Another fallacy in closed reduction is that coronal tilt is not always appreciated on radiograph, and the fact unveils itself only when deformity has already occurred⁴. Loss of reduction was a major concern in our series as we included only perfectly reduced fractures in group-II, any case with unsatisfactory reduction was managed by ORIF and excluded from series.

The main goal of surgical treatment of pediatric supracondylar humerus fracture is to safely create an adequately stable construct to prevent axial rotation and coronal or sagittal tilt to avoid post-operative deformity⁴⁻⁸, which historically has been reported as high as 17%^{9,10}. Internal rotation of the distal fragment is the major predisposing factor to varus deformity and is necessary for coronal varus tilt to occur^{5,8,11}. This is the most critical plane in which to achieve stability with fixation¹². The actual bony surface contact area of the fracture fragment is remarkably small, so even small amounts of rotational motion can lead to clinically significant varus tilt^{5,12}.

Closed reduction and percutaneous pinning has become the standard treatment for reducible supracondylar fractures. However delay in presentation¹² and the non-availability of image intensifier preclude successful closed management, both of which are common in developing countries. After

closed reduction and percutaneous fixation the tilt can be best appreciated only after the elbow is completely extended and if present it will require wire removal, repeat reduction and fixation, this sometimes lead to accepting less than accurate alignment. Achieving anatomical reduction under C-arm is also tough as it is basically closed reduction and it is difficult to judge reduction, specifically coronal tilt radiologically^{4,6}. Moreover the reported incidence of iatrogenic ulnar nerve injury ranges from 2% to 8%^{7,13,14}, with Gosens and Bongers reporting alarming 16.5% incidence of neurological compromise¹⁵ in series of 200 cases. Taking this fact into consideration some authors recommended two lateral pins⁷. Medial and lateral pin insertion provides better stabilization¹¹ and but opinion varies about stability of two lateral pins.

Most pediatric orthopedic surgeons would reserve ORIF for open fractures or for those associated with vascular injury¹¹. But it can give good results with low complication rate as anatomical reduction can be achieved by ORIF. In meta-analysis of 470 supracondylar fractures, Wilkins reported a 1.4% incidence of myositis ossificans and 0% incidence of lasting neurovascular deficit⁸.

Medial and lateral mini-incisions allow excellent view of the fracture anatomy, access to fracture site in case of any buttonholing and most importantly anatomical reduction. Additional advantage of open reduction is decompression of fracture hematoma which reduces the risk of compartment syndrome by decreasing the resistance to venous outflow. Haematoma drainage and elimination of secondary soft tissue injury from repeated attempts at CR reduces the predisposition to excessive callus formation and myositis ossificans, thus better post-op range of motion. Soft tissue injury is most important prognostic factor for recovery of elbow range of motion. Sibly pinned 35 cases in retroversion but still reported predominant extension loss¹⁶, thus concluding that extension loss is mainly due to soft tissue injury.

Rate of pin tract and superficial infection is high in our series which might be due to the fact that we have included all the cases where even angry looking inflammation around the pin tract was noticed without pus formation. Range of motion was significantly better in group-I with 16 cases showing near normal elbow flexion as compared to 11 cases in group-II (P=0.044). In cosmetic results, surgical intervention however does not provide immunity to cubitus varus deformity which still remains the commonest complication¹⁷.

In our series we had 16% incidence of cubitus varus in ORIF group which is better than CR group with 36% incidence. One case with significant extension lag in group-I was mishandled by traditional bone setter and reported in emergency late with huge swelling and gross displacement.

As per Mitchell and Adams criteria excellent to good results were seen in 80% cases in group-I while unsatisfactory results were seen in 20% which rose to 44% in group-II. The results of ORIF are comparable to those of many other authors in recent publications. Philip et al reported 82% excellent or good results, 12% fair and 6% poor results, in open reduction of irreducible supracondylar fractures¹⁸. Kumar et al reported 84% excellent and good results and 16% fair and poor results in primary ORIF using medial incision and crossed pins in type-III supracondylar fractures¹⁹. Closed reduction and casting for type-III fractures has been recently condemned by many authors^{20,21}. The final results of present series when compared using Chi-Square test significantly favor ORIF over CR & POP as the treatment of choice (P=0.005) for management of displaced supracondylar fractures of humerus in children.

From above study we conclude that primary ORIF of type-III supracondylar fracture gives good functional and cosmetic results as compared to closed reduction and POP splint, and surgeons must lower their threshold for open reduction of displaced supracondylar fractures. The fears of infection, significant loss of motion¹⁶ and myositis ossificans are unfounded. The ulnar nerve identification and mobilization in the length of incision makes iatrogenic nerve injury unlikely. The morbid pathology is visualized, and anatomical reduction can be achieved, which minimizes the chance of accepting less than excellent results. Cross pinning provide stable fixation and obviates the need to immobilize elbow in more than 90° flexion. Though percutaneous pinning obviates the need of surgery, however danger of nerve injury can not be ruled out, secondly in some fractures closed reduction may not be possible and open reduction is the only answer, thirdly expensive C-arm is must for percutaneous pinning.

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Displaced supracondylar fracture of the humerus in children : a modified technique of closed reduction

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Background: Reduction of supracondylar fracture in children is technically difficult and therefore numerous methods have been described in the past .

Method: We present a modified technique of reduction of grade three extension type supracondylar fracture of the humerus in children . All fracture except one were stabilized with two crossed pins after reduction under image intensifier. Early mobilization at 3 to 4 weeks with the pins in situ and pin removal at 4-5 weeks produced good results .

Results: Only three out of 38 patients treated by this method had poor results. No neurovascular complications were found in the patients treated by this technique, and indeed we found that this method worked well even in those cases who presented late or had a gross swelling over the elbow at the time of presentation. At the end of three weeks, Baumann's angle was found to range between 72-84 degrees.

Conclusion: The authors found this method to be effective and without any complications in the treatment of the displaced extension type supracondylar fractures of the humerus .

Key-words: Supracondylar fracture of the humerus; Two crossed pins.

Various methods have been described for the reduction of the fracture, such as reduction of the fracture by manipulation in flexion¹, milking maneuver to disengage the proximal fragment from the soft tissue^{2,3}, and manipulation reduction immobilization and fixation using a U-shaped slab with elbow in full extension⁴. The most popular method of reduction is longitudinal traction with elbow in extension and forearm in supination⁵. Two crossed Kirschner wires, the tips of which cross to the opposite cortices, provide an adequately rigid biomechanical construct than lateral Kirschner wires for maintaining the reduction^{6,7}.

Method and Material

From March 2002 to September 2002 we treated 38 patients with Gartland and Wilkins type three closed, extension type of supracondylar fractures of the humerus. All patients were treated by the same surgeon on an out patient basis immediately following presentation. There were 29 male and 9 female patients. The mean age was 7.2 years and range 2-14 years. The time of presentation varied from a few hours to 5 days after injury. Out of the 38 patients, 22 presented within 12 hours after injury, and 16 between 1 to 5 days, with the average being 2.6 days. Manipulation had been tried elsewhere in one patient and a history of massaging of the extremity was given by 5 patients. In 3 patients peripheral pulses were absent but none of the patients had a compromised distal circulation when checked by nail bed circulation and colour of the hand. One patient had a radial nerve palsy before manipulation which recovered completely within 3 months post reduction .

Method: Dissociative anesthesia (Diazepam and Ketamine) was used in all the patients and the image intensifier was positioned at the head end of the patient. Continuous traction was applied to the forearm against a counter traction on the arm, by the assistant for 2-3 minutes, with the elbow in full extension and forearm supinated such that the palm is held facing the ceiling (Fig. 1). This caused disimpaction of the fragments and

Introduction

Supracondylar fractures of the humerus in children are difficult to treat. Closed reduction is both difficult to achieve and maintain, because of the thinness of bone at the distal third between the coronoid and olecranon, where most supracondylar fractures tend to occur.

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Fig. 1. (a) Step one of reduction, traction and counter traction in extension of the elbow with fore arm supine and arm in neutral rotation; (b) Step two of reduction, anterior - posterior movement is done at the fracture site keeping the traction and counter traction on.

aligns the fragments in the normal anatomical position with respect to varus and valgus angulations. Then with the traction on, one hand was kept anteriorly over the proximal fragment and another was kept posteriorly over the distal fragment and gentle antero-posterior movement was carried out several times. During this movement one feels the click of reduction. After that the elbow was flexed and the alignment of reduction was checked under image intensifier. Lateral view was obtained by turning the image intensifier without rotating the arm with the elbow in flexion. If satisfactory alignment cannot be achieved the whole procedure is repeated till adequate reduction is achieved. The authors had tried this maneuver to a maximum of six times for a five day old injury. Medial and lateral displacement can be corrected by pushing the distal fragment medially or laterally, while lateral opening is corrected by pronating the forearm.

After reduction pinning of the fracture was done under image intensifier control. The lateral pin was introduced first, keeping the level of lateral pin in mind under image intensifier guide the medial pin was introduced avoiding the ulnar nerve. The author noted that the entry point of the medial pin was either at the same level or 1 to 2 mm posterior to the lateral pin.

At the end of three weeks the plaster of Paris slab was removed, a check X-ray obtained and active physiotherapy started. By the fourth to fifth weeks post

reduction the Kirschner wires were removed and follow up was maintained until 12 weeks. Baumann's angle and anterior humeral line were studied in all the patients at the end of three weeks.

The elbow was kept in a posterior slab at 120 degree flexion for three weeks, followed by removal of the support and radiographic evaluation.

Results

Results were classified on the basis of radiographic findings into three groups good, satisfactory and poor.

Good: Perfect alignment of the fracture fragments.

Satisfactory: Reduction with translation of distal fragments up to two millimeter in sagittal or coronal plane or few degrees of valgus angulation, but those with rotation, varus, or anterior angulation were not accepted.

Poor: Rotation or varus angulation, Baumann's angle outside the range of 70-84 degrees, anterior humeral line passing anterior to the capitellum fell in this group.

