# ORTHOPAEDIC DEPARTMENT

# NEWES LETTER

**(LEARNING IS CONTINEOUS)**

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## MESSAGE FROM EDITOR

***It gives us immense pleasure to come out with our Third edition of Newsletter. This time focus is on BONE BANK a facility necessary for Advanced Trauma and Orthopedic care. It will be part of larger TISSUE BANK with multispecialty domains. Along with this some interesting cases managed in department like pseudarthrosis tibia and a classic case of GOUT are been summarized.***

**We wish a warm welcome to everyone for our "NATIONAL BONE AND JOINT DAY" organized by our department on second consecutive year at CDSIMER on 4-8-2022.**

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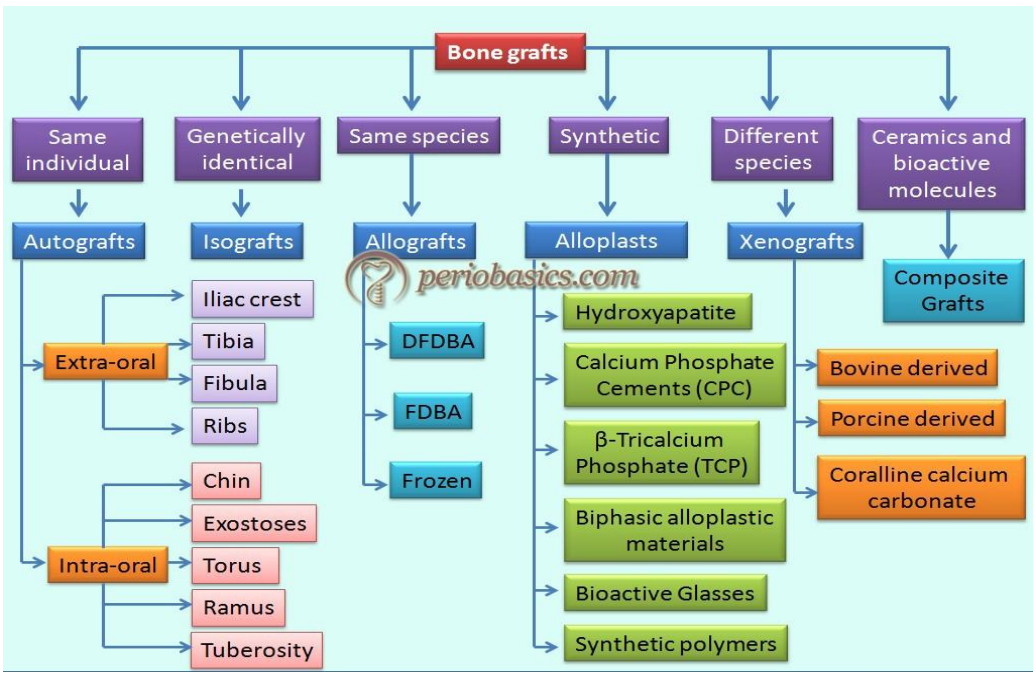
# BONE BANK

"The process of procurement, storage and supply of bone grafts is called bone banking". It is usually part of larger TISSUE BANKING Setup. Bone is the only organ in human body that heals when injured by forming new bone only, unlike scar tissue healing of other organs.

Allografts provides superior long-term results compared to implants and at the same time avoids donor site morbidities of autograft. So, demand for bone graft is increasing in orthopedic surgeries due to trauma, tumor, infection, spine and revision joint replacement. Having In house bone bank is always helpful when dealing with such cases. To increase the safety of transplanted tissues, standards for bone bank operation have been imposed by the government, which has limited the number of authorized Tissue Banks. The good performance in a bone bank depends on strict control over all stages, including: formation of well-trained harvesting teams; donor selection; conducting various tests on the tissues obtained; and strict control over the processing techniques used. Combination of these factors enables greater scope of use and numbers of recipient patients, while the incidence of tissue contamination becomes statistically insignificant, and there is traceability between donors and recipients. In this regard, I have tried to provide a comprehensive outlook on bone bank functioning in this article.

Bone grafts can be classified as below.



In bone banks we are dealing with - **Allograft,** which are "Tissue transplanted between genetically non-identical members of the same species" (either from living or cadaveric donor). It replaces the old term Homograft. Allograft may be divided depending upon the site of its placement in the recipient as,

1. Orthotopic
2. Heterotopic
3. Ectopic

**Orthotopic**: Transplanted into the same site in the recipient that it occupied in the donor E.g.: Proximal femur to proximal femur.

**Heterotopic**: Transplanted to a different site but one occupied by the same tissue as in the donor E.g. Fibula to spine.

**Ectopic**: Transplanted to a site normally occupied by a different type of the tissue. E.g.: Fascia lata as a tendon graft.

Normally orthotopic/heterotopic allografts have been widely used. Ectopic sites for grafting have been used mainly for investigation.

Syngenesio plastic graft: Allograft taken from an immediate relative like father, mother, sister and brother.

| GOALS OF BONE BANKING |
|---|
| **1. PRESERVATION OF PHYSICAL INTERGRITY OF GRAFTS & ITS INDUCTIVE PROTEINS** |
| **2. REDUCE IMMUNOGENICITY** |
| **3. ENSURE STERILITY** |

| BONE BANK FUNCTIONING |
|---|
| **ORGANIZATION** |
| **DONOR SELECTION** |
| **PROCURMENT & PROCESSING** |
| **STERILIZATION & SUPPLAY** |
| **DOCUMENTATION** |

# ORGANIZATION

## DIRECTOR

The Director is responsible for the issue and control of the documentation. He / She is responsible for the overall policy making of the bone bank. He / She is also responsible for obtaining approval from relevant ethical committees for procurement of donor material for the tissue bank. He / She shall be responsible for administrative and medical Operations including compliance with standards as laid down by the authorities.

## OFFICER-IN-CHARGE

Officer-In-charge is responsible for running of the bone bank, bone procurement, processing, storage and distribution. He / She is also responsible for training medical and technical staff from another organisation. He / She is responsible for ensuring that the prepared grafts are reliable for clinical use. He / She is also responsible for checking and maintaining all the documents.

## TECHNICIAN I LAB ASSISTANT

The Technician / Lab Assistant will be working in collaboration with the Officer In-charge and helping all the way from bone procurement to distribution.

## MONTHLY MEETING

However, the monthly performance of the bone bank should be discussed among the Director, Officer-in-charge, and other staff of the bone bank to make sure that the bone bank running smoothly.

## ADVISORY BOARD

The Advisory Board headed by the Dean of the Institution shall meet once in 6 months and review the functioning of bone bank. The Director the Officer-charge shall attend the meeting.

| ADVISORY BOARD |
|---|
| 1. DEAN |
| 2. Orthopaedic HOD |
| 3. Microbiology HOD |
| 4. Pathology HOD |
| 5. Forensic Medicine HOD |
| 6. Anaesthesia HOD |

| EQUIPMENTS USED IN BONE BANK |
| --- |
| Auto Clave: Used for sterilizing instruments and clothing. |
| Surgical Kit: used for procurement of the tissues. |
| Drying cabinet (Hot Air Oven): Used for drying glassware etc. |
| Deep-freezer |
| Water Bath: used for pasteurisation. |
| Band saw: Used bone cutting. |
| Freezed – drier: Used for removing the moisture. |
| Laminar airflow hood: Used for creating a sterile field for packing |
| Sealing machine: Used for packing the tissue, |
| Computer and Printer: used for record keeping and typing |
| Gamma Chamber |
| Fridge |
| Uninterrupted power supply 5kva with backup |
| Miscellaneous equipment's and accessories. |
| Glass and plastic wares (assorted) |
| Polyethylene craft paper bags(assorted) |
| Chemicals and reagents |

# DONOR SELECTION

Bone allografts may be obtained from living donors or from cadaveric donors.

## LIVING DONORS

1. Elderly patient with fracture neck of femur undergoing Hemiarthroplasty.
2. Elderly patient with Osteoarthritis hip undergoing total hip replacements.
3. Elderly patient with osteoarthritis knee undergoing Total knee arthroplasty.
4. Bone segments from corrective osteotomies of any age group.
5. Vascular ischaemia of lower limb without infection undergoing amputations.

## CADAVERIC DONORS

All bones from cadavers can be used, if all the selection criteria are met.

## DONATION AND DONOR EVALUATION

1. Consent for donation by working with families.
2. Donor selection and donor co-ordination.
3. Donor evaluation.

### Consent for Donation-Working with Families

The goal of approaching a family about donation is to offer an informed choice and to support their decision, whether they choose to consent or not. Families are given time to think about the options offered to them and to ask questions. If they choose to donate, the next of kin is asked to sign a consent document. An informed consent must include the specific organs and tissues the family wishes to donate, a statement regarding the intended use for the tissues (transplantation or advancement of medical science and education or research), and information regarding infectious diseases testing to be performed. Consent can be obtained by any of the procurement agencies or by hospital staff trained to obtain informed Consent.

