Journal of Biological Engineering Research and Review, 2015; 2(2): 21-30

ISSN: 2349-3232 Online
DOI: 10.5281/zenodo.15291839

Review Article

Treatment of Fracture: Associated with Bone Diseases

Vrish Dhwaj Ashwlayan

Pharmaceutical Technology, Meerut Institute of Engineering and Technology, Meerut, INDIA

E-mail: vrishsps@gmail.com

ARTICLE INFO

Received: 21/08/2015
Revised: 12/09/2015
Accepted: 26/11/2015
Available Online: 01/12/2015

Keywords:
Bone Fractures
Stress fractures
Osteoporosis
Osteoarthritis
Ageing
Immobilization
Pre-morbid occlusion

Abstract: Fractures occur particularly in osteoporotic people due to increased bone fragility, resulting in considerable reduction of quality of life, morbidity, and mortality. Stress fracture is quite painful and results from osteoporosis that disrupts normal bone calcifications. Osteoarthritis, a low bone mass disease with high risk of fracture is associated with the human ageing. In elder persons, debilitating skeletal muscle defect characterized by a loss of viable mass, and onset of a decrease in muscle strength and force generation can often lead to complete immobilization. Open fractures in which the broken ends of the bone pierce the skin and causes serious bleeding, pain, tenderness, crepitus, difficulty in moving and breathing, swelling, bruising, blue-grey tint on face skin and no rise and fall of chest movement are considered orthopedic emergencies. As prophylactic treatment, antibiotics should be given within 3 h of injury to reduce six-fold infection risk in open fracture. The first step of resuscitation methods is evaluation of the individual's airway, breathing and circulation. One method from among mouth-to-mouth, mouth-to-nose, cardiopulmonary resuscitation or artificial ventilation is continued at 10 breaths per minute. The fundamental principles of fracture treatment are reduction of bone by closed manipulation, mechanical traction, open operation, immobilization by a plaster of Paris cast or other external splint, continuous traction, external and internal fixation, rehabilitation (preservation of function and pre-morbid occlusion). Maintenance of reduction will optimize the conditions for fracture union and minimize potential complications. Exercise to increase muscle and bone fitness can reverse the risk of disability and disease.

INTRODUCTION

Fracture is described radiographically and clinically in terms of articular surface involvement, displacement, angular deformity, rotational deformity and fragmentation. In the United States, 3.5 million fractures occur each year [1]. Osteoarthritis, a low bone mass disease with high risk of fracture, osteoporosis and rheumatoid arthritis are more common in older people and result in reduction of quality of life, morbidity, and mortality [2]. Fracture incidence is multi-factorial and often complicated by the patient's age, sex, co-morbidities, lifestyle, and occupation. Examination of the limb is clinically assessed whether there is a wound communicating with the fracture or there is evidence of vascular, nerve and visceral injury. Full spinal precautions must be maintained until injury to the complete spine can be excluded clinically and radio-graphically with radiographs or computed tomography scans. An approach combining the assessment of bone mineral density, its clinical risk factors with use of the fracture risk assessment tool and bone turnover markers will improve the prediction of fracture risk and enhance the evaluation of patients with osteoporosis [3]. Wrist and hip fractures in older people and stress fractures (not shown by an X-ray) are diagnosed by computed tomography scan and magnetic resonance imaging, or a bone scan.