Out of 38 patients, 26 had good results (Fig. 2). Five patients out of nine from the satisfactory group presented 12 hours after injury and three patients were from the poor category. There was no iatrogenic injury to the ulnar nerve during percutaneous pinning of medial column, but one patient had a radial nerve palsy before reduction was attempted. Myositis ossificans was not found in any case.



Fig. 2. (a) Displaced supracondylar fracture of the humerus; (b) three weeks post reduction and fixation with kirschner wires.

No deep pin tract infection was noted in any of the cases. The average range of motion at the end of 8 weeks was 52 to 126 degrees and all the patients had a full range of movement by the 12th week. The range of Baumann's angle was 72-84 degrees, the average being 78.6 degrees.

Discussion

Boyd et al⁸ prefer two crossed medial and lateral Kirschner wires put percutaneously for unstable fracture. In their series, 70 of 71 patients had satisfactory results and only two cases had iatrogenic ulnar nerve palsies. Two crossed Kirschner wire fixation is the most popular technique for stabilization of displaced supracondylar fractures of the humerus, but reduction of fracture to the correct alignment is often technically difficult⁹.

We have modified the technique advocated by Wilkins⁵ where reduction was achieved only by longitudinal traction. In this method along with longitudinal traction gentle antero-posterior movement was done at the fracture site, which helped the fracture fragments to align in proper position. The important key to reduction by this method is the continuous traction and counter traction for 2-3 minutes with shoulder in neutral rotation and forearm supinated so that the palm is facing anteriorly. We found that this method was effective and safe for management of displaced supracondylar fracture of the humerus in children. The frequency of ulnar nerve injury during insertion of medial pins percutaneously ranges from 0 - 5 % in various studies^{10,11}. For that a small incision and identification of the ulnar nerve has been advised⁹, if the entry point of the medial pin is kept at the same level as that of lateral pin, injury to the ulnar nerve can be avoided. Rotating the image intensifier rather than the arm for the antero-posterior and lateral view prevents the displacement of reduction. Baumann's angle^{12,13}, anterior humeral line¹⁴, rotational malalignment and varus angulation were considered in the assessment of the reduction. The authors found this method to be effective and without any complications in the treatment of the displaced extension type supracondylar fractures of the humerus.

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Outcome after open reduction and internal fixation of intraarticular fractures of the calcaneum without the use of bone grafts

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Background: Intraarticular fractures of calcaneum are commonest type of calcaneal fractures. Lots of controversies exist about the ideal management for them. The focus is now shifting on operative management by open reduction and internal fixation for these fractures with or without the use of bone grafts.

Method: Thirty intraarticular fractures classified by Essex Lopresti radiological classification, were treated by open reduction and fixation. The patients were followed over a mean period of 30 months (25-40 months).

Results: All the fractures united at a mean duration of 14 weeks. 86% patients had excellent functional outcome with one patient having fair and one having poor functional outcome.

Conclusion: Open reduction and internal fixation with plate is a good method for treatment of intraarticular fractures of calcaneum to achieve anatomical restoration of articular surface under vision, stable fixation, early mobilization and an option for primary subtalar arthrodesis if deemed necessary.

Key-words: Intraarticular fracture calcaneum, Essex Lopresti classification, Open reduction internal fixation with plate without bone grafts.

Introduction

Calcaneum is the most commonly fractured tarsal bone. Majority of all calcaneal fractures are intraarticular and 30% are extraarticular¹⁻³. The incidence of fracture calcaneum has remained relatively constant⁴. The mechanism of injury is axial loading in a majority of patients but others like brake pedal injuries and high-velocity trauma leading to open fractures are also common. The fracture line usually moves medially forming an antero-medial and postero-lateral fragment. The

sustentacular fragment usually stays associated with talus because of strong ligaments. The postero-lateral fragment is important as it contains the posterior facet and can be rotated by as much as 180° in extreme cases. The postero lateral part of talus forces a free lateral piece of posterior facets into tuberosity fragment^{1,2,5}.

Conservative treatment of intraarticular fractures very often leads to increased morbidity due to incongruity of articular surface^{1,2,5,6}, widening of heel, talar dorsiflexion, loss of talo-calcaneal lever arm⁵ and peroneal tendon impingement⁷⁻¹¹. Hence focus has shifted to operative management with better outcome⁶⁻¹⁰. History of treatment suggests diverse treatment options; hence we have carried out a study to know the outcome of intraarticular fracture of calcaneum after operative treatment by open reduction and plating, without the use of bone graft.

Materials and Methods

Thirty intraarticular fractures of calcaneum were operated upon from December 2001 to April 2003 with one case of bilateral fracture calcaneum. Twenty five patients were male and 4 female. Sixteen fractures were on right side and 14 on left side. The mechanism of injury was fall from height in 26 patients and road traffic accidents in 3 patients. Two patients had associated spinal injury, one patient had pelvic fracture and three patients had associated ipsilateral lower limb trauma. One patient had open grade 1 injury with wound on medial aspect of the foot. Twenty eight patients were operated within one week of trauma and one patient was operated 12 days post injury because of adverse local condition. We have used the fracture classification system by Essex Lopresti based on X-rays^{1,2}. But the fracture pattern was assessed by using lateral, as also axial and Broden's view². Accordingly 21 fracture had joint depression variety and 9 fracture had tongue type fracture configuration. Though we understand that CT scan classification is much better^{1,2}, we were unable to apply it for all the patients due to financial constraint.

After admission the patients were placed in a bulky Jones dressing and assessed for operability by AP, lateral and

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Fig. 1. (a) *Pre-operative calcaneal view and lateral view (joint depression variety of fracture);* (b) *post-operative calcaneal view and lateral view showing restoration of posterior facet by inter-fragmentary screw passed outside the plate*



axial views of both affected and normal foot (for comparison). CT scans were obtained whenever it was possible to do so. Pre-operatively Gissane's angle and Bohler's angle were measured.

All the patients were operated in a lateral position by a lateral approach under tourniquet control and fixed calcaneal plate which best suited fracture configuration and 4mm simple cancellous screws with meticulous assessment of screw size to prevent injury to medial neurovascular bundle.

Primary subtalar fusion was not done in any of the cases inspite of extensive comminution of posterior facet in three fractures and acceptable alignment was achieved by buttress plating and interfragmentary screw fixation.

Surgical Technique: All the patients were operated by basic approach, advocated by Sanders¹ using Benirsche and Sangeorzan incision.¹³ Accordingly right angled skin incision was made on the lateral aspect of the limb. The horizontal limb was kept at the junction of thick plantar and thin dorsal skin. The vertical limb extended midway between lower border of fibula and tendoachilles. The angle was curved and not sharp. At the distal end, the horizontal incision was turned upwards at the calcaneo-cuboid joint. The incision was carried down to the lateral wall cutting the inferior peroneal retinacula and calcaneofibular ligament thus elevating a flap of tissue, but carefully protecting the peroneal tendon sheath, which was not opened. Peroneal tendons were mobilized over the fibula and self retaining retraction was obtained by passing K-wires in lateral malleolus, talus, cuboid which were bent away from the operative site to obtain excellent exposure of the subtalar joint and the posterior facet.

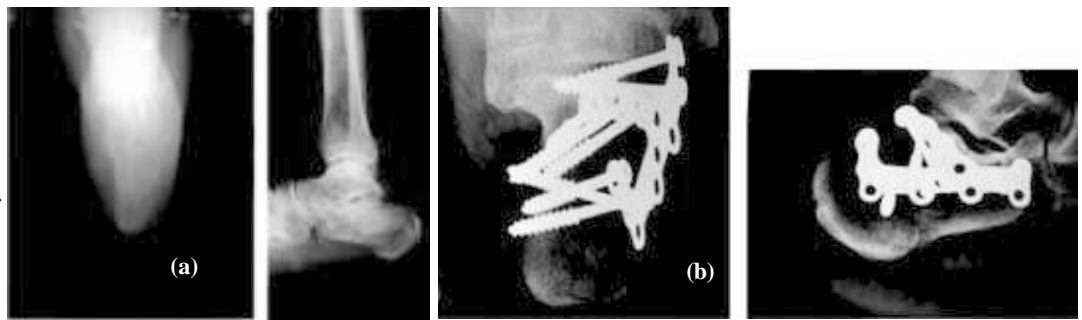
Primary fracture line in the lateral wall was exposed and opened, the depressed posterior facet was dug out and elevated with the help of an elevator. After lifting out the posterior facet; with the help of a schanz screw drilled in the posterior tuberosity fragment varus angulation, impaction,

increased heel width and loss of a calcaneal height were corrected by giving a valgus corrective force in the opposite direction. Achievement of congruous posterior facet was the prime aim of surgery although congruous reduction of anterior, middle facet & calcaneocuboid joint was also attempted. This reduction was appreciated under direct vision and provisionally fixed with 2.5 mm K-wires passed axially. On table a radiographic assessment was made for restoration of Bohlers and Gissane's angle. On achieving acceptable reduction, especially of posterior facet, final fixation was done either with an anterior cervical spine fusion plate, reconstruction plates, Sanders or modified Sander's plate and 4mm simple cancellous screws. After the lateral wall had been repositioned into anatomical position to obtain the height of calcaneum. The medial sustentacular fragment was fixed with a screw passed under IITV control through the plate from lateral to medial side, into sustentaculum tali.

In 5 patients there was a sagittal split in posterior facet which was successfully compressed using interfragmentary screw passed through the plate. The reduction of the posterior facet was successfully maintained by a screw passed through the subchondral bone just below the posterior facet. The flap was apposed using Vicryl 1-0 in subcutaneous plane and skin by silk.