### Donor Selection and Donation Co-ordination

Donor selection is based initially on information available at the time of the death. This includes a review of available medical records; discussion with medical staff and next of kin. Interview may be performed at a later date if the family is unable to complete it at the time of donation. Donation co-ordination determines preliminary suitability and schedules

the recovery of tissues that are then placed in quarantine while donor evaluation is completed.

## Donor Evaluation

- All procured tissues are initially placed in quarantine and donor evaluation continues until all records are reviewed. Medical records and autopsy reports are ordered.
- Donor family interviews and additional interviews are done if indicated, the donation coordinator reviews all this information, continuing to obtain additional information if needed.
- During time infectious disease testing is completed. To ensure that the blood sample is adequate for testing, the potential for dilution of the donor's plasma by administration of large volume of crystallized or blood products is evaluated, all donors are tested for Hepatitis B surface Antigen (HBsAg), Hepatitis C Antibody (HCV), Hepatitis B core antibody (HBc), Syphilis (RPR), HIV' 1 and 2 antibodies {HIV & 2), Human T-lymphotropic virus type I(HTLV-I) and HIV P24 antigen. Results may be reported as non-reactive. PCRHIV testing of a frozen lymphocyte sample may be done in place of HIV antigen. CMV testing and ABO Rh typing are completed whenever possible.
- Once all the information has been obtained and by the co-ordination, the donor chart is reviewed for completeness by the donation specialist and then forwarded to the quality assurance supervisor for QA review and sign off.
- The medical director or bone bank medical officer reviews charts weekly and makes the final determination regarding donor suitability.
- After harvesting of the bones, the tests with Gram stain and bacterial fungal culture should be done to rule out the contamination of the allograft, Histopathology of the graft harvested should be done to rule out the metabolic bone diseases and malignancies. Radiology (X-ray) of the tissue harvested is necessary in case of massive allografts, used in larger defect reconstructions after tumour resection for exact size matching.

| BONE ALLOGRAFT DONOR SCREENING STEPS |
| --- |
| Medical and social history interview with next of kin to exclude those with infections, malignancy, HIV or hepatitis risk behaviours. |
| Physical examination-IV drug abuse, Signs of HIV infection, unexplained Jaundice. |
| Bland Tests Rh factor, Anti-HIV 1 / HIV 2, HBsAg, Anti HCV, Syphilis, Anti HTLV, CMV, Blood culture. |
| Autopsy results if performed. |

| MEDICAL HISTORY EXCLUSION FROM BONE ALLOGRAFT DONATION |
| --- |
| Presence of infection. |
| Presence of history of malignant disease |
| Presence Of degenerative neurologic diseases including dementia |
| Use Of human pituitary-derived growth hormone |
| Connective tissue disorders or vasculitis |
| High dose corticosteroid use |
| Significant exposure to toxic substance |
| Irradiation ta donated tissue |
| HIV or Hepatitis risk behaviour |

| DONOR AGE GROUP |
| --- |
| 15-50 years for long bone. |
| Femur Head - Age no limit |

| TESTS FOR TISSUE HARVESTED |
| --- |
| Culture {Bacterial (anaerobic and aerobic) and fungal} |
| Histopathology |
| Radiology |

# ALLOGRAFT PROCUREMENT

Allografts can be procured from both living donors and cadaveric donors. For living donors, the procurement is done in sterile operating rooms and the procured bones are packed in a sterile manner by a separate staff nurse and sent to the storage place.

## CADAVERIC DONORS

Procurement should be done at the place where the guidelines of class I sterile room by FDA is followed. The place may be a sterile operating room or a clean sterile room at the bone bank or at the mortuary room.

### Time of Procurement of Cadaveric Donors

Ideal time is within 12 hours if the cadavers are stored in the room temperature or 24 hours if the Cadaver is stored in the temperature of 4-8 degree Celsius,

## LIVING DONOR PROCUREMENT TECHNIQUE

- Procurement is done by routine surgical procedures.
- Femoral head or received bone segment is flushed with Normal Saline to remove all blood and fat globules.
- Samples are taken for smear, culture and histopathological examination. Biopsy or curettage is better than swab for microbiological investigations.
- The tissue is soaked in Normal Saline with antibiotic in a kidney tray for 10-15 minutes.
- Then the tissue is packed with sterile double jar technique and labelling is done and the jar is placed in freezer.

## CADAVERIC DONOR PROCUREMENT

1. This is usually done as a part of multi organ and tissue procurement including heart, liver, kidney, cornea and bones.
2. This process is co-coordinated by the transplant co-ordinator responsible for taking consent and performing all necessary laboratory-screening tests mentioned above. All the potential donors with sudden but known cause of death are approached for the donation of bones.
3. Only one fifth of the potential donors donate the bone.
4. Consent form should include the limbs from which the bones and ligaments could be harvested.

5. Procurement team should contain Orthopaedic surgeons. Bones from two limbs can be harvested by two teams.
6. Transplant co-coordinator informs tissue bank manager who in turn alerts the members of the teams. If the donors are not in the concerned hospital, then an ambulance pre-equipped with major orthopaedic instruments set and consumable of the staff is used.
7. Time is a crucial factor in the multi-organ retrieval. The order of retrieval is kidneys, liver, cornea and lastly the bones.
8. The teams should ideally take a maximum of 2 hours to complete the whole procedure
9. If the lower limb bones are to be procured, 2 teams should work simultaneously.
10. Adhesive labels should be prepared beforehand to save time.
11. Procurement should be undertaken in a planned manner for maximum utilization of the tissue obtained from one deceased donor.

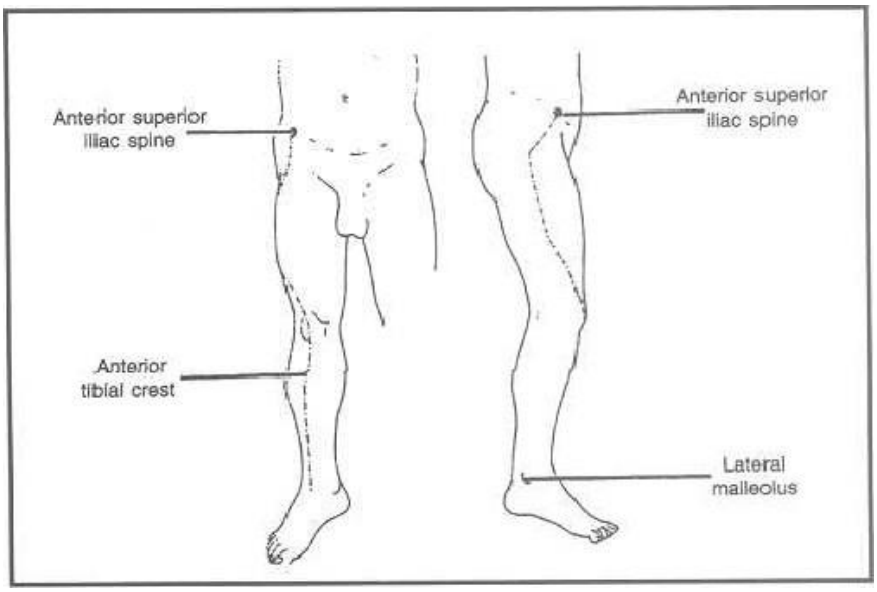
From the lower limbs the following segments are retrieved.

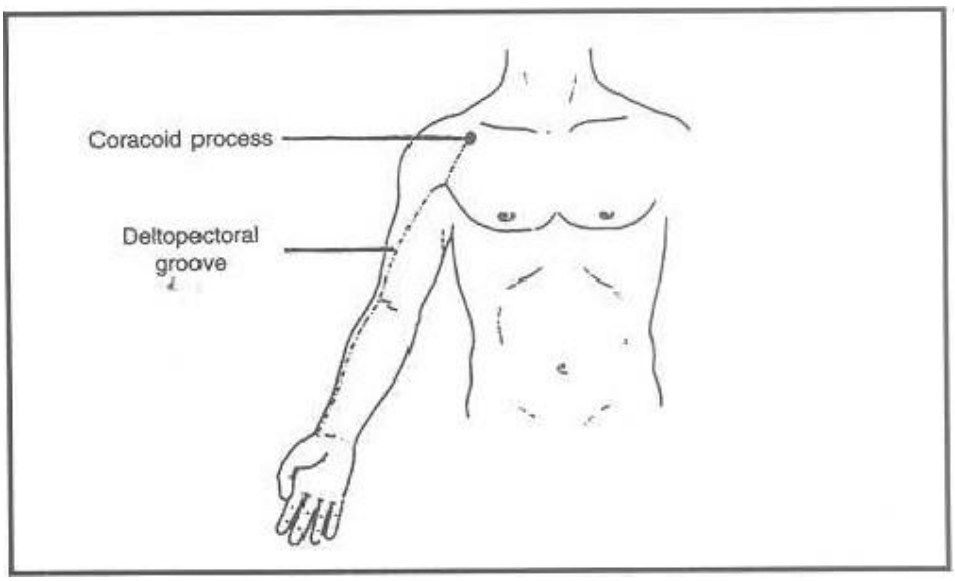
1. Femur

Femoral head

Proximal half

Distal half






Picture showing line of incision used for procuring tissues from upper limb and lower limb