Types of fracture

Simple or closed fractures are spiral, oblique or transverse and do not pierce the skin whereas the broken ends of the bone pierce the skin in open or compound (I, II, III_a, III_b, III_c) fracture. A multi-fragmentary fracture is one that has more than two breaks in the bone. The complex multi-fragmentary fracture is a segmental fracture or one in which there is no contact between the proximal and distal fragments without the bone shortening. Wedge fractures are either spiral or bending due to low or high energy respectively and allow the proximal and distal fracture fragments to remain in contact with each other [4]. In comminuted (com : together, miunted : crumbled) fracture, the bone is splintered, crushed or broken into pieces, and smaller bone fragments lie between the two main fragments. Greenstick fracture, a partial fracture in which one side of bone is broken and the other side bends; occurs only in children, whose bones are not yet fully ossified and contain more organic material than inorganic material. One end of the fractured bone is forcefully driven into the interior of the other in impacted fracture. Pott's fracture is a fracture of the distal end of fibula, the lateral leg bone, with serious injury of the distal tibial articulation. Colles' fracture is a fracture of the distal end of the lateral fore armr adius bones in which the distal fragment is displaced posteriorly. A stress fracture is a series of microscopic fissures in bone that forms without any evidence of injury to other tissues. About 25% of stress fractures involve the tibia.

MANAGEMENT FOR FRACTURES

A simple (closed) fracture does not pierce the skin, but if it is left untreated, it can develop into a open (compound) fracture in which the broken ends of the bone pierce the skin and cause serious bleeding, pain and tenderness, difficulty in moving and breathing, swelling, bruising, change in skin colour [5]. Management of multi-fragmentary fractures may be more complicated than that for simple fractures because loss of blood is a greater liability to shock in severe open fracture than closed fracture. The ultimate goals of fracture treatment are realignment of the bone fragments, immobilization to maintain realignment, and restoration of function. The principles of operation for open fracture is to clean away all dirt and foreign matter and to remove dead and devitalized muscle and small loose fragments of bone, leaving the wound surfaces clean and viable. Immediate (within 3 h of injury) antibiotics supplementary treatment intravenously provides six-fold reduction of infection risk in open fracture. Cefazolin a first-generation cephalosporin is adequate for gram-positive infections with type I and type II fracture injuries [6]. If the wound is severely contaminated (type III) gentamicin or tobramycin, aminoglycoside should be added to complete treatment [7] depicted in Table 1.

Table1: Types of open fracture and its management with antibiotic therapy.[6, 7,10]

Type	Prevalence rate (%)	Definition	Example fracture patterns	Antibiotic choice	Antibiotic Dose and duration
I	1.4	Open fracture, clean wound, wound <1 cm in length	Simple transverse or short oblique fractures	Cefazolin*	*1-2 g intravenously Every 8 h for three doses
II	3.6	Open fracture, wound > 1 cm in length without extensive soft-tissue damage, flaps, avulsions	Simple transverse or short oblique fractures	Pipercacillin/tazobactam† OR Cefazolin and tobramycin	3.375 g Every 6 h Continue for 24 h after wound closure
III	22.7	Open fracture with extensive soft-tissue laceration, damage, or loss or an open segmental fracture. This type also inculdes open fractures caused by farm injuries, fractures requiring vascular repair, or fractures that have been opened for 8 h prior to treatment	High energy fracture pattern with significant involvement of surrounding tissues	Pipercacillin/tazobactam OR Cefazolin AND tobramycin‡ plus penicillin for anaerobic bacteria if needed	‡5.1 mg/kg IV every 24 h (recommend pharmacy to assist with monitoring levels) Three days
IIIA	10-50	Type III fracture with adequate periosteal coverage of the fracture bone despite the extensive soft-tissue laceration or damage	Gunshot injuries or segmental fractures	Pipercacillin/tazobactam OR Cefazolin AND tobramycin plus penicillin§ for anaerobic bacteria if needed	§2–4 million units IV every 4 h Continue for three days after wound closure
IIIB	10-50	Type III fracture with extensive soft-tissue loss and periosteal stripping and bone damage.Usually associated with massive contamination. Will often need further soft-tissue coverage procedure (i.e. free or ratational flap)	Above patterns but usually very contaminated	Pipercacillin/tazobactam OR Cefazolin AND tobramycin plus penicillin for anaerobic bacteria if needed	Continue for three days after wound closure
IIIC	10-50	Type III fracture associated with an arterial injury requiring repair, irrespective of degree of soft-tissue injury.	Above patterns but with vascular injury needing repair		