Post Operative: Post operative elevation was maintained for 48 hours. Number 10 drain was used in all cases and removed at 48 hours and a below knee splint was given over a bulky compressive dressing. Active ankle and subtalar motion was encouraged from 2nd or 3rd day post operative as pain permitted and was assessed by the 'circle draw test'. Sutures were removed at an average of 18 days. The patients were kept non weight bearing for 8 weeks. Gradual weight bearing progressed from 8 to 14 weeks and patients were full weight bearing by the end of 14 weeks. Regular check X-rays obtained at 6 to 8 weeks and then at 14 weeks. Podograms were taken at final follow up and compared with the opposite

Fig. 2(a) Pre-operative calcaneal view and lateral view (joint depression variety of fracture); **(b)** Post-operative calcaneal view and lateral view showing restoration of posterior facet and Bohler's and Gissane's angle



side in unilateral cases. The results at an average 2 years of follow up were analyzed using Creighton and Nebraska score⁷ and radiological assessment was done with Gissane's angle and Bohler's angle (Fig 1, 2).

Results

Post operative restoration of Bohler and Gissanes angle was possible in all the patients. In all the patients Bohlers angle (Normal 25 to 40 degree) was decreased to average of 10 degree pre-operatively indicating depressed posterior facets. Post operatively we were able to achieve a Bohler's angle of average 30 degrees. Gissane's angle (Normal 90–110 degree) was disturbed in all the patients and post operative we were able to restore it in a normal range. Post operative average Gissane's angle was 100°.

Patient distribution as per various criterias of Creighton-Nebraska scoring has been shown in table I. Post operative infection requiring implant extraction at 12 weeks was seen in one patient contributing to fair result and superficial infection which responded to antibiotics was seen in one patient.

Table I. Patients distribution as per total score and resultant functional outcome

Result	Points	No. of patients
Excellent	90-100	25
Good	80-89	2
Fair	65-79	1
Poor	≤64	1

Discussion

Intraarticular fractures are common as compared to extraarticular fractures, hence the importance of anatomical reduction to decrease the possibility of joint incongruity and subtalar arthritis. Open reduction and internal fixation is now more aggressively advocated for management of intraarticular fractures of calcaneum. Intraarticular fractures are commoner and hence importance of anatomical reduction to decrease the complication of subtalar arthritis, joint incongruity and late ankle arthritis.

In the present series, joint depression variety was commoner as compared to tongue type. This observation matches with that cited by other authors also.^{7,12} Associated injuries were common, especially involving spine and lower limb, as was also noted by other.^{12,14} In our study, it was possible to restore the Gissane's angle and Bohler's angle post-operatively. The average pre-operative Bohler's angle was 10° and it was 30° post operatively. Scalmberg et al¹² reported average pre operative Bohler's angle of 6° and average post operative angle of 26°.

In our series 25 patients had no pain on activity. This is in contrast to the other reports¹⁵⁻¹⁷, which claim that pain was not improved by surgery. Only in four patients the range of inversion and eversion was restricted to 40% to 60% of normal, this is similar to that reported by other authors¹⁸. No patient had to change jobs and only 5 patients had to work with some restrictions as was also observed by Leung et al⁷. No patient underwent change in shoe size though 6 patients had changes in size of podogram at 2 yrs. follow up. Thus asymptomatic heel widening occurred in a significant number of patients. At 2 yrs. follow up only 3 patients had moderate swelling. Of this only one patient had it because of causalgia contributing to poor result. Operated patients had very good outcome with less time off work as has been suggested by others^{1,18}.

Surgical technique, soft tissue dissection and local conditions are most important in determining the success of surgery and rate of infections. Though CT scanning is better we found accurate radiological evaluation is adequate in planning operative management. In no patient we opted for primary subtalar arthrodesis. In no patient did we damage the neurovascular bundle because of long screws.

Tendoachilles shortening and heel broadening can be adequately prevented by open reduction and internal fixation, though asymptomatic heel broadening occurred in 6 patients. In our series in spite of gross comminution seen in 3 cases, good functional results were obtained in two cases by

achieving acceptable alignment of posterior facet and in these cases need for primary subtalar arthrodesis did not arise. This is contrary to some reports^{19,20}. However one patient developed causalgia with moderate swelling and subtalar stiffness contributing to poor result. This observation matched with views of Sanders et al²² and Buch et al²³.

With strict post operative protocol of non weight bearing crutch walking no patient developed secondary collapse. Post operative achievement of Gissane's angle and Bohlers angle correlated well with activity and range of inversion and eversion, this is in concordance with Leung et al.⁷ Postoperative arthritic changes were seen in three cases but till date two of them have good functional range of motion and minimal symptoms. As contrary to some authors^{8,21} we didn't find bone grafting as essential to prevent collapse and maintain the height of calcaneum.

It is concluded that open reduction and internal fixation with plate is an excellent method for treatment of intraarticular fracture calcaneum even if not supplemented by bone graft, provided adequate importance is given to local condition and meticulous soft tissue dissection because of a slight high rate of infection.

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Claviclectomy for bone tumors

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Background: Total or partial excision of the clavicle has been advocated for many neoplastic and non neoplastic conditions. But the functional outcome after claviclectomy for tumours, has not been clearly described. By this study, we aim to analyze the oncological and functional outcome after claviclectomy for tumours of the clavicle.

Methods: Between 1991 and 1998, twelve patients underwent claviclectomy for various tumours. Histopathologically, Ewing's sarcoma was the commonest. These patients were followed up for a variable period ranging from 2 to 9 years with a mean follow up of 4.9 years.

Results: Functional results were analyzed using AMSTS scoring system. Functional outcome was excellent in 5 cases and good in 7 cases. Two patients of Ewing's sarcoma died of disease and the rest were continuously disease-free at their latest follow up.

Conclusion: Partial or total claviclectomy can be successfully employed for bone tumours with good oncological and functional results. A new classification system for claviclectomy is reported, based on the extent of resection

Key-words: Clavicular tumours; Resections; Classification; Outcomes.

Introduction

Clavicle is the bone, which connects the upper limb to the axial skeleton. Gurd¹ described the clavicle as a surplus part of the skeleton. No significant defect in the shoulder function has been described following clavicular resections^{2,3}. Hence it is considered as an accessory baggage of the skeleton^{2,4}. Still the following few functions can be assigned to this bone: (a) it provides bony protection to the brachial neurovascular bundle. (b) it provides bony attachment for many muscles of the shoulder girdle. (c) it acts as a strut to maintain the distance between the shoulder joint and the

sternum. This enables rhythmic, arcuate motion of the shoulder joint without which the shoulder movements are more linear than arcuate^{4,5}. (d) it transmits supporting force of the trapezius muscle to the scapula through coracoacromial ligaments⁶. Hence if trapezius muscle is paralysed or damaged, claviclectomy may produce poor cosmetic and functional results⁶. (e) it serves a cosmetic function by providing a graceful curve to the base of the neck⁴.

Abbott and Lucas² have demonstrated that there was no functional deficiency after claviclectomy. Srivastava⁷ et al in a series of patients aged from 6 years to 22 years with osteomyelitis have noted no abnormality in the shoulder function following claviclectomy.

Spar⁸ has described total claviclectomy for 2 cases of pathological fractures. He noted complete relief of pain but persistence of mild weakness of the extremity. Lewis et al described 4 cases of en bloc claviclectomy, operative procedure and post-operative testing of functions⁹. This study confirmed that claviclectomy did not impair the normal activity of daily living. But mechanical testing revealed some weakness in shoulder abduction, flexion and adduction, but not in internal rotation or extension. In most of the studies, post-claviclectomy functional status of the shoulder was good to excellent.

Claviclectomy has been indicated in tumour and tumour like lesion¹⁰, infection⁷, pathological fractures, non unions, severely comminuted fractures⁸, surgical exposure of the neurovascular structures¹¹ and an adjunct to surgical collapse of the chest wall¹².

We describe the results of 12 cases of clavicular tumors treated by claviclectomy with a review of the literature and a new classification for clavicular resections.

Materials and Methods

Between 1991 and 1998, twelve patients underwent claviclectomy for various tumors. Age of the patients ranged from 4 years to 70 years. Eight patients were females and 4 were males. Histopathological diagnosis was Ewing's sarcoma in six patients, aneurysmal bone cyst in three, chondroma in one, adeno-carcinoma of unknown primary in one and post-irradiation sarcoma in one patient (Table I).

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Table I. Clinical data of 12 patients of claviclectomy

Case No.	Age	Sex	Diagnosis	Site	Enneking Stage ³
1	28	F	Chondroma	Lateral clavicle	Not applicable
2	15	F	Ewing's sarcoma	Medial clavicle	II B
3	19	M	Ewing's sarcoma	Mid clavicle	II B
4	4	M	Ewing's sarcoma	Mid clavicle	II B
5	20	F	Ewing's sarcoma	Mid clavicle	II B
6	55	F	Metastatic adenocarcinoma	Medial clavicle	Not applicable
7	11	F	Aneurysmal bone cyst	Mid clavicle	Not applicable
8	18	M	Ewing's sarcoma	Medial clavicle	II B
9	38	F	Aneurysmal bone cyst	Mid clavicle	II B
10	16	F	Ewing's sarcoma	Lateral clavicle	II B
11	70	F	Post irradiation sarcoma	Clavicle and upper sternum	II B
12	22	M	Aneurysmal bone cyst	Medial clavicle	Not applicable

Swelling with or without pain was the commonest presentation. Anatomical location of the tumor was medial third of the clavicle in four patients, shaft in five, lateral third in two and medial third of the clavicle with sternum in one patient. Staging studies included plain X-ray films; CT scan and technetium bone scan in all patients. Open incisional biopsy was performed through a linear incision along the longitudinal axis of the clavicle so that it can be incorporated in the definitive surgical procedure. All patients with Ewing's sarcoma had received neoadjuvant chemotherapy.

Post operatively standard dressings and arm sling were applied. Immobilization was continued for 2 weeks. Then both active and passive exercises were started. These patients were followed up for variable periods ranging from 2 years to 9 years with mean follow up of 5 years.

Extent of resection of clavicle is dependent on the location, histopathological type and stage of the tumor according to new classification system evolved for clavicular resections (Fig 1 and Table II).