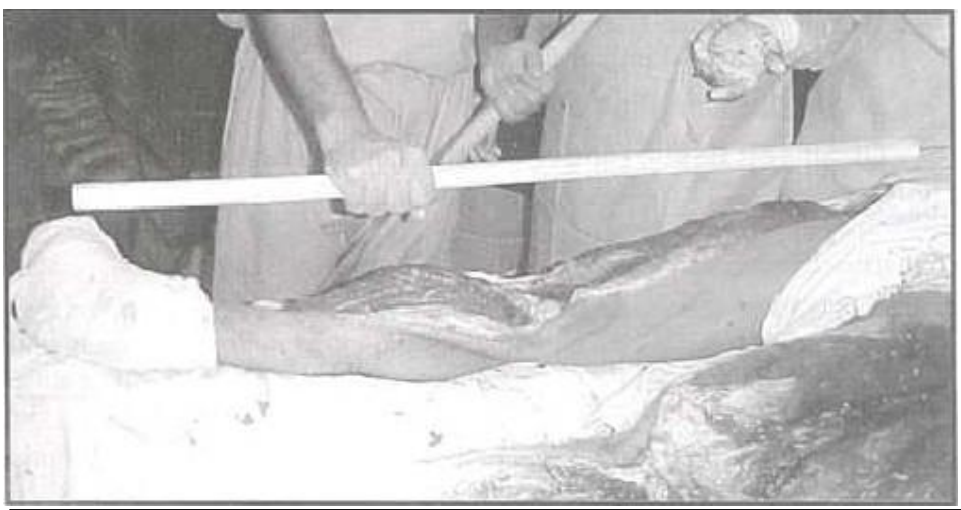


Figure showing reconstruction of the cadaver using wooden rods done at All India Institute of Medical Sciences, New Delhi Delhi

2. Tibia
Proximal half
Distal half
Patellar tendon

3. Calcaneal tendon (Achilles)-Two longitudinal halves for 2 patients

4. Large piece of iliac crest
5. Other soft tissue tendons of tibialis anterior and tibialis posterior

## PACKAGING

- Sterile cleaning and labelling of procured material are done on a separate trolley_
- Each fragment is washed with copious saline and specimens taken from each segment for culture and histopathologic examination and then soaked in 2 litres of Normal Saline containing antiseptic or antibiotic solution for 10-20 minutes.
- Smaller grafts like femur head, patellar and calcaneal tendon and other soft tissues are packed by 'sterile double jar technique'.
- Large grafts like femoral shaft / tibial shaft and iliac crest are packed by sterile triple jar technique using inner polythene, middle linen and outer polythene wrap.

## RECONSTRUCTION OF CADAVER

- This is the most important procedure which determines the long-term success of the bone banking.
- Cadavers should be treated with great respect.
- The limb should be made to look normal by using plastic tibia and femur. Every effort should be made to do this great job of reconstruction.
- The team should finally thank the donor's relatives for organ donation and should make arrangements for the funeral.

## STORAGE

- The collected graft, specimens and donor form are immediately transported to the bank and stared in the quarantine freezer till the investigation results are obtained,
- TWO types of freezers are required; quarantine and the definite freezer.
- Freezer should have separate compartment for each type of allograft stored. It should be equipped with high temperature sensors (recording a drop of even $10^0$ Celsius) and a chart recorder to verify maintenance of the environment.
- This system should be checked and the temperature documented weekly with a manual thermometer.

# ALLOGRAFT PROCESSING

Allografts are processed according to the requirements of the recipient and differ to the various diseases of the patient.

They are processed as:

1. Fresh allografts
2. Fresh frozen allografts
3. Freeze dried allografts
4. Demineralised bone allografts
5. Cryopreserved allografts
6. Physically treated allografts

## FRESH ALLOGRAFTS

The type of graft is, used in young patients with osteochondral defect and/or resurfacing abnormal cartilage,

- The chondrocyte survival varies after transplantation and is universally related to time from retrieval.
- The ideal time is within 1-2 hours following retrieval.
- The dissected tissue is stored in Hartmann solution containing antibiotics and is transported on wet ice.
- Different types cryopreservatives like glycerol or dimethyl sulfoxide have been used in an attempt to improve chondrocyte survival.
- The time of procurement and usage is very short and insufficient for complete donor testing, so risk of disease transmission is Very high.
- This method of processing is very rarely used nowadays and not followed anywhere in the world except in some research centers.

## FRESH FROZEN ALLOGRAFTS (DEEP FREEZING)

- In this method the graft is collected and frozen slowly in two steps; first to $20^0$ Celsius for 8 hours, followed by freezing to -80 degree Celsius in order to stop all enzymatic activity,
- Allografts can be preserved up to 5 years by deep freezing.

## Advantages of Deep Freezing

1. Long bones Such as femur and tibia are stored as fresh frozen allografts.

2. Storage up to 3 months reduces the immunogenicity of the allografts, so the chances of graft resorption are very rare.
3. Stored bone has got superior strength than Other methods of processing.

## Disadvantages

1. High cost of purchasing, operating and maintaining the freezer.
2. Requires regular monitoring for the inside temperature of thaw freezer.

## CRYOPRESERVED ALLOGRAFTS

- The lower the temperature, the greater the reduction of molecular activity, including enzymatic activity.
- At -160 degree Celsius (the temperature of liquid nitrogen) essentially all molecular action is stopped and tissue can be stored indefinitely.
- By cryopreservation allografts can be stored for life.
- Most of the bone banks in the world don't prefer the cryopreservatives due to

1. Its high cost.
2. Liquid nitrogen preservation.
3. Rapid turnover of tissue makes it unnecessary to store them indefinitely,
4. Liquid nitrogen may increase the brittleness of bone due to immediate crystallization of Water that occurs upon rapid exposure to very low temperature,

## FREEZE DRYING (FREEZE DRIED ALLOGRAFTS)

- Freeze drying or lyophilisation is a process in which frozen bone is dehydrated by sublimation.
- Tissue moisture passes directly from the solid phase to the vapour phase and is converted to ice on the condenser of the freeze nitrogen.
- A vacuum is maintained in the freeze dryer during the process, ensuring that bottles of bone allografts are sealed in a sterile manner.
- This process allows tissues to be maintained at room temperature for at least5 years or as long as the vacuum seals remain unbroken.

## Advantages of Freeze-Drying

1. It can be kept at room temperature so storage made easy and cheap.
2. Reduced antigenicity as compared to deep freezing.
3. Transfer of disease is a rare possibility.

## Disadvantages

1. Decreased torsional and bending strength of cortical grafts,
2. Not a suitable technique to preserve long bones.
3. It should be reconstituted by immersion in normal saline before use.

## DEMINERALISED BONE ALLOGRAFTS

- Demineralised or Autolysed Antigen extracted Allogenic bone (AAA) consists of collagen and entrapped noncollagenous proteins.
- Bone Morphogenic Proteins are preserved in this method. So, these types of allografts are both osteoconductive and osteoinductive.
- Protocol for preparing AAA bone are
    1. Chloroform-methanol is used to extract lipid and cell membrane lipoprotein (4 hours)
    2. 0.5% of HCI extracts soluble proteins and demineralises the bone Surface (24 hours)
    3. Natural phosphate buffer in the presence of sulfhydroxyl group enzymes extracts endogenous extra-cellular and intracellular antigens (72 hours)
    4. Then the demineralised bone matrix is freeze-dried and packed in vacuum.
- AAA bone rapidly incorporates in the recipient bed with less cell-mediated immune reaction.
- AAA bone is the choice of graft wherever fusion and early incorporation is needed.

## Advantages of Demineralised Bone

1. Both osteoconductive and osteoinductive.
2. Ease of manipulation and insertion
3. A potentially unlimited supply through bone banks
4. Risk of disease transmission is least.

## Disadvantages

1. Biomechanically weakest form of allograft.
2. It has to be rehydrated before implantation.
3. Different batches have different potencies because of wide variety of donors.

## PHYSICALLY TREATED ALLOGRAFTS

- Radiation doses exceeding 3 mega rads are known to weaken bone matrix.
- There appears to be a significant drop of breaking strength of bone with more than three mega rads.

- The effect is magnified When radiation is combined with freeze-drying.
- Boiling destroys all inductive -capacity,
- Autoclaving produces Haversian canal coagulation and denaturation of bone protein, which severely retards host incorporation.
- Chemical processing of bone grafts may present significant problems such as potential carcinogens, difficulty of penetration into bone and destruction the Osteogenic capacity of bone.