If the injury is a "barnyard injury" (contaminated with soil) or water-type injury, penicillin should also be added to provide prophylaxis against *Clostridium perfringens* and *Clostridumtetani,* gram-negative anaerobic bacteria [8]. Beads over 24-gauge wire with 3.6 g of tobramycin mixed with 40 g of polymethylmethacrylate cement in conjunction with systemic antibiotics placed into the wound and covered with an impermeable dressing (Ioban, 3M, Minneapolis, MN) decreased infection rates from 12 to 3.7% in severe open fractures. Any patient with an open fracture that has not completed the tetanus toxoid immunization or has not had their booster in the last 5 years should be given a tetanus toxoid booster. If the wound is prone to contamination with *Clostridium tetani*, the tetanus toxoid should be combined with 250–500 IU of human tetanus immune globulin (HTIG). Furthermore, if more than 10 years has elapsed since the last tetanus booster or the patient's immune system is compromised, both the tetanus toxoid and HTIG should be given [9]. The HTIG will offer most patients 3 weeks of protection.

Once these are accomplished, the fracture should be reduced and the reduction should be maintained, which will optimize the conditions for fracture union and minimize potential complications. Bone remodeling includes lamellar bone creation. The three fundamental principles of fracture treatment are reduction, immobilization and preservation of function [10] as follows:

- Anatomic reduction of the fracture fragments: For the diaphysis, anatomic alignment ensuring that length, angulation, and rotation are corrected as required; intra-
- articular fractures demand anatomic reduction of all fragments.
- Stable fixation, absolute or relative, to fulfill biomechanical demands.

- Preservation of blood supply to the injured area of the extremity and respect for the soft tissues.

Reduction

For bones to unite properly, the fractured ends must be brought into alignment, a process called reduction, commonly referred to a setting of a fracture. A gradual pull is exerted on the distal (lower) fragment of the bone until it is in alignment with the proximal fragment in reduction of a fractured bone. Imperfect apposition of the fragments can be accepted much more readily than imperfect alignment. When a joint surface is involved in a fracture, the articular fragments must always be restored as nearly as possible to normal, to lessen the risk of subsequent osteoarthritis. Ideally, fracture reduction should be performed within 7-10 days. After this period, the risks of mal-union, malocclusion, and facial asymmetry increase. Two relative contradictions for open reduction with internal fixation include poor bone height, and a pediatric mixed dentition that limits the placement of fixation devices. Reduction may be carried out in three methods by closed manipulation, mechanical traction with or without manipulation and open operation.

Manipulative reduction: Closed manipulation is the standard initial method of reducing most common fractures. It is usually carried out under general anaesthesia, but local or regional anaesthesia is sometimes appropriate. The technique is simply to grasp the fragments through the soft tissues, to disimpact them if necessary, and then to adjust them as nearly as possible to their correct position.

Reduction by mechanical traction: When the contraction of large muscles exerts a strong displacing force, some mechanical aid may be necessary to draw the fragments out to the normal length of the bone. This particularly applies to fractures of the shaft of the femur, and to certain types of fracture or displacement of the cervical spine. Traction may be applied either by weights or by a screw device, and the aim may be to gain full reduction rapidly at one sitting with anaesthesia, or to rely upon gradual reduction by prolonged traction without anaesthesia.

Operative reduction: When an acceptable reduction cannot be obtained, or maintained, by these conservative methods, the fragments are reduced under direct vision at open operation. Open reduction may also be required for some fractures involving articular surfaces, or when the fracture is complicated by damage to a nerve or artery. When operative reduction is resorted to, the opportunity should always be taken to fix the fragments internally to ensure that the position is maintained.