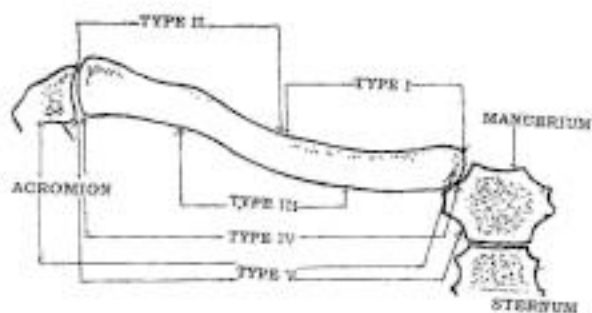


Fig 1. Mayil, Meller and Malawer's classification of clavicular resections

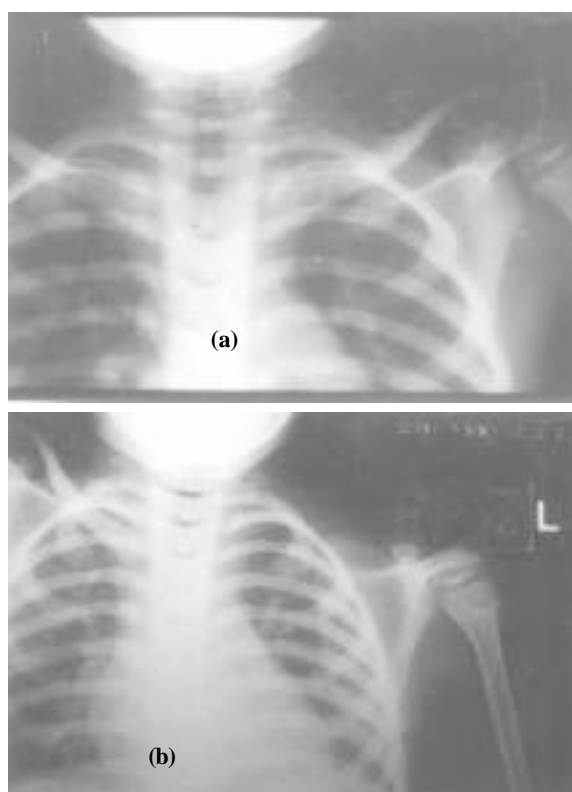


Fig 2. (a) Pre operative radiograph of a case of Ewing's sarcoma (case 8) of the left clavicle - medial 1/3; (b) after type IV resection

Table II. Mayil, Meller and Malawer's classification of clavicular resections

Type	Resection	No. of cases
Type I	Medial one third	1
Type II	Lateral one third	2
Type III	Intercalary resection	2
Type IV	Total claviclectomy	6
Type V	Extended claviclectomy (i.e. part of the acromion or upper sternum)	1



Fig 3. (a) Pre operative radiograph of a case of chondroma (case 1) of the right clavicle - lateral 1/3; (b) after type II resection.

Results

Shoulder function was evaluated by measurement of shoulder motion and by manual muscle power testing. Patients were assessed for the neurovascular status. Functional results were analysed using AMSTS¹³ scoring system and found to be excellent in 5 cases and good in 7 cases. The strength of abduction and flexion was limited in 2 patients but did not impinge on the overall functional outcome. Oncologically, ten patients were continuously disease free at their latest follow up. Two patients (Cases 2 and 4) of Ewing’s sarcoma died of disseminated disease at 5 and 3 years respectively. All patients were satisfied with their cosmetic outcomes. Table III depicts the functional and oncological outcomes of all the twelve patients.

Table III. Functional and oncological results of 12 patients of claviclectomy for bone tumors

Case No.	Procedure	Follow (Years)	Functional Results	Oncological Status
1	Lateral claviclectomy	7	Excellent	CDF
2	Total claviclectomy	5	Good	DOD
3	Total claviclectomy	6	Good	CDF
4	Total claviclectomy	3	Good	DOD
5	Total claviclectomy	3	Excellent	CDF
6	Total claviclectomy	2	Excellent	CDF
7	Intercalary resection	7	Excellent	CDF
8	Total claviclectomy	4	Good	CDF
9	Intercalary resection	5	Excellent	CDF
10	Lateral claviclectomy	4	Good	CDF
11	Extended claviclectomy	9	Good	CDF
12	Medial claviclectomy	7	Good	CDF

In case 6, we encountered an accidental tear of the subclavian vein, which was repaired primarily. One patient had (case 3) superficial wound infection, which was managed conservatively. Case number 11 developed chylothorax

because of the injury to the thoracic duct which resolved with conservative measures. There were no permanent neurovascular complications.

Discussion

Primary tumors and tumor like lesions of the clavicle are uncommon. Klein¹⁴ in a review of the literature found that only 0.45 percent of more than 13,000 primary bone tumors involved the clavicle. Nevertheless, most types of bone tumor and tumor like lesions have been described in this location^{10, 14, 15}. Malignant tumors are more common than benign tumours¹⁰. A large nation wide series from the Bone Registry of Japan¹⁶ however, demonstrated that occurrence of benign primary bone tumor of the clavicle was almost equal to that of malignant tumors. Frequently reported lesions include Ewing’s sarcoma, lymphomas, myeloma, metastatic and eosinophilic granuloma.

Movements of the shoulder girdle involve a complex mechanism where clavicle scapula, head of the humerus and posterior thoracic wall participate¹⁴. Loss or defect in any one of the components of this synchronised system may result in an altered shoulder mechanism. It is the impression from the literature that the clavicle is functionless because its removal leads to no apparent defect in the shoulder function^{1,17}. But some studies have shown mild weakness in abduction, flexion and adduction^{12,13}. Analysis of this series of claviclectomy conforms that shoulder function is not impaired following claviclectomy. Measurement of shoulder motion has shown no limitation in any of the patient. Manual muscle testing has revealed mild weakness of abduction and flexion. This is because of partial loss of the deltoid attachment over the clavicle and due to the loss of clavicular head of the pectoralis major muscle. Other than inherent

complications of any major surgical operation, proximity of the clavicle to important neurovascular structures, imparts additional risks. We had encountered injury to subclavian vein in one patient. Thoracic duct was injured in a case of post irradiation sarcoma, where type V resection was performed with the excision of the upper sternum. There were no permanent neurovascular complications in our series.

A classification system has been described for clavicular resections. This system is primarily based on the location of the tumor and the extent of the bone resection (Fig 1 and Table II). In type I resection, along with the whole clavicle, either a part of the adjacent sternum or the acromion process is also resected as necessary for tumor clearance.

Tumors of dispensable bones like clavicle, fibula, scapula, patella are treated by enbloc removal without significant functional impairment. Even though controversies exist, it appears from the review of the literature that results of total claviclectomy are good and encouraging^{3,7,8,9,13}.

Our study again confirms that post claviclectomy functions and oncological results are good and cosmetically acceptable. Thus removal of clavicle is not a disaster; in fact, clavicle is an accessory baggage in the skeleton².

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Plantar pressure changes in normal and pathological foot during bipedal standing

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Background : Plantar pressure measurement during bipedal standing provides an important information of loading of human body on foot under various postural activities. Therefore, the objective of the present work was to monitor the plantar pressure during bipedal standing in normal and pathological conditions. Use of orthotics in attenuating the peak pressure to distribute it uniformly on plantar surface of the foot was also examined.

Methods: The pedobarographs of 66 subjects were recorded using computer assisted indigenously developed optical pedobarograph. The pedobarographs were evaluated using Asha 3-D software developed during present study. Standard size universal orthotics (Footmaxx™, Canada) was used to determine the effect in attenuating the peak pressure.

Results: Results showed distribution of plantar pressure in the right and left foot of normal subject under the various regions was not equal. It was observed that among the normal subjects 17% experienced equal pressure on the both feet, 7% showed greater pressure on left foot and 76% found higher load on the right foot. Similarly the pathological subjects were analyzed and noticed the changes in the pedobarographs depending upon the type and location of pathology. It was found that orthotics improved the plantar pressure and distributed it uniformly to make the person standing comfortably.

Conclusion: Plantar pressure measurement techniques are useful in the analysis and understanding of the biomechanics of human foot. It was found that orthotics attenuated the peak pressure and distributed it uniformly on the plantar area of the foot. The data seem to be useful in understanding the biomechanics of bipedal standing.

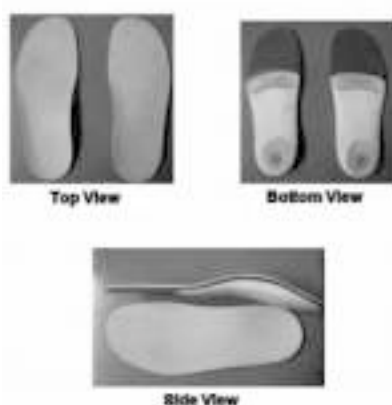
Key-words: Foot; Plantar pressure; pedobarograph; Stance phase; Orthotics.

Introduction

The study of plantar pressure measurements has received a considerable attention in the assessment and treatment of various orthopedic disorders¹⁻³. The normal foot in bipedal standing exhibits contact across the heel, forefoot and usually the lateral border of foot. There have been reports of normative plantar pressure studies, but quantitative studies have produced contradictory results in terms of a normal pressure position, pattern and value⁴. Some investigators found that the heel experienced twice or three times of the forefoot weight^{4,5} and other found equal load on the heel and the forefoot⁶⁻⁸. These results seem to be contradictory to each other. Although there are studies on normal barefoot standing using different pressure measuring systems, but the standard normal pressure distribution to compare the result is yet to be established. Hence, analysis of the results is mostly based on the experience of the user. Patil and Srinivasan studied leprotic feet where loss of sensation and irreversible nerve damage caused paralysis in muscle leading to physical deformity⁹. Static studies are quite useful in studying the basic information of prosthesis, leprotic feet and in many other clinical situations where it is suspected that one foot is weaker than other.

Different orthotic materials were investigated by Brown et al to demonstrate the beneficial effect of orthotics in relieving high pressures¹⁰. Foot orthosis reduces the strain on injured structure in the foot and lower extremity, allowing them to heal and become less painful. It also helps to prevent the occurrence of future problems in the foot and lower extremity by reducing abnormal forces acting on these areas¹¹. There is a wide variation of the threshold described by earlier researcher, which could vary from 500 kPa to 1000 kPa^{12,13}. It seems to be more confusing and may lead to incorrect interpretation of the clinical observations. The diversity of commercially available systems to measure plantar pressure has established that different measuring systems produce different results. Therefore, we used the technique of percentage pressure normalized to peak pressure instead of absolute value of pressure.