# STERILIZATION OF ALLOGRAFTS

The implantation of an allograft into the body carries with it an inherent risk of infection. It is extremely important to reduce the rate of infection by appropriate sterilization of the allografts. Sterilization has been defined as the process or act of inactivating or killing all forms of life especially microorganisms. Aseptic procurement of allografts from living donors who have little risk of infection, in sterile operating rooms doesn't need secondary sterilization, but allografts from the cadaveric bones need secondary sterilization where ever the procurement has taken place. The sterilization of allografts is an important inevitable process which needs to be taken strictly to, get the success of bane transplantation.

## METHODS OF STERILIZATION

A. Physical Sterilization

1. Thermal
   - Hot air, Pasteurization
   - Steam, autoclaving
2. Non-Thermal
   - Radiation
   - Gamma electronic beam

B. Chemical - Ethylene Oxide, Formaldehyde

## Pasteurization

This is the process of disinfecting tissue or bones by heat. In this process mild temperature of 63 degree Celsius to 66 degree Celsius for 30 minutes are used to kill the microorganisms. This is usually not recommended for sterilization of tissues because certain microorganisms are not completely inactivated.

## Autoclaving

- Bacteria are more readily killed by moist heat than by dry heat, Steam kills bacteria by denaturing their protein.
- 121 degree Celsius for 15 to 20 minutes is the best method of steam sterilization.
- Autoclaving is not recommended by the American Association of Tissue banks because it alters the structure of proteins and alters the bone strength.

## Chemical Sterilization

Chemicals used to sterilize contaminated allografts are

1. Ethylene oxide
2. Formaldehyde
3. Glutaraldehyde
4. Chloro/Bromo compounds
5. Betapropionolactone

Most widely used agent is Ethylene oxide.

- Ethylene oxide is applied in a gaseous state in mixture with inert diluents such as carbon dioxide and freon (dichlorodifluro methane)
- After sterilization, the residual ethylene oxide is removed by flushing inert gas in like carbon dioxide.
- Ethylene oxide Sterilization of allografts also has lost its popularity because of its carcinogenic property.

## Radiation Sterilization

Two types of radiation are employed for sterilization namely Ionizing radiation and non-ionizing radiation. Ultra violet rays are non-ionizing radiations most effective at 253.7 nm wavelengths. It is mainly used for surface sterilization as it has very low penetration. Ionizing radiation includes high-energy electrons generated from accelerators, electromagnetic rays such as gamma rays emitted by radioisotopes Cobalt 60 and Caesium 137, and x-rays generated by x-ray machine. Ionizing radiation kills all types of microorganisms through the ionization process and usually has enough energy for useful penetration into solids and liquids of the tissue. The direct action of radiation involves the interaction between ionizing radiation and critical biological molecules, which results in an excitation lesion and scission of polymeric structure. These rays can break and change the DNA strands. The treatment does not heat up tissue materials significantly and are widely used for industrial Sterilization of the heat sensitive medical and laboratory products. Therefore, this has gained popularity in sterilization of allograft.

- Gamma radiation is very effective against bacteria at doges of 15 to 25 K Gy and less effective against the viruses. 40K Gy radiation is needed to inactivate HIV virus in allografts.
- American Association of Tissue Banks and International Atomic Energy Association recommend the dose of sterilization of bone allografts as 25 K Gy.
- WHO and Bangkok biomaterial research center advise the combination of pasteurization and radiation to eliminate HIV virus with pasteurization at 56 degree Celsius for 30 minutes followed by gamma radiation at 25 K Gy.
- Gamma radiation sterilization is used in more than 90% of the tissue banks throughout the world.

The dose of radiation necessary for killing the microorganisms has been listed in the following table

**RADIATION RESISTANCE OF MICRO ORGANISMS**

| GROUP | ORGANISMS | STERILIZING DOSE (K Gy) |
|---|---|---|
| **Sensitive** | Vegetative bacteria<br>Animal viruses >75um | 0.5-10 |
| **Moderately resistant** | Moulds and yeast<br>Animal viruses 20-75gm | 4-30<br>10-30 |
| **Resistant** | Spores<br>Animal viruses <20gm<br>HIV virus | 10-50<br>30-40<br>35-40 |
| **Highly resistant** | Moraxella<br>Foot and mouth virus | 50<br>50 |

# STERILE PREPARATION OF ALLOGRAFTS

The allografts can be processed, sterilized and stored in different methods like deep freezing and cryopreservation. Certain processed allografts like AAA bone and freeze-dried bone Can be stored in room temperature for several years. These processed allografts should be prepared sterilely according to their type and used cautiously in the operating room to get the maximum benefit from bone transplantation. Carelessness may lead to increase in the infection of allografts.

## PREPARATION TECHNIQUES FOR DIFFERENT TYPES OF GRAFTS

- Deep frozen grafts
- Cryopreserved osteoarticular grafts
- Freeze dried grafts
- Deep frozen soft tissue allografts

### Deep Frozen Grafts

After taking Out of the freezer, the allografts are kept in 2 litres of Normal Saline for at least I hour before operation, after taking samples for culture and sensitivity. Remove all the soft tissue cartilage and periosteal attachments with a sharp instrument. Wash with Normal Saline and mark with methylene blue the Segment of bone required. Cut the femur head into pieces and use for the transplantation purpose.

### Cryopreserved Osteoarticular Grafts

Same procedure as deep-frozen grafts processing is followed. Glycerol wrapping over articular cartilage should be removed by washing with Normal Saline.

### Freeze Dried Allografts

When opened from the sterile packing, the allografts Should be rehydrated with Normal Saline for using before transplantation.

- Cancellous chips - 20 minutes rehydration.
- Cortical grafts - one hour of rehydration.
- Cancellous chips Should not be rehydrated for more than 20 minutes as it weakens the graft significantly.

### Soft Tissue Allografts

Thawing and rehydration is done in 2 litres of Normal Saline for at least 1 hour before operation. Removing fat and Other unnecessary soft tissue with a sharp instrument is the main step.

Bacterial and virus transmission have been reported with fresh frozen bone allografts. The disease transmission is rare in freeze dried bone allografts and demineralised freeze-dried bone allografts.

| The following bacterial and Viral infectious agents have been reported with the use of allografts |
|---|
| Group A Streptococci |
| HIV virus |
| HCV (Hepatitis C virus) |
| HBV (hepatitis B virus) |
| Treponema pallidum |

| COMPLICATIONS OF ALLOGRAFT USAGE IN VARIOUS CONDITIONS |
|---|
| 1. Infection |
| 2. Non-union |
| 3. Graft fracture |
| 4. Transmission of infectious diseases |
| 5. Graft resorption |
| 6. Cartilage fragmentation |
| 7. Implant failure |

# LEGAL ISSUES IN BONE BANKING

Donation and transplant coordination are a very complex process that requires Synchronized involvement of large number of health care professionals, specialists, counsellors and organizations in order to be successful. The Government of India enacted the Transplantation of Human Organs Act in 1994, to regulate the process of organ donation and prevent commercialization of human organ donation. Hence a clear understanding of the act and abiding by the law is mandatory. Since the majority of potential donors are the victims of accidents, there are several medico legal issues involved that need efficient coordination between the police, medico legal experts, medical team and transplant coordinator in order to retrieve the organs in such cases.

**LEGAL ISSUES IN ORGAN DONATION**

1. Getting the consent
2. Organ retrieval in medico legal cases
3. Organ retrieval in unclaimed cases

**CONSENT**

- Consent should be got according to the prescribed pattern as in the Transplantation of Human Organs Act in 1994.
- Consent should be got broadly, i.e., Received Organ may be used for educational, research and transplantation purposes.
- If the death occurs at home, it is advisable to take police clearance as well as
- Consent from the family in a prescribed format,

**ORGAN RETRIEVAL IN MEDICO LEGAL CASES**

The team should get no objection certificate from the police and proper consent from the donor (if living) or from the donor's family in case of cadaveric retrieval. Transplant coordination unit should work with the forensic department. The whole process should be carried out in the presence of a forensic expert who will also complete the post-mortem.

**ORGAN RETRIEVAL IN UNCLAIMED CASES**

The unclaimed bodies in the hospital or in the prison can be utilised as donors for bone banking if the following recommendations were followed,

1. The bone should be Claimed only after 48 hours from the time of death.
2. During 48 hours from the time of death all efforts should be made through press, post and Television to identify their relatives,
3.The consent can be given by the person in charge of the management of the prison or hospital.
4. The efforts for identifying the relatives are to be made by the police in medico-legal cases and in non-medico-legal cases it is done by the hospital authorities

# ETHICAL ISSUES IN BONE BANKING

The bones for the bone bank come from Cadaveric donors or living donors. There is a chain of events for the successful running of the bone bank with donor identification, donor screening donor management, consent organ retrieval, organ allocation, operational systems like storage processing in the bone bank and surgical cases of the procured allografts. Ethical issues should be handled at every step of the procedure.