Closed reduction

The fractured ends of a bone are brought into alignment by manual manipulation, and the skin remains intact e.g. displace, shorten or angular fracture and maxillomandibular fixation (MMF) or intermaxillary fixation. Airway compromise often accompanies mandible fracture. Because of the inherent design of the mandible, a unilateral fracture is rare. Fractures are seen in a higher frequency in males 21-30 years of age. Children younger than 6 years make up only 1% of the total number of cases. Children with mandibular fractures often have other associated injuries. The areas of the mandible most commonly fractured include the *condylar-subcondylar region*, body, and angle. Location of the fractures and associated frequency are as follows: Condyle - 29%, Angle - 24%, Symphysis - 22%, Body - 16%, Ramus - 1.7%, Coronoid - 1.3%. Causes can include intraoral bleeding, edema, loose teeth or dentures, and posterior displacement of the mandible and/or tongue due to a flailed segment of the mandible. With increased use of vehicular restraints (seat belt), the incidence of maxillofacial trauma resulting from motor vehicle accidents (43%) has been on the decline. On the other hand, the number (34%) of mandibular fractures resulting from assault has risen. Other causes include injury from a fall (7%), sports-related injuries (4%), bicycle accidents, work related (7%), and miscellaneous (5%). Improper initial management of fractures can lead to significant long-term morbidity and, potentially, mortality. Treatment goals are to restore function and premorbid occlusion. Mastication, speech, and normal range of oral motion should be achieved. Contour defects must be corrected. Early treatment curtails the possibility of infection. Consider an emergent tracheotomy or a cricothyrotomy when an obstruction persists despite use of basic cardiopulmonary resuscitation (CPR). As with any trauma, the fundamentals of good trauma care must be followed. The airway must be secured and breathing and circulation must be confirmed. Possible cervical spine (C-spine) injury needs to be ruled out. With mandibular fractures, earlier reduction is associated with better outcomes. Although, if other injuries dictate, repair may be delayed 5-7 days, surgical correction is recommended as soon as possible. Current concepts include early intervention with wide surgical exposure to allow for precise alignment and rigid fixation. 4-point MMF can be used to avoid many ill effects of MMF with use of arch bars and ligatures. Otherwise, arch bars are placed with wire ligature (24-26 gauge) or composite resin. Closed reduction and MMF were more cost-effective when compared with ORIF. In some situations, MMF may not be the best therapy, and open reduction with internal fixation may be a better alternative. Poor candidates for MMF include the following:

- Patients who are noncompliant.
- Patients with alcoholism, seizure disorder, severe pulmonary dysfunction, mental retardation, psychosis, or poor nutrition (eg, patients with diabetes).
- Patients who are pregnant.
- Patients with multiple injuries.
- Patients who are unwilling to make the change in lifestyle that is needed for 4-6 weeks.

Non-operative (closed) therapy consists of casting and traction (skin and skeletal traction).

Casting: This is achieved by applying traction to the long axis of the injured limb and then reversing the mechanism of injury/fracture, followed by subsequent immobilization through casting or splinting. Splints and casts can be made from fiberglass or plaster of Paris. Barriers to accomplishing reduction include soft-tissue interposition at the fracture site and hematoma formation that create tension in the soft tissues [11]. Unintentional cast saw injuries are attributable to casting material or improper removal technique. Another factor associated with the risk of injury is the "safety distance," the distance between the inner perimeter of the cast and the patient's skin [12].

Closed reduction is contraindicated under the conditions like un-displaced fractures, If displacement exists but is not relevant to functional outcome (e.g. humeral shaft fracture where the shoulder and elbow motion can compensate for residual angulation), severely comminuted fracture; if the reduction, when achieved, cannot be maintained and if the fracture has been produced by traction forces (e.g. displaced patellar fracture).