Fig 1. Different views of orthotics



In the present study, an attempt has been made to study the pedobarographs of left and right foot in normal and pathological subjects during bipedal standing. Percentage pressure profiles were plotted to see the distribution of loading on the plantar surface of the foot. The effects of universal orthotics on pressure points in normal and pathological subjects were also evaluated.

Material and Methods

Barefoot pressure measurement was carried out on 66 subjects (46 males and 20 females). Height and weight of all the subjects were recorded and all of them were asked to fill the questionnaire to get the information about type and preference of footwear used and any present/past injury, which affects the gait.

Fifty-eight subjects who participated in this study had normal gait and 8 had abnormal gait. Subjects were in the age group of 11 to 59 years (mean age 29±13 years). Normal subjects included in the present study had no major musculoskeletal or neurological pathologies that affected gait. The locally designed optical pedobarograph was used to collect plantar pressure information. The pedobarographs obtained by optical pedobarograph were evaluated using the Asha 3-D software developed during this study. The software maps the entire pedobarograph and calculates the value of intensity for every pixel. These values could be displayed in terms of percentage of normalized point pressure or absolute pressure at any point.

Before taking final readings, all the subjects were trained to stand on the platform. Prior to pressure measurements, subjects familiarized themselves with the testing procedure and details of the procedure were explained to them. The subjects were told to look straight ahead, while standing on the platform. The subjects were told to stand on the optical

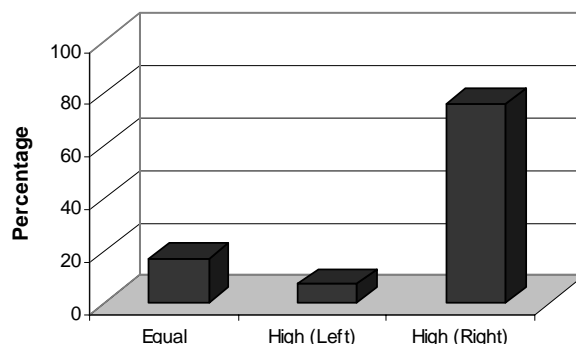


Fig 2. Comparison of peak pressure on right and left foot in normal subjects

pedobarograph with both the feet separated, based on their normal style of standing. Pedobarograph were recorded using the CCD camera (National Panasonic M9500). Pressure measurements were also carried out with standard size (Fig. 1) universal orthotics (Footmaxx™, Canada) by placing it under the foot of the subject.

To reduce the error due to posture sway, three readings for every individual subject were taken. The most useful information for interpretation of clinical analysis is the peak pressure plots. Highest pressure in each part of the foot that occurred during any point of the contact is recorded in relation to the reference maximum peak pressure.

Results

Figure 3 shows the distribution of peak pressure in right and left foot of the normal subjects. It was found that intensity patterns among normal subjects were not uniformly distributed on the plantar surface. It was also observed that

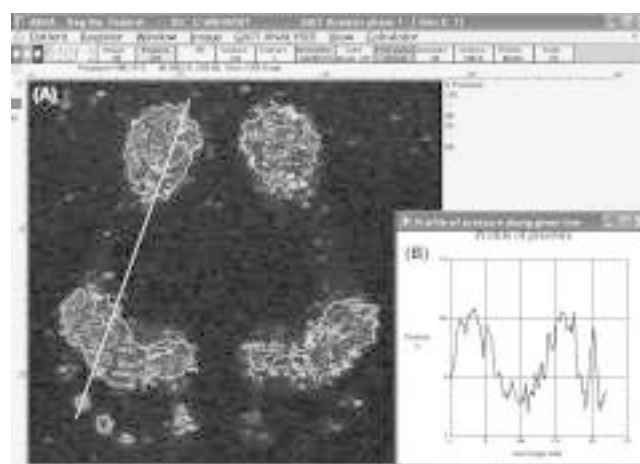


Fig. 4. Distribution of plantar pressure in normal subject b. Pressure profile from heel to forefoot showing equal pressure on heel and forefoot in right foot

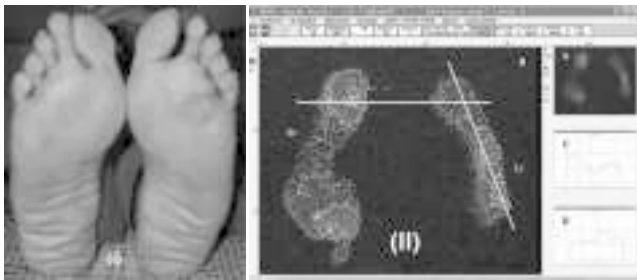


Fig 4 (I) Photograph of pathological left foot showing callus at forefoot (II) (A) Image obtained with optical pedobarograph, (B) Plantar pressure distribution of same foot, pressure profiles shows abnormal left foot (C) Pressure profile of heel to heel in both feet (D) Pressure profile of heel to toe in left foot

among normal subjects 17% had equal pressure on both the feet, 7% showed greater pressure on left foot and 76% subjects experienced greater load on right foot. Figure 4 shows the pressure distribution in normal foot.

It was found that in normal foot the load is distributed equally on the heel and forefoot whereas the midfoot experienced minimum load ($50.66\% \pm 16.55$). It was also observed that in right foot, pressure on heel, metatarsal regions (Mt-1, Mt-2, Mt-3, Mt-4) and toe was also equally distributed (with in 10%). However, under the 5th metatarsal the pressure was lower by 19.3%. The same pattern was found in left foot, but the variation was little higher than the right foot (Fig. 5).

Among the pathological subjects, there were wide variations in the pressure of right and left foot. In pathological subjects pressure varied depending upon the type and location of the pathology. Figure 6 shows the plantar distribution in pathological foot having callus in heel and forefoot.

Figure 7 and 8 show the pressure distribution in pathological left foot and flat foot respectively. In flat foot the pressure is high in the midfoot. In pathological left foot the pressure was 30% at forefoot in comparison to the right forefoot where pressure was 95%. Figure 9 shows the effect of orthotics on plantar pressure. The pressure under the feet with orthotics is more uniform than without orthotics as it attenuated the peak pressure.

Discussion

The changes were observed in peak plantar pressure of right and left foot and this was in agreement with the earlier studies¹⁴. Whereas these results do not coincide with the findings of Tuna et al¹⁵, who found no significant difference between static pressure values for the right and left foot. The

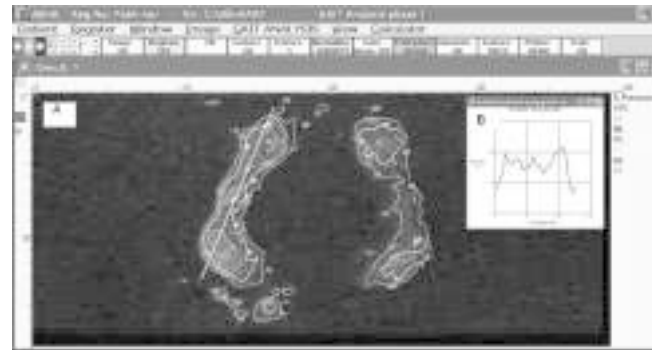


Fig 7. Flat foot (A) Plantar pressure distribution in flat foot (B) profile showing variation in pressure from heel to forefoot in right foot

difference in plantar pressure may be because of the standing posture, which has become part of their habit. Cavanagh et al found approximately 2.6 times higher heel pressure against forefoot pressures in symptom-free feet of 107 subjects during bipedal standing⁴. The highest forefoot pressures were located under the second and third metatarsal heads. They also found no load sharing by the toes during standing position. Contrary to this, in the present study, variation in heel and forefoot pressure was minimal (figure-5) and the toe equally shared the pressure. Equal pressure on heel, forefoot and toe indicates normal and stable standing posture. Higher peak pressure observed by Cavanagh et al under metatarsal 2 and 3 was in agreement with this study⁴.

Furthermore, in agreement the Cavanagh et al peak plantar pressures did not show a significant relationship to the body weight of subjects¹⁶. The peak pressures beneath the one to four metatarsal heads were higher than the 5th metatarsal region. No differences in plantar pressures were found between the male and female subjects. Only 3.45% subjects showed high pressure in the midfoot indicating that in normal subjects with normal arch height there is minimal pressure in the mid foot region.



Fig 8. Comparison of plantar pressure with and without universal orthotics (I) Plantar pressure distribution with bare foot (II) Plantar pressure distribution with universal orthotics

The wide variation in the plantar pressure of pathological subjects was in agreement with the clinical evaluation. One of the pathological subject was not able to apply any load on heel and toe of the left foot. Whereas, heel to heel profile of right and left feet showed high pressure on right foot as compared to left foot (Figure. 6 C). The heel to toe pressure profile of left foot showed more pressure on left midfoot (Fig. 6 D). In flat foot the pressure is high in the midfoot (Fig. 7). In pathological left foot there was no visible difference but the loading of pressure was less (30%) at forefoot in comparison to the right forefoot where it was 95% (Fig. 8)

Evaluation of the questionnaire showed that the soft innersole of the shoes was preferred by 93% of the subjects. For comfortable walking, 60% of the subjects were using sports shoes in routine. It was also found that if given a choice, subjects preferred branded sports shoes (Nike, Adidas, Reebok, etc) than locally manufactured ones (Bata, Action, etc). Ninety percent of the subjects agreed that choice of shoes is important from health point of view. Seventy percent of the subjects agreed that shoes are fashion and life style accessories, but if not comfortable they could be harmful. It was also observed that all the subjects felt more comfortable with universal foot orthotics as it uniformly distributed the plantar pressure. Figure 9 clearly shows the effect of orthotics on plantar pressure. The pressure under the feet with orthotics is more uniform than without orthotics.