The following suggestions should be handled by the transplantation unit to manage the ethical issues regarding bone banking.

- The transplantation unit should promote voluntary, non—remunerated tissue donation as an autonomous informed choice free of coercion and pressure.
- The right to donation should be respected. The transplantation unit should support, importantly, the equitable allocation of allografts. It should equally distribute without regard to race religion sex, material origin, sexual orientation social or economic Status.
- Should place importance in maintaining confidentiality.
- Bone bank should promote standards of practice that help to ensure safety and effectiveness of allografts.
- It should acknowledge and treat with respect, the gifts that have been donated and to reflect this in all activities related to procurement, processing and distribution by maximizing the usefulness of the gifts while minimizing risks and wastes.
- Should share information about bone transplantation whenever permissible and thus contribute to growth and equality of professional knowledge and continue to emphasize the importance of donation.
- It should encourage public confidence in organ donation and transplantation and ensure that the allografts are made available on a priority basis to patients who need lifesaving and reconstructive procedures.
- Regarding advertising services, bone bank should consider carefully the public perception of the advertising terms that cheapen the concept of the gift of Life. It should be truthful, provide accurate Information and avoid unethical and misleading statements. It should emphasize community support and avoid advertisements that undermine community support of organ donation.

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# CONGENITAL PSUDOARTHROSIS TIBIA

**DEFINITION**:- Pseudarthrosis is a false joint associated with abnormal movements at the site.

**INTRODUTION**:-

Congenital pseudarthrosis of tibia refers to nonunion of tibial fracture that develops spontaneously or after trival trauma in a dysplastic bone segment of tibia diaphysis.

CPT is rare & Usually develops in first 2 yrs of life. Aetiology is unclear, Incidence is 1: 250,000.There is a strong association with neurofibromatosis.6% of the patients with Neurofibromatosis have the deformity and up to 55% of cases with anterolateral bowing and pseudo arthrosis are associated with neurofibromatosis. Some authors have also found anterolateral bowing to be ultimately associated with neurofibromatosis in nearly every instance. The presence or absence of neurofibromatosis doesn't affect the outcome of the tibial pseudo arthrosis. Fibrous dysplasia is seen up to 15% of patients with Anterolateral bowing.

**PATHOLOGY:**

Unclear, Recent studies have shown that there is hyperplasia of fibroblast with the formation of dense fibrous tissue. This invasive fibromatosis is located in the periosteum & between broken bones ends causing compression, osteolysis & persistence of pseudarthrosis. Paley et al theorized that pathology of pseudarthrosis is not bony but rather its periosteal in origin. Thickening with hamartomata's transformation of periosteum.

Appearance of strangulation of bone with atrophic changes followed by avascular changes. Failure of remodelling leading to stress fractures. Pathologic analysis of HERMANNS-SACHWEB et al confirmed that pathologic periosteum is the cause of CPT. Neural cells form a tight sheath around the periosteal vessels. Periosteum undergoes hypoxemic changes resulting in the formation of a thick fibrous cuff. Leads to impaired oxygen & nutrient supply to the subperiosteal bone & atrophic changes are observed.

**NEUROFIBROMATOSIS**

NF-1 occurs due to mutation on the gene coding for NEUROFIBROMIN on chromosome 17. Neurofibromin is expressed in a broad range of cells & tissue type. It negatively regulates Ras activity ( cell proliferation & function). Its deficiency leads to increased Ras activity. Affects Ras-dependent MAPK( mitogen activated protein kinase) activity which is essential for osteoclast function & survival.

**CLINICAL FEATURES**

Associated with anterolateral bowing of tibia. Bowing usually occurs at the junction of middle & distal third. Deformity may be associated with skin dimple, limb shortening, dysplasia of fibula & ankle valgus. Usually unilateral. If cutaneous signs of neurofibromatosis are present the diagnosis is readily apparent.

**CLASSIFICATION:** Boyd's classification is commonly used.

Boyd divided CPT into 6 types :

**Type 1** :-

Pseudarthrosis occurs with anterior bowing. A defect in tibia present at birth. Other congenital deformities may be present which may affect the management of pseudarthrosis.

**Type 2** :-

Pseudarthrosis occur with anterior bowing & a hourglass constriction of the tibia is present at birth. Spontaneous fractures or after minor trauma. Commonly occur before 2 yrs of age. Also known as HIGH RISK TIBIA. Tibia is tapered, rounded, sclerotic & obliteration of medullary canal. Most common type. Associated with NF-1 .Poorest prognosis.

**Type 3**:-

Pseudarthrosis develops in a congenital cyst usually near the junction of middle & distal third of tibia. Anterior bowing may precede or follow the development of fracture. Recurrence of fracture is less common after treatment. Originates in a sclerotic segment of bone. Without narrowing of tibia.

**Type 4:-**

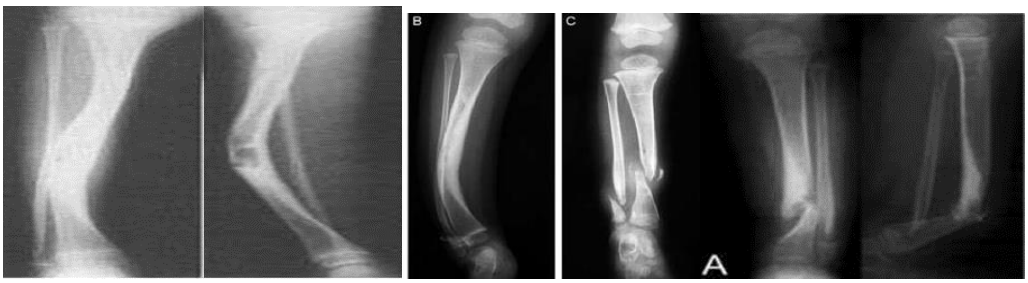
Medullary canal is partially or completely obliterated. An insufficiency or stress fracture develops in the cortex of tibia & gradually extends through the sclerotic bone. Prognosis is good.

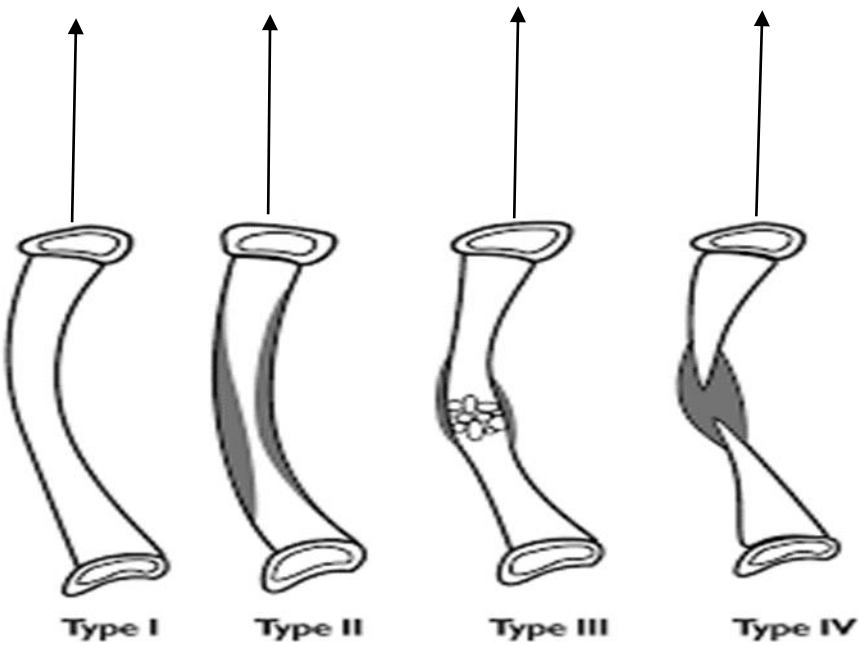
**Type 5 :-**

Pseudarthrosis of tibia occurs with a dysplastic fibula. Pseudarthrosis of both bones may develop. Prognosis is good if the lesion is confined to fibula. If the lesion progress to tibia then the natural h/o usually resembles type 2.

**Type 6 :-**

Occurs as an intraosseous neurofibroma or schwannoma. Extremely rare.




**TREATMENT:-**

**AIM**

- Achieve union
- Prevent refracture
- Correct limb length inequality
- Correct associated growth abnormalities
- Prevent ankle deformity and arthritis.

**PROPHYLAXIS**

1. Once the diagnosis of a non-resolving anterolateral bowing of the tibia has been made the first step is to prevent fracture if possible.
2. In an infant before walking age, no specific treatment is needed other than education of the caretakers.
3. Once the child begins weight bearing prophylactic bracing should be attempted although there is no documentation that such a program can prevent a fracture.
4. A clam shell like orthosis that provides circumferential support is usually recommended.
5. Protection of the unfractured tibia should be continued indefinitely till skeletal maturity or until patient approaches skeletal maturity.