Traction: For hundreds of years, traction has been used for the management of fractures and dislocations that are not able to be treated by casting.With the advancement of orthopedic implant technology and operative techniques, traction is rarely used for definitive fracture/dislocation management. Two types of traction exist: skin traction and skeletal traction. In skin traction, traction tapes are attached to the skin of the limb segment that is below the fracture or a foam boot is securely fitted to the patient's foot. When applying skin traction, or Buck traction, usually 10% of the patient's body weight (up to a maximum of 10 lb) is recommended. At weights greater than 10 lb, superficial skin layers are disrupted and irritated. Because most of the forces created by skin traction are lost and dissipated in the soft-tissue structures, skin traction is rarely used as definitive therapy in adults; rather, it is commonly used as a temporary measure until definitive therapy is achieved. Femur fracture is managed with skeletal traction and by use of a Steinmann pin in the distal femur. In skeletal traction, a Steinmann pin is placed through a bone distal to the fracture [13]. Weights are applied to this pin, and the patient is placed in an apparatus to facilitate traction and nursing care. Skeletal traction is most commonly used in femur fractures. A pin is placed in the distal femur or proximal tibia 1-2 cm posterior to the tibial tuberosity. Once the pin is placed, a Thomas splint is used to achieve balanced suspension. Traction or casting of femoral fractures in children less than 10 years of age is safe, and good long-term results can be expected. Children over 10 years of age had a high risk of residual angular deformity, which correlated with knee arthritis. In this age group, tibial skeletal traction should be avoided [14].

Open reduction

Open reduction is an excellent modality for fracture segment reduction. Open fractures were considered orthopedic emergencies [15]. Care is taken of any bleeding to treat open fracture. An open wound is lightly covered using a clean dressing. The injured limb is secured to a solid part of the body. Fractured arms should always be supported by the body using a sling, usually made from a triangular bandage [16]. Signs of shock are watched. The person is kept warm. The first step of resuscitation methods is evaluation of the individual's airway, breathing, and circulation. Mouth-to-mouth resuscitation is needed, if a person's breathing has stopped. Mouth is carefully opened with a finger to remove blockages from the airway. The person's head is tilted using two fingers under the chin with hand on the forehead. Mouth to Nosemethod can be used when it is difficult to breathe into the mouth. The pulse is checked after giving 10 breaths. Cardiopulmonary resuscitation is given if there is no pulse, respiration or heartbeat is lower than 60 breaths per minute. If it is above this, then artificial ventilation is continued until help arrives. This method is continued at 10 breaths per minute. Immediate endotracheal intubation and rapid administration of intravenous fluids will be necessary. Once the patient is hemodynamically stable, a complete physical examination is performed. Fractures to the pelvis and femur can have substantial hemodynamically altering effects and assessment of these areas should be included in initial resuscitation efforts. If a patient sustains an open fracture, hemostasis is essentially achieved as rapidly as possible by placing a sterile pressure dressing over the injury site. Surgical urgent irrigation and debridement (I&D) within 24 hours of injury are sufficient. For type II and type III injuries, serial I&Ds are recommended every 24-48 hours after the initial debridement until a clean surgical wound is ensured and no necrotic tissue persists. It is generally accepted to use a minimum of 3 L of normal saline as irrigation for a type I fracture, 6 L for a type II fracture, and 9 L for a type III fracture. Indications for surgical intervention include failed non-operative (closed) management, unstable fractures that cannot be adequately maintained in a reduced position, displaced intra-articular fractures (>2 mm), patients with fractures that are known to heal poorly following nonoperative management (eg, femoral neck fractures), large avulsion fractures that disrupt the muscle-tendon or ligamentous function of an affected joint (e.g., patella fracture), impending pathologic fractures multiple traumatic injuries with fractures involving the pelvis, femur, or vertebrae, unstable open fractures any type II or type III open fracture, fractures in individuals who would poorly tolerate prolonged immobilization required for non-operative management (e.g. elderly patients with proximal femur fractures). Fractures in growth areas in skeletally immature individuals that have increased risk for growth arrest (e.g. Salter-Harris types III-V) and Nonunions or malunions that have failed to respond to non-operative treatment.