The study suggests that the bipedal standing guarantee a stable support of the body. The human foot attenuates potentially harmful impact shocks, and provides a sensory information regarding the contact with the ground. Pressure distribution measurement techniques are useful in the analysis and understanding of the biomechanics of human foot in bipedal standing. Orthotics are useful for the uniform distribution of plantar pressure. It was found that orthotics attenuated the peak pressure and distributed it normally on the plantar area of the foot. Various disorders related to musculoskeletal system and nervous system could be analyzed using plantar pressure technique. Plantar pressure distribution instrumentation could be used as a standard clinical tool for diagnostic and therapeutic interventions.

Acknowledgement : Authors are thankful to Mr SL Kapoor, Managing Director of TSG Integration, New Delhi for helping us in developing the software for analyzing plantar pressure.

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Solitary osteochondroma of thoracic spine — A case report

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Introduction

Osteochondroma also known as “osteocartilaginous exostosis” is one of the more common benign tumours usually found in appendicular skeleton but rarely in spine. Osteochondroma of spine usually arise from neural arch of cervical and thoracic vertebra and compression of spinal cord is seen more often in hereditary multiple exostosis than in solitary lesion^{1,2}.

We report a case of solitary osteochondroma arising from the neural arch of T₃-T₄ vertebra without neurological deficit.

Case report

A 25 year young policeman presented with a 2yr history of swelling and pain in the left side of back of the chest. The swelling was associated with a dull aching pain which increased on doing heavy work and relieved by rest. Examination of the spine revealed an elliptical tumor of 8x6 cm size situated lateral to T₃-T₄ vertebra on left side. The swelling was firm to bony hard in consistency which appeared fixed to the underlying corresponding vertebra and ribs. The characteristic feature of the swelling was that it became more prominent as the patient bent forwards (Fig 1). Skin over the swelling was normal. The patient had cutaneous hemangioma over anterior wall of the chest. There were no similar swellings in any other parts of the body. The neurological examination and remainder orthopedic examination was normal.

Plain X ray AP view of the thoracic spine showed expansile lesion with irregular calcification within the tumor (Fig 2). Plain CT of thorax revealed the evidence of expansile lesion seen to arise from the posterior elements of T₃-T₄ vertebra with the lesion showing mixed density with central dense calcification. The normal marrow was seen between the mass and the normal vertebra and the mass was not extending in the spinal canal (Fig 3). Contrast CT scan did not show enhanced uptake by the tumor. FNAC of the tumor was done and it was reported as chondroma. Excision biopsy of the tumor was planned.

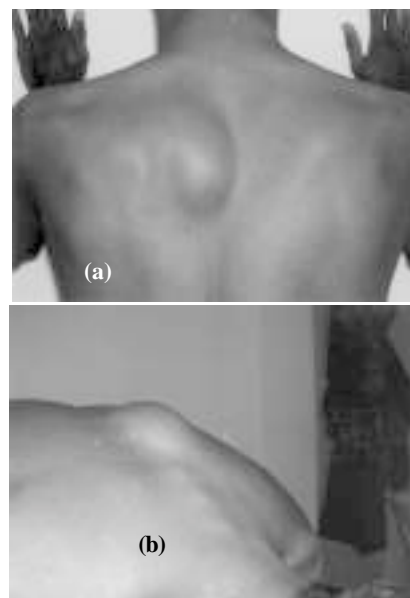


Fig. 1. (a, b) Tumor situated in left paraspinal area.

Under general anaesthesia, patient was put in prone position. A 10 cms long vertical para median incision was made on the tumour. Trapezius was dissected paraspinal muscles were incised along the fibres to expose the tumor. Elliptical capsulated mass was seen with all the borders well defined. En bloc excision of the tumor was carried out. Tumor revealed (fig 4) a hard mass measuring 8 x 6 x 4 cms along with multiple grey white bony pieces. The mass appears partly encapsulated and cut section shows slightly friable grey white tissue mixed with haemorrhagic areas.

Microscopic picture showed a benign neoplasm consisting of a mixture of osteoid tissue and cartilage. The cartilagenous tissue had normal appearing chondrocytes. The lobules were intermingled with osteoid elements and marrow. At some areas there was endochondral ossification. The whole lesion is encapsulated in a fibrous capsule. The neoplasm was vascular. The histopathological examination was suggestive of osteochondroma. Postoperative course was uneventful and patient got relieved of his symptoms after surgery.

Discussion

Dahlin and Unni have suggested that osteochondromas account for 36% of all benign bone tumors and that multiple

Fig. 2. X-ray of the tumor showing expansile lesion with irregular calcification within tumor.



exostosis constitute approximately 12% of all symptomatic lesions³. Between 1.3 to 4.1% of solitary osteochondroma arise in spine⁴; approximately 9% of patients who are affected by hereditary multiple exostosis harbours spinal lesions.

Osteochondromas are thought to arise through a process of progressive enchondral ossification of aberrant cartilage of a growth plate as a consequence of congenital defect or trauma. Knowledge of how the spine develops could help us to speculate on another explanation. In adolescence, secondary ossification centers, which lie in the spinous process, transverse process, articular process, and end plate of vertebral body, complete the growth of the vertebral column. These secondary ossification centers appear in children between the ages of 11 and 18 years and develop in to complete ossification in the cervical spine during adolescence: in the thoracic and lumbar spine during the end of second decade of life and in the sacrum during the third decade of life. The cartilage of these secondary ossification centers could be the origin of aberrant islands of cartilaginous tissue that cause osteochondroma to form. It can be speculated that the more rapidly the ossification process of these centers develop, the greater is the probability that aberrant cartilage will form. Therefore, the fact that osteochondroma is more frequently located in the upper segments of the vertebral column could be explained by different durations of the ossification process in these centers¹.

Radiculopathy and/or myelopathy are uncommon manifestation of osteochondroma⁵, when present it is more commonly due to multiple osteochondromas. The neurological deficit is invariably the result of compression caused by an expanding lesion arising from the posterior elements². Spinal osteochondromas typically appears as a sessile or pedunculate bone like lesion in which the cortex and spongiosa are in continuity with those of the host vertebra¹.

Fig. 3. Plain c.t. Scan of t3 and t4 vertebra.

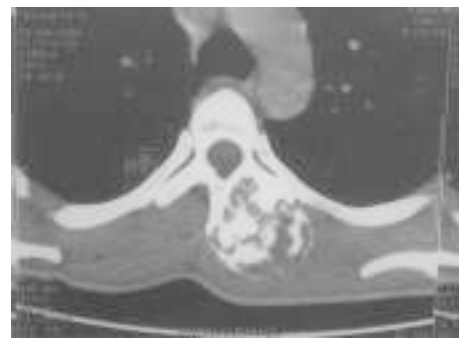
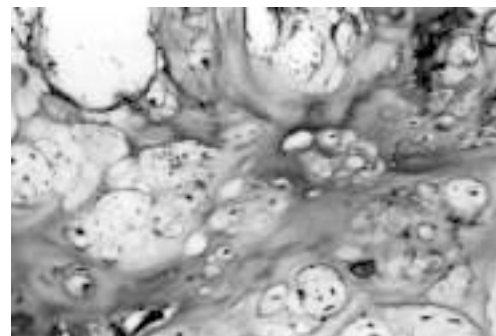


Fig. 4. Microscopic picture of the tumor, 10x.



Solitary spinal osteochondroma are rare and rarely do they present with myelopathy and or radiculopathy. Most commonly they arise from posterior elements of the cervical and upper thoracic spine could be explained by different durations of the ossification processes that occur in these centers. CT is the diagnostic procedure of choice. Outcome in the majority of surgically treated patients are good and malignant degeneration is a very rare event.

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A huge intramuscular lipoma of occipito cervical region — A case report

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Introduction

The incidence of lipoma in cervical region is quite common but mostly they are of small size and remain asymptomatic for years. They may arise in all parts of body but their occurrence in the head and neck, however, is relatively rare¹. Location at the limbs is the more frequent, with 50% of cases located in thigh, 20% in the shoulder region and upper arm, 20% in the chest wall, and 10% in other locations. This type of lipoma is extremely rare in the head and neck region, and its congenital type is rare²⁻⁴. Two cases of oral infiltrating lipoma were reported by Bennhoff and Wood⁵. This case report describes a huge lipoma present in the occipito cervical region of an eighteen year old boy since childhood.

Case Report

An eighteen-year-old male presented with a big swelling in posterior aspect of his head and neck. The size of the swelling was exceptionally large and it was bigger than the size of patient's head and neck together. It was present since his childhood and kept on increasing in size as the boy grew up gradually. Till eighteen years of age the patient was asymptomatic except the huge size of the swelling. Later he developed pain in the head and neck region and because of this big mass he was not able to walk and stand comfortably and could not sleep in supine position and had to lie down in lateral position only. The size of swelling was measuring about 12 inches x 12.5 inches. On the surface of swelling, the skin was shiny, tense, and with large diameter veins running over it. It was non-tender and consistency was uniform all over.

Hematological investigations were normal and X-ray cervical spine showed no bony involvement by the growth. MR study showed a huge well defined mass (approx. size 22 cm x 24 cm x 16 cm) in the posterior neck region extending from high left occipital region to either side of midline to

infratemporal region, more on left side upto the lower neck region. It was showing fat signal intensity on T₁ wt with low signal intensity linear shadows, which may represent fibrous septae and few, flow voids. It was displacing posterior paraspinal neck muscles, more on left side with deep insinuation into deep muscle planes at places. No extension of the mass was seen into the spinal canal; however its slips were seen extending into left neural foramina at C₄ – C₇ level. No intracranial extension was seen. However mass was causing pulling of the soft tissue in left facio temporal region due to its bulk. No obvious evidence of bony destruction was seen. The brachial plexus regions appeared to be spared. Major neck vessels (carotid artery & veins) were normally seen in the anterior part of the neck and are separate from the mass.