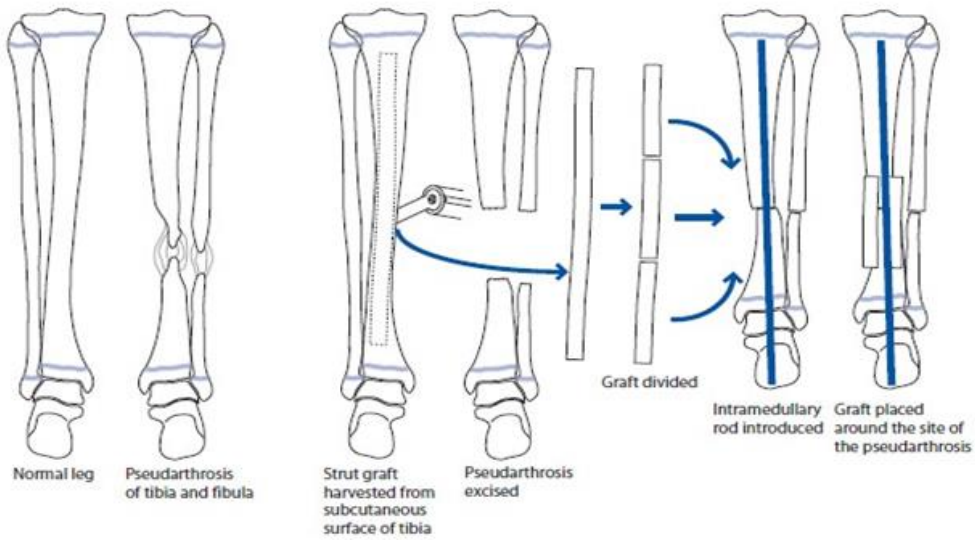
**SURGICAL OPTIONS**

- Vascularized fibular graft
- External fixation
- Intramedullary nail
- BMP
- Electrical stimulation.

| Factors to be considered | Microvascular free fibular transfer | Ilizarov technique | Intramedullary rodding and bone grafting |
|---|---|---|---|
| Reported union rate | >70% | >70% | >70% |
| Success in children under the age of 3 years | Poor | Poor | Good |
| Ability to reduce risk of refracture | Does not reduce risk | Does not reduce risk | Reduces risk |
| Simultaneous correction of limb length inequality | Not possible | Possible | Not possible |
| Simultaneous correction of all deformities | Not possible | Possible | Not possible |
| Prevention of late ankle valgus | Not possible | Not possible | Possible |
| Complexity of the procedure | Very complex | Complex | Simple |
| Cost | Very high | High | Low |

## INTRA MEDULLARY NAIL

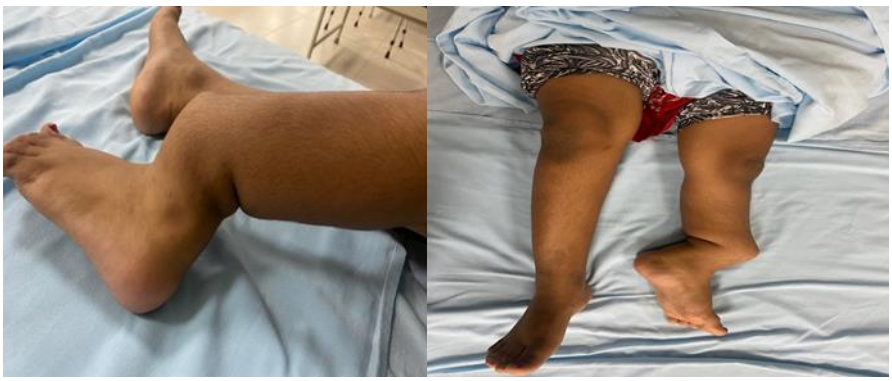
- Excision of the pseudarthrosis involves excising the tapered ends of the bone until fresh bleeding is encountered
- There is general agreement that autogenous bone grafting facilitates union.
- Three struts of cortical bone are placed around the site of the excised pseudarthrosis after ensuring that the fragments are well apposed.



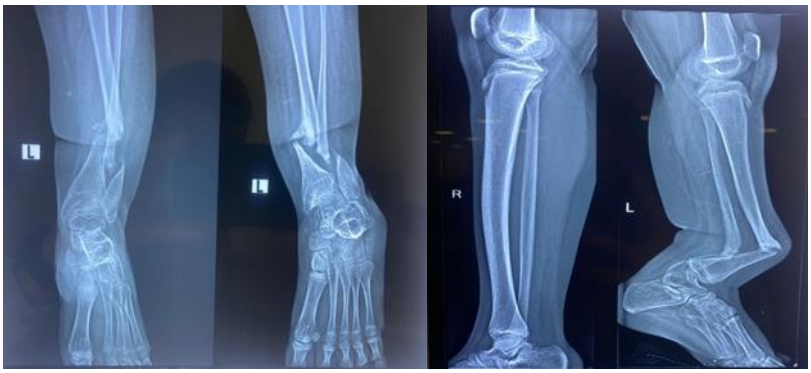

## A CASE OF PSEUDOARTHROSIS TIBIA OPERATED IN CDSIMER

A 10 year old female patient presented to outpatient department with deformity and inability to walk since she started weightbearing. On clinical examination there was gross deformity of left lower limb(>80deg angulation at the non-union site) associated with multiple Café-au-lait spots and lisch nodules. Patient and attenders were counselled regarding the risks involved with deformity correction and was taken up for surgery.

- Deformity correction achieved intraoperatively ,iliac crest bone grafting and bone fixation done with telescopic (fussier-duval) nail and 3.5MM Dynamic compression plate.

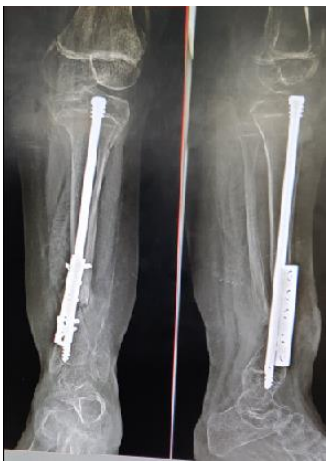


**Clinical Pictures of patient showing anterolateral bowing of left tibia**




**X ray of same patient showing Type 3 pseudo arthrosis tibia left leg**

intra operative pictures showing excision of psedo arthrosis with bone grafting



Post op x-ray showing expandable IM TIBIAL NAIL with 3.5 DCP fixation

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# GOUT

Gout is one of the oldest recognized arthropathies and the term “gout” was first used by Randolphus around 1200 AD. Gout is derived from Latin word “gutta” meaning “a drop of liquid (poisonous)” representing the residue left by blood (“dropping”)around joints.

The term gout is used to represent a heterogeneous group of diseases found exclusively in the human species that include:

- An elevated serum urate concentration (hyperuricemia)
- Recurrent attacks of acute arthritis in which monosodium urate monohydrate crystals are demonstrable in synovial fluid
- Aggregates of sodium urate monohydrate crystals (tophi) deposited chiefly in and around joints, which sometimes lead to deformity and crippling
- Renal disease involving glomerular, tubular, and interstitial tissues and blood vessels
- Uric acid nephrolithiasis.

## TYPES OF GOUT

| Primary | Secondary |
|---|---|
| *Diminished Renal Excretion of Uric Acid* | |
| Isolated renal tubular defect in fractional clearance of uric acid (most patients) | Renal insufficiency |
| Familial juvenile hyperuricaemic nephropathy | Hypertension |
| | Drug administration:<br>• Any diuretic (but particularly thiazides)<br>• Low-dose salicylates<br>• Ciclosporin<br>• Pyrazinamide |
| | Lactic acidosis e.g. due to alcohol, fasting, or vomiting or rigorous exercise |
| | Volume depletion |
| | Lead toxicity |
| | Glucose-6-phosphatase deficiency |
| *Increased Production of Urate* | |
| Increased purine synthesis *de novo*:<br>• Idiopathic<br>• Hypoxanthine–guanine phosphoribosyl transferase deficiency<br>• Phosphoribosyl pyrophosphate synthetase superactivity | Increased turnover of purine nucleotides:<br>• Myeloproliferative disorders, e.g. polycythaemia rubra vera, chronic granulocytic leukaemia<br>• Lymphoproliferative disorders, e.g. chronic lymphocytic leukaemia<br>• Severe exfoliative psoriasis |
| | Accelerated catabolism of purine nucleotides:<br>• Cytotoxic drug therapy (‘tumour lysis syndrome’)<br>• Alcohol ingestion<br>• Fructose ingestion/intolerance<br>• Glucose-6-phosphatase deficiency (GSD type I)<br>• Myogenic (GSD types III, V and VII) |