The fractured ends of a bone are brought into alignment by a surgical procedure in which internal fixation devices such as screws, plates, pins, rods, and wires are used [16]. After MMF, an incision is made to allow for direct alignment of the segments. Access can be achieved via either an intraoral or extraoral incision. To maintain fixation, titanium plates and screws or stainless steel wire may be used. Even with an incision, percutaneous access may be needed for the placement of plates, screws, or wire. It can also be used in edentulous patients with unstable fractures. Stainless steel pins and composite resin placed lateral to the mandible keep the fracture rigidly reduced. When an infection or severe comminution is present, an external fixation device may be used. Other alternatives include use of the patient's dentures to reduce the fracture. The dentures act as a splint, and with the use of circumferential mandibular wires, they can stabilize the fracture. The upper and lower dentures can be wired together to maintain MMF [17]. If the patient is edentulous, but without dentures, a Gunning-type splint can be fabricated and used in the same manner as dentures. Contradictions to surgical reconstruction are as follows:

- Active infection (local or systemic) or osteomyelitis
- Soft tissues that compromise the overlying fracture or the surgical approach because of poor soft-tissue quality due to soft-tissue injury or burns, excessive swelling, previous surgical scars, or active infection
- Medical conditions like recent myocardial infarction that contradicts surgery or anesthesia.

Immobilization

Elderly individuals require a prolonged recovery phase in order to return to initial muscle mass levels following short-term immobilization. A fracture is immobilized to prevent displacement or angulation of the fragments, movement that might interfere with union and relieve pain. Movement can move the broken bones further, which may damage internal organs. So moving should be avoided by person. Applying pressure to a compound fracture to stop bleeding should be avoided otherwise it may cause extreme pain and can move bones [18].

Biodegradable fixation

Biodegradable fixation systems reduce/delete the problems associated with titanium plate removal [19]. Polymers, including polylactic and polyglycolic acids and polydioxanone, are resorbable suture materials that are currently undergoing continued redesign and refinement for use as rods or screws that reabsorb with time. These devices offer the theoretical advantage of eventual resorption, eliminating the need for later removal, while allowing stress transfer to the remodelling fracture. Current bioabsorbable implants do not have mechanical properties to match metallic implants; therefore, their indications are limited, and their fixation usually requires protection from motion or significant loading. Degradation rates vary, and local inflammatory reactions, such as chondrolysis noted with placement in proximity to joints, have been reported with some implants. These devices are a consideration when fixation of low stress areas is needed and when later removal is anticipated, such as in pediatric patients or in medial malleolar fractures, syndesmotic fixation, orosteochondral fractures in adults. Recovery of skeletal muscle mass from immobilisation-induced atrophy is faster in young than older individuals. Diminished muscle re-growth after immobilization in elderly humans was associated with a lesser response in satellite cell proliferation in combination with an age-specific regulation of myostatin [20]. This means less surgical discomfort, and a reduction in costs. Cases in which amputation, rather than attempt at fracture fixation, would better serve the limb and the patient. Immobilization is unnecessary in Fracture of the clavicle; undisplaced fracture of a phalanx of a finger. The fragments are held stable by the intact periosteal sheath. When immobilization is deemed necessary there are four methods by which it may be affected by a plaster of Paris cast or other external splint, continuous traction, external fixation and internal fixation.

Immobilization by plaster, splint or brace

For most fractures the standard method of immobilization is by a plaster of Paris cast. Plaster of Paris is hemi-hydrated calcium sulphate. It reacts with water to form hydrated calcium sulphate. The reaction is exothermic, a fact that is evidenced by noticeable warming of the plaster during setting. Ready-made proprietary bandages are best used with cold water because setting is too rapid with warm.

Technique of soaking a plaster bandage: The end is unwound for a few centimeters so that it will be found easily when the bandage is wet. The wet bandage is squeezed lightly from the ends but is not wrung out. A plaster is best dried simply by exposure to the air: artificial heating is unnecessary. If marked swelling is expected, as after an operation upon the limb, a more bulky padding of surgical cotton wool should be used. Substitutes for plaster offer the advantages of lighter weight, radiolucency and imperviousness to water, though at much greater cost. Most such products are also more difficult to apply; nevertheless, they are being used on an increasing scale.