A 'T' shaped incision was given and a bright yellow fatty tissue mass was visible lying in between the muscle planes, displacing the posterior paraspinal neck muscles, whole tumour was well encapsulated with its multiple lobulated extensions going in the muscle planes. The whole tumour mass was separated from surrounding tissues & was delivered as a whole. Adequate haemostasis was achieved and, the dead space was closed beneath the skin using buried interrupted vicryl sutures. A suction drain was placed and the skin was then closed with interrupted Nylon sutures. A pressure dressing applied to reduce the incidence of haematoma formation. Specimen was submitted for histologic analysis. Three units of blood were transfused and patient was kept in ICU for one day.

Post operatively patient was comfortable and a splint to support the neck was given. The weight of the tumour was



Fig. 1. (a,b) Clinical photograph showing huge swelling in neck

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5.5 kg. The patient became ambulatory next day and suction drain was removed after forty-eight hours. It was about after ten years that the patient was able to sleep in a comfortable supine position. Histopathology sections showed striated muscle bundles enclosing a lesion comprising of sheets and lobules of mature adipose cells. There was no evidence of malignancy with a final impression of intramuscular lipoma.

After removal of the tumor, he was able to sleep and move properly and all this was possible after a long time of suffering both physical social & psychological. The 15 months follow up studies revealed no recurrence.

Discussion

Lipomas are adipose tumors that are often located in the subcutaneous tissues of the head, neck, shoulders, and back. Approximately 25% of lipomas and their variants arise in the head and neck region¹, most commonly in the subcutaneous posterior neck⁶. They also develop rarely in the anterior neck, infratemporal fossa, in or around the oral cavity^{7,8}, larynx^{9,10}, tonsillar area¹¹, parotid area¹², hypopharynx¹³, nasopharynx¹⁴, and retropharyngeal space¹⁵. These tumors may also be found in deeper tissues such as intramuscular septa, the abdominal organs, the oral cavity, the internal auditory canal, the cerebellopontine angle and the thorax. Lipomas have been identified in all age groups but usually first appear between 40 and 60 years of age. Congenital lipomas have been observed in children. These slow growing, nearly always benign tumors, usually present as nonpainful round, mobile masses with a characteristic soft, doughy feel. Most lipomas tend to grow insidiously large without any symptoms and cause few problems other than those of a localized mass and cosmetic concerns^{7,15}. Rarely, lipomas can be associated with syndromes such as hereditary multiple lipomatosis, adiposis dolorosa, Gardner's syndrome, and Madelung's disease. Some tissue lipomas are believed to have developed following blunt trauma.

While solitary lipomas are more common in women, multiple tumors (referred to as lipomatosis) are more common in men, Hereditary multiple lipomatosis, an autosomal dominant condition also found most frequently in men, is characterized by widespread symmetric lipomas appearing most often over the extremities and trunk. Lipomatosis may also be associated with Gardner's syndrome. An autosomal dominant condition involving internal polyposis and cysts, and, the term Madelung's disease, or benign symmetric lipomatosis, refers to lipomatosis of the head, neck, shoulders, and proximal upper extremities. Persons with

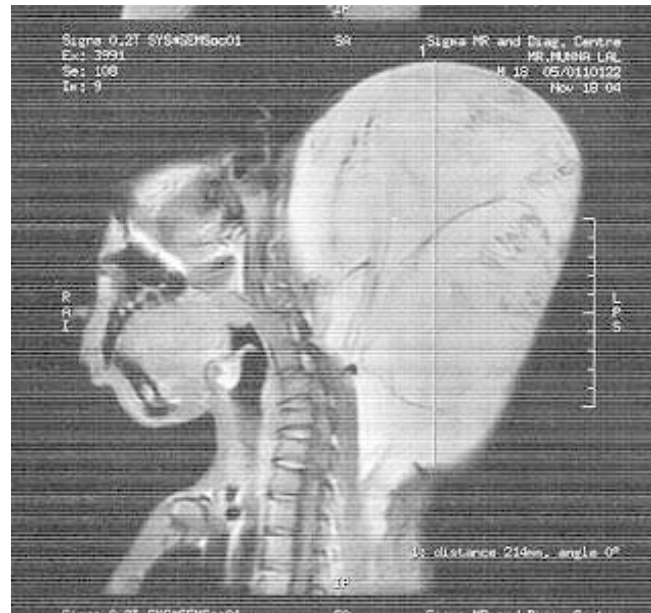


Fig. 2. MRI showing extent of tumour.

Madelung's disease, often men who consume alcohol, may present with the characteristic 'horse collar' cervical appearance. Rarely, these patients experience swallowing difficulties, respiratory obstruction, and even sudden death.

Microscopically, lipomas are composed of mature adipocytes arranged in lobules, many of which are surrounded by a fibrous capsule. Four other types of lipomas may be noted on biopsy specimen like angiolipomas, pleomorphic lipomas, spindle cell lipomas and adenolipoma. Two main varieties of deep seated infiltrating lipomatous lesions have been described ; lipoma (the present case) and angiolipoma is characterized by prominent vascular components, whereas infiltrating lipoma is composed of mature adipose cells, inconspicuous blood vessels, and delicate strands of connective tissue^{2,16}.

MR imaging provides better tumour delineation because it has superior soft tissue contrast resolution and clear definition of the location and longitudinal extent of the mass. Multiplanar capability moreover, clearly shows planes of cleavage between the lipoma, muscle and vessels. It is particularly important in the oral facial region where the margins of lipoma are commonly ill defined, because these lesions often are surrounded by normal fat tissue and have a very thin capsule⁷. IV administration of contrast medium better depicts the tumor margins and can detect irregular vascularization when sarcomatous degeneration is considered^{7,17}.

Malignancy is rare but can be found in a lesion with the clinical appearance of a lipoma. Liposarcoma presents in a fashion similar to that of a lipoma and appears to be more common in the retroperitoneum, and on the shoulders and lower extremities.

Most lipomas are best left alone, but rapidly growing or painful lipomas can be treated with a variety of procedures ranging from steroid injection to excision of the tumor. In cases of infiltrating lipomas, complete surgical excision is mandatory because of the infiltrative nature and potentially high rate of recurrence after inadequate surgery².

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Fellowship report

Johnson & Johnson / Robert Roaf Traveling Fellowship 2005-06

(25th Dec. 05 – 25th Jan. 06)

At the outset, we would like to thank IOA and especially to Dr. Ashok Johari, Inland Fellowship Secretary for having selected the four traveling fellows for this prestigious fellowship.

Mumbai (25th Dec – 31st Dec, 05)

We attended the *Golden jubilee IOACON 2005* and participated in pre-conference workshops of personal interest on 25th Dec. During the next 2 days we liked the instructional course lectures and the Continuous Medical Education. The next two and half days were full of academic activities in the form of lectures, free papers and posters. We enjoyed various scientific deliberations in this conference. On the last day of the conference we were invited by Dr. Ashok Johari and his family for dinner. New Year eve at Mumbai started with a visit to his nursing home. We saw the master of paediatric orthopaedics at work. His boundless energy and enthusiasm is worth emulating.

Pune (1st – 2nd Jan, 06)

We celebrated New Year with Dr. Sancheti at his grand farm house on a hill top. Next day at Sancheti Institute for Orthopaedics and Rehabilitation began at 6:30 early morning with prayer & meditation. This was followed by the extensive case discussion and seminar presentation by the residents. Later we went for rounds along with Dr. Parag who detailed us about the making and working of this state of the art institute. He also demonstrated his skills in a case of posterior wall acatabular fracture. Watching Dr. K.H. Sancheti performing ASR (Articular Surface Replacement) in a young patient of ankylosing spondylitis was a visual treat. In the evening, he outlined the advantages of his indigenously designed Indus knee on his laptop. Our short and sweet trip ended with a cozy dinner at Dr. Parag's house.

Chennai (3rd – 9th Jan, 06)

We reached, Chennai on 3rd afternoon and met IOA president, Dr Mayil V Natarajan over a dinner. Schedule at Chennai began with a visit to the famous hand surgery unit of the Stanley Medical College hospital where we met Prof. Chandran & his team (all plastic surgeons). We witnessed routine hand cases in their OT. On 5th Jan, we went to Sundaram Medical Foundation and were joyfully received



by Dr PV Jayashankar and Dr Sudakar Williams. We were inspired by their research work on diabetic foot and muscular dystrophy. The afternoon session was spent with Prof. K. Sriram at the child's trust hospital. We saw variety of paediatric orthopaedic cases and their long follow up. His sincerity and dedication towards his patients is admirable. Next day was marked for Madras Medical College where we were warmly received by Dr RH Govardhan, Hon Secretary of IOA. The newly made Orthopaedic section and the OT complex is a shining example for all government hospitals. We saw application of custom mega prosthesis (CMP) in a patient of osteogenic sarcoma operated by Dr Mayil's team and hybrid THR by Dr Govardhan. In the afternoon we were felicitated by Dr Mayil. Later he hosted a cocktail dinner at a club. Next day, we reached Madras Institute of Orthopaedics & trauma (MIOT) at 7 AM. As Prof PVA Mohandas was busy in his meetings, he refused to meet us. On Sunday Dr Mayil invited us at his residence for a grand breakfast followed by memorable trip to Mahabalipuram. The warmth & magnanimity shown by him will be remembered for long. On last day we were cordially received by Prof SSK Marthandam at Sri Ramachandra Medical College at Porur. This deemed university has a huge campus and good infrastructure. After brief operative session, we left Chennai by afternoon flight for Kolkata.