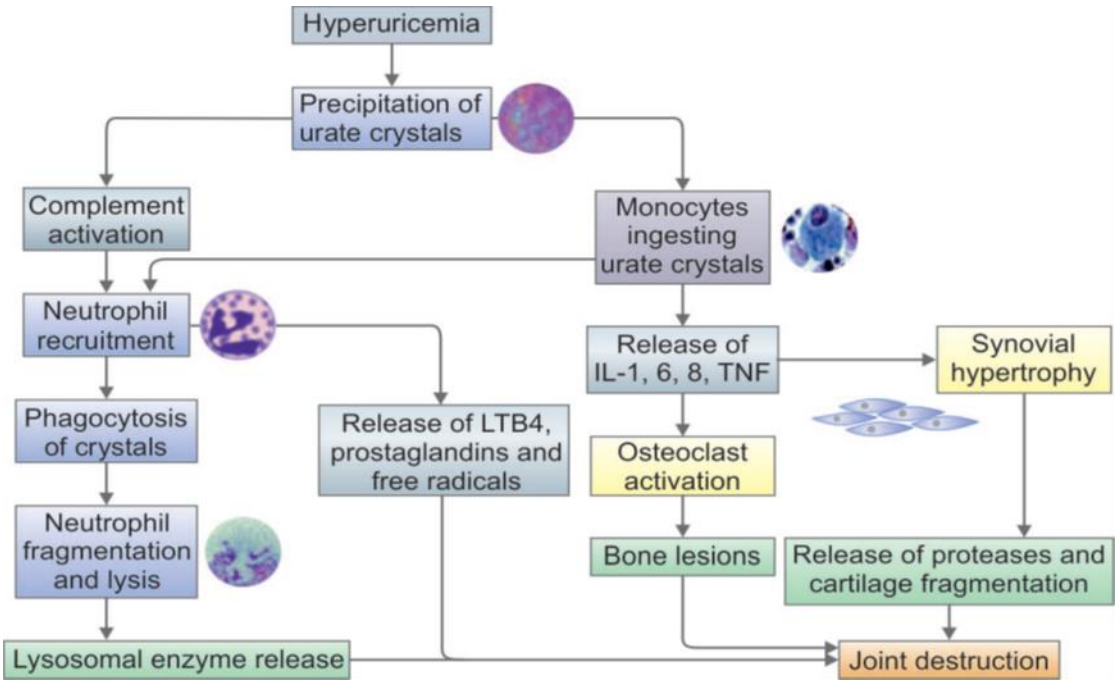
Primary gout is predominantly a disease of adult men with a 4:1 male to female ratio making gout as the major cause of inflammatory arthritis in men over the age of 30. In females the onset is often delayed (postmenopausal) secondary to other hyperuricemia producing conditions.

## PATHOPHYSIOLOGY

Uric acid is the end point of purine metabolism. The synthesis of purine is by two pathways. One is synthesis from nonpurine precursors that forms the bulk of uric acid component. The other is the salvage of free purine bases derived from the breakdown of nucleic acids of endogenous and exogenous origin. With inefficient salvage mechanism and greater synthesis is from nonpurine precursors, uric acid production is increased and gout results. The term asymptomatic hyperuricemia is applied to the state in which the serum urate concentration is abnormally high, but symptoms of urate crystal deposition have not occurred. High concentrations of uric acid may result from either underexcretion (90% of primary gout cases) or from overproduction. Excretion of urinary uric acid in excess of 600 mg/day indicates uric acid overproduction. Values more than 1,000 mg/day are clearly abnormal.

Some rare enzymatic deficiencies result in overproduction of uric acid. These include patients with phosphoribosyl pyrophosphate synthetase overactivity, Lesch-Nyhan syndrome (hypoxanthine-guanine phosphoribosyl transferase (HGPRT) deficiency), and Von Gierke's disease (glucose-6-phosphatase deficiency, glycogenosis Type 1).

Synovial fluid has low pH so urate crystals dissolve poorly more so in peripheral joints due to lower temperature there is higher likelihood of crystals to precipitate.




***PATHOPHYSIOLOGY OF GOUT***

## CLINICAL FEATURES

The symptoms of gout arise from precipitation of urate crystals into joint spaces especially feet (1st MTP joint classically called podagra), the marrow and the soft tissues.

- Pain that suddenly appears in 12–24 hours. Usually occurs overnight (metabolic changes)
- Skin over affected joint is Red-purplish, tight and shiny
- Joints are painful, swelling, warmth
- One to two joints affected at a time. Cooler joints affected more commonly because urate
- crystals form at cool temperatures
- Podagra or pain in the first metatarsophalangeal joint is the classic presentation.

In the joints, an inflammatory arthropathy occurs that usually present as recurrent self-limiting attacks of synovitis
(Gout flare) producing a red, tender, hot, swollen joint.

Deposition in marrow causes intraosseous tophi that may lead to para-articular erosive changes, causes hard, painless soft tissue tophi and inflammatory masses in the soft tissues.

**Gout generally passes through four stages:**

1. Asymptomatic hyperuricemia
2. Acute gouty arthritis (the gout flare) lasting few days to weeks
3. Intercritical (or interval) gout is the period when the symptoms resolve fully immaterial of how incapacitation
the flare was.
4. Chronic tophaceous gout that is characterized by the identifiable deposition of solid urate (tophi) in connective tissues, including articular structures, with ultimate development of a destructive arthropathy, often with secondary degenerative changes. Here, due to repeated acute attacks monosodium urate crystals precipitate until visible deposits form and the synovium becomes progressively more fibrotic and thickened, with pannus formation. This pannus destroys the underlying bone and associated functional impairment.
5. A tophus is an aggregate of monosodium urate crystalline material with its accompanying inflammation and foreign body giant cells. This the pathognomonic hallmark of this disorder. Tophi can be seen in the articular cartilage, periarticular ligaments, bone and tendons. They are also seen in soft tissue around olecranon and knee (patellar bursae), helix of ear (typical extra-articular site), kidneys, nasal cartilage, skin of the finger tips and soles.

## PREDISPOSING FACTORS:

- Genetic predisposition
- Obesity
- Hypothyroidism
- Cancers and blood disorders
- Alcohol abuse
- Duration of hyperuricemia

- Renal failure
- High intake of purine containing food
- Radiation treatment
- Pharmacologic agents (thiazides, cyclosporine, pyrazinamide, ethambutol, nicotinic acid, warfarin, low dose salicylates).

**DIAGNOSIS:**

The American College of Rheumatology has 11 criteria
and the presence of six or more suggests that gout is present.

1. More than one attack of active arthritis
2. Maximum inflammation develops within one day
3. Oligoarthritic attack
4. Redness observed over joint
5. First metatarsal phalangeal joint painful or swollen
6. Unilateral first metatarsophalangeal joint attack
7. Unilateral tarsal joint attack
8. Tophus (proven or suspect)
9. Hyperuricemia
10. Asymmetrical swelling within a joint on radiography
11. Complete termination of an attack.

**RADIOLOGY:**

The major role of radiography is to exclude other causes of arthritis during an acute attack. Typical early gout shows deposition of mildly hyperdense material in the soft tissues representing tophi adjacent to joints. The common joints affected are:

- First metatarsophalangeal joint
- Tarsal joints
- Ankles
- Fingers
- Wrist
- Elbow.

Over time the bones develop sharply punched out round to oval defects situated in the marginal areas of the joint that are surrounded by a

sclerotic border. The appearance of clasp-like erosions in a distribution that is typical for gout is nearly pathognomonic.

## TREATMENT

- Medicines are the mainstay of treatment both in acute stage and in chronicity. The treatment is aimed primarily at terminating the acute attack as fast and as gently as possible, to reverse or prevent complications of crystal deposition and to prevent recurrences of acute arthritis.
- Nonsteroidal anti-inflammatory drugs are the mainstay for controlling inflammation during acute attack or flare. Few NSAIDs also have uricosuric effect (etodolac, etoricoxib).
- Corticosteroids have been highly effective in controlling the acute flare. Injectable steroids have no parallel in pharmacotherapy for controlling acute joint inflammation limited to 1–2 joints that can be injected.
- For acute severe attack initial combination therapy with full dose of either (1) colchicine and NSAIDs, (2) oral corticosteroids and colchicine or (3) intra-articular steroids with all other modalities has been recommended
- Colchicine has a low therapeutic index and usually an oral dose of 0.5 or 0.6 mg is taken hourly until one of three things occurs: (1) joint symptoms ease; (2) nausea, vomiting, or diarrhoea develops or (3) the patient has taken a maximum of 10 doses
- For chronic gout the pharmacotherapy is primarily directed to reduce the serum uric acid levels and prophylaxis for acute attack:
- Reduction of the serum urate concentration is achieved pharmacologically by: a. Increasing the renal excretion of uric acid (uricosuric agents) or b. By decreasing uric acid synthesis.
- For those patients with gout who excrete less than 800 mg of uric acid per day and have normal renal function, reduction of serum urate concentration can be achieved with a xanthine oxidase inhibitor or a uricosuric drug. Allopurinol is probably the drug of choice because it can be used with fewer restrictions compared to uricosuric agents in most cases.
- Uricosuric agents are indicated in patients less than 60 years with hyperuricemia and urinary excretion of less than 800 mg/24 hour on a regular diet, satisfactory renal function and no renal calculi. These agents are ineffective with compromised renal function and GFR of less than 30 mL/minute.