A layer of stockinet forms a comfortable lining which prevents the plaster from sticking to the hairs. An alternative is to use a single thickness of cellulose bandage. Synthetic (plastic) splinting materials are applied in much the same way as plaster bandages, usually with warm water. Since they are stronger weight for weight than plaster, fewer layers are required. Moulding to the body contours is more difficult than with plaster bandages. A splint made from metal, wood or plastic is more appropriate—for example, the Thomas's splint with Pearson knee flexion attachment, is used mainly for fractures of the shaft of the femur, or a plastic collar for certain injuries of the cervical spine. The canvas strips slung between the two bars support the limb. Cervical collar is constructed from polyethylene foam. For more rigid support of the neck a 'halo-thoracic' splint may be used.A plaster is removed by electrically powered oscillating plaster saws or the traditional plaster-cutting shears for removing a very thick plaster or synthetic cast and for cutting a window through a plaster.

The technique of operating the plaster shears: Only the handle away from the plaster (in this case the one in the surgeon's right hand) is oscillated: the other handle is held steady, parallel to the surface of the plaster. In this way the point of the blade is always directed outwards against the inside of the plaster, away from the patient's skin. It is best to cut down through the plaster in multiple sections each equal to the diameter of the blade, rather than to slide the oscillating blade along the plaster. A correct line of cut is identified for removal of plasters with the hand shears. There are three essential points to remember in the operation of plaster shears:

- The line of cut should be over soft tissues and concavities and should avoid the bony prominences.
- The point of the shears should be slid along in the plane immediately deep to the plaster—in the case of a cotton-lined plaster, between the plaster and the lining.
- Only one handle of the shears should be oscillated—namely the handle that is farther away from the plaster. If this rule is observed it will be found that the point of the blade will be directed constantly away from the skin towards the inside of the plaster, and will remain automatically in the correct plane.

In the forearm plaster the cut should be made in the midline of the anterior surface, crossing the wrist in the hollow between the tuberosity of the scaphoid bone and the pisiform bone. Only one cut is required, because the plaster is thin enough to be opened out without difficulty when it has been cut through. In the leg plaster two cuts should be made. The first cut should be made along the lateral surface and should pass behind the lateral malleolus, in the hollow between the malleolus and the heel. Hence it should extend along the lateral border of the sole of the foot. The second cut should be made along a corresponding line at the medial side of the plaster, passing behind the medial malleolus.
Disadvantages of the powered saw are that it is noisy and rather frightening for the patient, and that it creates an unpleasant amount of dust. The plaster spreader is a useful instrument with which to open up a plaster cast that has been split down one side.

Splint is a method of keeping movement in a fractured bone to a minimum. They are easy to fit. The suspected fracture is examined to determine whether it is simple or compound. Circulation above and below the fracture, and movement of fingers/toes are checked if appropriate. Any constricting jewellery (watches, bracelets, rings) is removed. Bleeding is controlled by applying a dressing if necessary. Pain medication is administered, if necessary. The splint is applied above and below the injury [21]. If possible, the splint is prepared on an uninjured body part, and then it is transferred to the injured area. This minimizes potentially damaging movement of the injured part and minimizes the pain associated with splinting. Splints can be created from sticks, cardboard, foam pads, ski poles, tent poles or other similar objects. Belts, triangular bandages, tape, shirtsleeves, and blankets are fastened. Slings can be made from triangular bandages, sheets, and ropes. Following precautions should be taken:

- When applying the splint, be sure not to interfere with circulation.
- If the fracture is simple and there are no signs of decreased circulation, it is advisable to apply ice packs/snow to the swollen area, but be sure not to apply ice directly to the skin.
- After the splint is applied, check the limb every 15 minutes to make sure that swelling inside the splint has not cut off the circulation. This is particularly important to remember in cold weather, where numbness can be a confusing factor.
- Elevate the injured part to minimize swelling.
- Depending on which bone is affected, descend and seek medical help. E.g., it may be possible to continue with a fractured toe, but not a broken leg.