Kolkata (9th Jan – 15th Jan, 06)

We met our local coordinator Dr Nirmal Dey, who had planned visit to two hospitals each day. On 10th Jan. we went to SSKM Hospital and met Prof ND Chatterjee and Dr DP Baksi who demonstrated his total elbow in a patient of failed osteosynthesis and pes anserinus transfer for habitual dislocation of patella. Afternoon session was spent at CMRI

where Dr S Dasgupta demonstrated a TKR. Evening was spent at his house and we had good Bengali food. Next day we met Dr. Tapas Chakraborty and his team at the R.K.M. Seva Pratisthan. He operated a case of recurrent dislocation of shoulder by redirection glenoplasty. Later in the afternoon, we had a good academic discussion with Prof. N.K. Das and Dr. Arindam Banerjee at Institute of Child Health. In the evening Dr. S.M. Lakhota accompanied by his wife took us for shopping followed by splendid dinner at his house. On 12th Jan, we were affectionately greeted by Dr AJ Kundu of the NRS Medical College & Hospital. He is heading a well dedicated team of surgeons. His colleague Dr D Bhattacharya demonstrated a posterior spinal fixation and anterior decompression in a D12 burst fracture. Afternoon session turned out to be very exciting and stimulating at Aurobindo Seva Kendra. There we were affably received by Dr R HomChaudhury and his team. We were highly impressed by his sense of humor & positive attitude. He demonstrated his surgical skills in a 70 year old lady with unstable I/T # by introducing BS nail in just 15 minutes. Next day we interacted with Dr MS Ghosh at Kothari Medical Center. In the afternoon we interacted and later observed Dr PK Banerjee performing a TKR with great precision and skill using all aseptic measures at Peerless hospital. On Saturday (14th Jan), we visited BC Roy Polio Clinic and hospital for crippled children where we met Paediatric Ortho Surgeon, Prof TK Maitra operating a poliottic child. We also met a very Senior Orthopaedic Surgeon. Dr AK Das who seemed to be very active at his age. From there we were taken to BORRC, the farm house cum hospital built by Dr Shailendra Bhattacharya. We were amazed to see his positive spirit & commitment to work despite his age. We enjoyed the WBOA monthly clinical meeting conducted at his place by Dr. Gopinath Roy. Our last day at Kolkata was spent at BP Poddar hospital where we were witness to an array of presentations. Later we visited the Belurmath temple before leaving for Jabalpur in a train. We must compliment West Bengal Orthopaedic Association for excellent planning and hospitality of the fellows during our stay at Kolkata.

Jabalpur (16th –19th Jan, 2006)

We reached Jabalpur on Monday evening and were cheerfully received by Dr. Alok and Dr. Abhay at the station. Next morning at the Jabalpur Medical Research Centre we observed Dr. Seth doing Arthroscopic tibial spine fixation. Afternoon session was spent with Dr Verma and Dr Alok who presented their work. Later we visited the famous Bheraghat and Dhuandhar falls with him. There we witnessed awesome spectacle of nature and the evening was well spent. Next day we had an exhaustive scientific and clinical discussion with our IOA president elect Dr HKT Raza

interspersed with OT sessions. He demonstrated the application of his indigenously designed cobra plate in a couple of cases. His sheer dedication, hard work and time management was apparent at the end of the day. To beat it all we were honoured at the Jabalpur Orthopaedic Association clinical meeting held later in the evening. The last day at Jabalpur was no less exciting with a visit to a temple at a hill top followed by a discussion on deformity correction. In the afternoon we were warmly sent off by Dr Raza and Dr Alok who came personally at the station.

Delhi (20th –25th Jan, 2006)

As expected we were all eager to reach our home and as per the programme we all assembled and met at LNJP Hospital on 23rd Jan. We met Dr Dhal in the operation theatre where he demonstrated the application of fasciocutaneous flap in a case of grade III B, open # both bone leg. During lunch we also met our local coordinator Dr Sudhir Kapoor and other faculty members of the Orthopaedic department. Next day we witnessed Dr IPS Oberoi performing shoulder arthroscopy in a female athletic with labrum avulsion at the railway hospital. His zeal and enthusiasm is worth mentioning. Later we went to St. Stephens's hospital the largest private charitable hospital of the Delhi. We were amazed to see Dr Balu Sankaran still active in the OPD. We met the Director and HOD, Dr Mathew Varghese in the OT where we was doing an open reduction in a neglected elbow dislocation. After a delicious lunch we had a very useful session enriched with academic activities in the form of presentations and discussion. The amount and quality of work done by Dr Mathew and his committed team is laudable. After a brief ward round and high tea we all departed to meet again next day at GTB Hospital. Our last day of the fellowship at this Hospital was no less thrilling where we met Dr Sudhir Kumar and Dr AK Jain, editor elect of the IJO. They had planned series of cases for operation. Dr AK Jain demonstrated his innovative technique of correction in a case of Pott's paraplegia with a severe kyphotic deformity. His documentation and digital video recording of the case is worth appreciating. Dr Sudhir Kumar demonstrated his proficiency in a case of recurrent dislocation of shoulder by redirection glenoplasty. In the afternoon he took as out along with other faculty members for an excellent lunch.

Now it was time to bid good bye to everyone and we hugged each other for having a wonderful time together.

Overall this fellowship was very useful and informative and we would cherish the memories of this for long.

VIKAS GUPTA (SJH, Delhi)

VIKAS GUPTA (AIIMS, Delhi)

ZILE SINGH KUNDU (PGIMS, ROHTAK)

PRAVESH KUMAR AGRAWAL (DELHI)

Book review

Clinical Orthopaedic Examination by Ronald McRae.
5th Ed. New Delhi: Elsevier. 2005pp vii + 318 with numerous
line diagrams and illustrations. ISBN 0443074070

This book first published in 1976, continues to enjoy the same popularity even today as it used to in the past. The line diagrams are accompanied by clear and unambiguous text, and guidance is given on what to look for the radiographs. Anatomical details are also summarized in a helpful way. The line diagrams have been improved and additional information included on many topics in this new edition. In addition, text has been updated and reorganized in many places, and a number of new texts have been included.

This is an outstanding book in contents and style of presentation and is thoroughly recommended to all the medical students, physiotherapists, general practitioners and junior Orthopaedic doctors.

GN Khare

Obituary

Prof. Prakash Chandra

Prof. Prakash Chandra was born on 31st March 1922 in a very small town in UP. He graduated from King George's Medical College; Lucknow in 1945 and then went the UK and obtained M.Ch Orth. and FRCS. He worked in various capacities in UK but his patriotic instinct brought him back to India to occupy the chair of Professor and Chief of Orthopaedics at AIIMS in 1961 which he held for nearly 24 years.

He devoted his full energies to develop a department from scratch and built it into one of the most modern departments of Orthopaedics in the country. The department is now regarded as a citadel of excellence in all its dimensions. His students are occupying important positions both in India and abroad.

He became Dean at AIIMS in 1979, a position which he occupied till his superannuation in 1984. His contributions to the Institute as Dean have been remarkable. He undertook the task of revising the curriculum for the undergraduate students and initiated the B.Sc. (Hons.) course in Nursing and B.Sc. in Human Biology.

He was thinker and philosopher and devised and modified a large number of instruments on his own. He was also an expert to supervise the technical aspects of a surgical instruments plant for IDPL. He conceived the project of Centralised Services for Trauma and Accidents in Delhi which will be commissioned soon.

His contributions in the field of Orthopaedics have well been recognised – he was bestowed upon with the national honour of Padmashree in 1983 and prestigious B.C.Roy Award in 1984. He was honoured with Emeritus Professorship at AIIMS in 1984.

Prof. Chandra's contributions to the Indian Orthopaedic Association were noteworthy. He was founder member of IOA and Secretary of the Indian Orthopaedic Association in 1967. He was the President of the Association in 1976. He was founder editor of The Indian Journal of Orthopaedics which was started in 1967.

He was not keeping good health in last six months and passed away on 24th November 2005.

He has left behind large number of his students and disciples who deeply mourn passing away of Prof. Chandra and pray that his soul will rest in heaven and GOD will give all his family members strength to bear this loss.

*Surya Bhan
PP Kotwal*

Obituary



Professor M. Natarajan

Orthopaedic fraternity on India has lost a leader and pioneer in the demise of Professor M. Natarajan. His contributions for the rapid advance of the speciality especially in Tamil nadu were immense.

He was born on 18th March 1920 in the hinterland of erstwhile Madras state. After graduating as a B.A, he entered Stanley Medical College, Madras. He had a brilliant academic career winning medals and prizes including University and college Blue ribbons earning the sobriquet, 'Medal' Natarajan.

He joined Armed Forces Medical Service in the dying years of the second World War. On return to Madras Medical Service, he was seconded for training to Orthopaedics in United Kingdom where he proceeded FRCS., England and MCh. Ortho., Liverpool with ease. He had the temerity to point out a mistake in Sir Reginold Watson Jones, 'Fractures and Joint Injuries' receiving the approbation of the author.

On return, he became orthopaedic surgeon Stanley Medical College and Hospital and visiting surgeon Government Tuberculosis sanatorium for few years.

Professor Natarajan's contributions for the Medical Education in general and orthopaedic surgery, Traumatology and Rehabilitation in particular began during his tenure as professor of orthopaedic surgery, Madras Medical College and Government General Hospital, Madras. He was mainly responsible for the holistic development of the speciality with starting of Diploma and Master's Degree comes in Orthopaedics, a school of physiotherapy a school of prosthesis and orthotics, drawing the plan for Government Institute of Rehabilitation and Artificial Limb Centre at Madras and blue print for Accident services for Tamilnadu. He used to say proudly that 'I sit on three stools, Orthopaedics, Physical Medicine and Prosthesis and Orthotics'. Witness the pathetic state of so-called independence of these specialities.

His book for undergraduates has 5 editions since 1982. his collaboration for 'Madras study of Tuberculosis' with MRC of Great Britian and TRC of ICMR, with US Agency for Rehabilitation and WHO have contributed vastly for better management of the common orthopaedic problems of the developing countries.

He was conferred Honorary Fellowship of Royal College of England, Honorary D. Litt of Annamalai University and many more. He was a Founder Member of Indian Orthopaedic Association, World orthopaedic concern and Tamilnadu orthopaedic Association.

He retired as the principal of Madras Medical College and was made the Emeritus professor of orthopaedic surgery of the college.

He was a family man with three of his children qualifying for different

specialities of medicine. He lived to see the election of his eldest son to the highest office of IOA.

I wish the Indian Orthopaedic Association commemorate suitably the memory of Professor M. Natarajan, a teacher- par-excellence, a visionary and an institution builder of the speciality.

TK Shanmugasundaram