- Probenecid is the most commonly used uricosuric agent while diflunisal, etodolac, fenofibrate also have clinically useful uricosuric activity.
- Febuxostat (TMX-67) is a new class of uric acid lowering drug. It is a nonpurine, selective inhibitor of xanthine oxidase distinguishing it from allopurinol and oxypurinol (purine analogs) that are nonselective inhibitors and inhibit at least five enzymes in the purine and pyrimidine pathway other than xanthine oxidase.
- Uricase therapy has been tried and is still evolving. Expression of uricase enzyme ceased in humans during evolution. The therapy is based on premises that the enzyme converts uric acid to allantoin which is much more soluble. Rasburicase (the non-PEGylated recombinant fungal enzyme) is one such enzymatic drug.

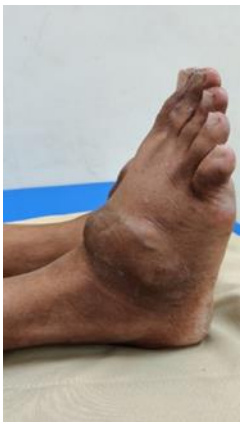
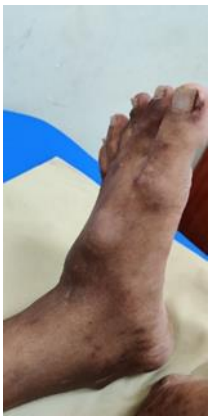
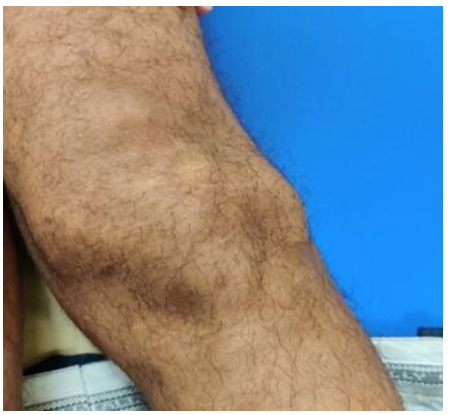
## LIFESTYLE MODIFICATION AND ANCILLARY THERAPIES

1. Restricting dietary purine—the foods rich in purine include:
    - Anchovies
    - Beans
    - Meat gravies
    - Shellfish
    - Organ meats
    - Asparagus
    - Lentils
    - Mushrooms.
2. Weight loss in obese and hypertensive patients
3. Alcohol restriction.
4. Increased coffee intake is associated with reduction in urate levels.
5. Increase water intake (restrict in renal patients).

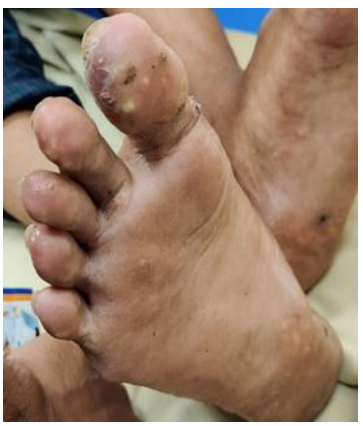
## A CASE OF CHRONIC TOPHACEOUS GOUT

A 34 year old male patient presented to outpatient department with insidious onset of multiple swellings on bilateral feet, bilateral knees, olecranon, posterior aspect of pinna. Painful joints in bilateral hands and feet since 1 year. Waxing and waning of symptoms were present in the course. He was a chronic smoker and alcoholic in the past 15 years and predominantly non vegetarian diet. On clinical examination multiple swellings(tophi) which are firm in consistency and in soft tissue plane

were noted. Chalky white discharge was seen from the swellings. No restriction of movement was noted in joints.

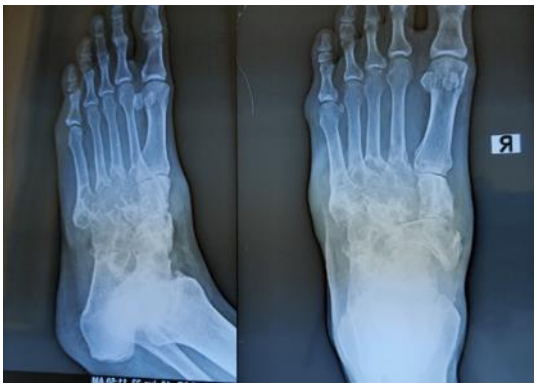




Multiple swellings containing tophaceous material seen around ankle & knee

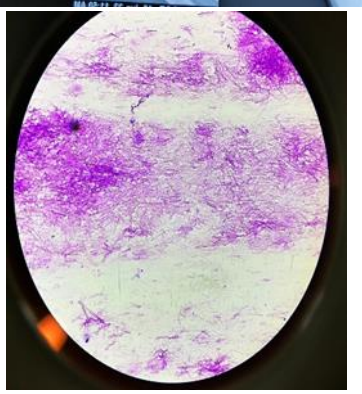


Chalky white discharge from tophi in plantar surface of great toe

Further evaluation was carried out. His s. uric acid was elevated (11.9 mg/dl), creatinine 3.08 mg/dl. X-rays showed clasp like marginal erosions with sclerotic borders. Ultrasound abdomen revealed features of grade 1 chronic kidney disease with bilateral kidney shrunken in size with max diameter of 5.6 cm. Fine needle aspiration cytology from the tophi was done which revealed uric acid crystals on microscopy.



X-ray of foot showing marginal erosions with sclerotic borders and advanced arthritis



FNAC from tophi when viewed under normal microscope after staining with may Grunwald giesma staining

Keeping in mind his kidney status colchicine wasn't used. To abort his acute flare up of symptoms oral prednisolone 10 mg twice daily, Febuxostat 40 mg bd and iv paracetamol 1gram tid started. It was converted to oral route after 3 days. Post 1 week after treatment patient had his pains subsided and size of tophi decreased. His s uric acid was 8 mg/dl and s. creatinine 2.54mg/dl. Prednisolone dose was tapered to 5mg and stopped.

He was discharged with diet and lifestyle modification advise and febuxostat 40mg/dl bd dose.

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# STATISTICS: DEPARTMENT OF ORTHOPAEDICS

## OPD(OUT PATIENTS DEPARTMENT)

| | JAN | FEB | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2020** | 1421 | 1531 | 1177 | 324 | 660 | 520 | 210 | 190 | 170 | 356 | 256 | 520 |
| **2021** | 788 | 698 | 768 | 779 | COVID-19 | 279 | 755 | 1075 | 1140 | 1128 | 1503 | 1714 |
| **2022** | 1296 | 1171 | 3252 | 3837 | 3911 | 4591 | 4445 | | | | | |

## IP(IN PATIENTS)

| | JAN | FEB | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2021** | 24 | 30 | 27 | 21 | COVID | COVID | 31 | 36 | 47 | 40 | 59 | 56 |
| **2022** | 32 | 40 | 44 | 57 | 64 | 59 | 75 | | | | | |

## OT(OPERATION THEATER)

| | JAN | FEB | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2021** | 24 | 30 | 27 | 21 | COVID | COVID | 31 | 36 | 47 | 40 | 59 | 56 |
| **2022** | 32 | 40 | 44 | 57 | 64 | 59 | 55 | | | | | |

# BONE/TISSUE BANK MESSAGE

## *"LIFE .....PASS IT ON!"*

**At a certain moment doctor will determine that my brain has ceased to function and that, for all intents and purpose, my life has stopped.**

**When that happens don't call this my "DEATHBED" call it my "BED OF LIFE" and let my body be used by others to lead fuller lives.**

**Give my Heart to a person whose own heart has caused nothing but endless days of pain.**

**Give my Eyes to a man who has never seen some a baby's face of love in the eyes of a woman.**

**Give my Blood to the teenager who has been pulled from the wreckage of his car, so that he might live to see his grandchildren play**

**Give my Kidneys to one who depends on a machine to exist from week to week.**

**Take my Bones, every Muscle, every Fibre and every Nerve from my body to find a way to make a crippled child walk.**

**Explore every corner of my Brain, take my Cells and let them grow so that Someday a speechless boy will shout at the crack of a bat and a deaf girl hear the sound of rain against her window.**

**Burn what is left of me and scatter the Ashes to the Winds to help the flowers grow.**

**If you must Bury something, let it be my Faults, my Weaknesses and all my Prejudice against my fellow men. Give my Sins to the Devil and give my Soul to God.**

**If you do what I have asked.**

**I WILL LIVE.....FOREVER**

***- Legacy of Robert N, West***