Locking plate: A newer concept is the ‘locking plate’, that uses screws with heads that are threaded and when tightened lock into matching threads in the holes of the plate. This produces a more rigid fixation in terms of length and angle, which is particularly valuable in comminuted fractures in osteoporotic bone. It can also be inserted with less stripping of soft tissue that preserves bone vascularity, particularly in the metaphyseal region.

Cast bracing: Functional fracture bracing, is a technique in which a fractured long bone is supported externally by plaster of Paris or by a mouldable plastic material in such a way that function of the adjacent joints is preserved and use of the limb for its normal purposes can be resumed. The technique entails snug fitting of the plaster or plastic material over the appropriate limb segments and the incorporation of metal or plastic hinges at the level of the adjacent joint. Functional brace (cast brace) is suitable for fractures of the femoral shaft or tibia. The plastic hinges may be incorporated at the knee and fitted at the ankle.

Immobilization by sustained traction
The plane of the fracture is oblique or spiral, because the elastic pull of the muscles then tends to draw the distal fragment proximally so that it overlaps the proximal fragment. In such a case the pull of the muscles must be balanced by sustained traction upon the distal fragment, either by a weight or by some other mechanical device. Elastic pull of muscles, which tends to cause overriding of the fragments, may be balanced by sustained weight traction. The ‘gallows’ or Bryant method of traction for femoral shaft fractures in young children employs the principle of immobilization by traction without any additional splintage e.g. traction upon the skull for cervical spine injuries.

External fixation

External fixation provides fracture stabilization at a distance from the fracture site—without interfering with the soft-tissue structures that are near the fracture. This technique not only provides stability for the extremity and maintains bone length, alignment, and rotation without requiring casting, but it also allows for inspection of the soft-tissue structures that are vital for fracture healing, as well as subsequent wound care. Indications for external fixation (temporarily or as definitive care) are as follows:-

- Open fractures that have significant soft-tissue disruption (e.g. type II or III open fractures).
- Soft-tissue injury (e. g. burns)
- Pelvic fractures: Pelvic fracture is managed with external fixation.
- Severely comminuted and unstable fractures
- Fractures that are associated with bony deficits
- Limb-lengthening procedures Ilizarov fixator.

- Fractures associated with infection or nonunion

Open reduction and internal fixation (ORIF)
Poor bone height and a pediatric mixed dentition limit the placement of fixation devices. The objectives of ORIF include adequately exposing the fracture site, while minimizing soft tissue stripping and obtaining a reduction of the fracture [22]. Once a reduction is achieved, it must be stabilized and maintained. Six methods of internal fixation for fractures are given below:

Plates and screws: Plates and screws are commonly used in the management of articular fractures. This use demands an anatomic reduction of the fracture fragments and allows for early ROM of the injured extremity. Plates provide strength and stability to neutralize the forces on the injured limb for functional postoperative aftercare. Type B ankle fracture is assessed by preoperative radiographs, whereas open reduction and internal fixation is assessed by ankle fracture radiograph. Locking plates or fixed angle devices are also helpful. A locking plate acts like an internal fixator. There is no need to anatomically contour the plate onto the bone, thus reducing bone necrosis and allowing for a minimally invasive technique. Locking screws directly anchor and lock onto the plate, thereby providing angular and axial stability. These screws are incapable of toggling, sliding, or becoming dislodged, thus reducing the possibility of a secondary loss of reduction, as well as eliminating the possibility of intra-operative over tightening of the screws. The locking plate is indicated for poor quality bone (i.e. osteoporotic fractures), for short and metaphyseal segment fractures, and for bridging comminuted areas. These plates are also appropriate for metaphyseal areas where subsidence may occur or prostheses are involved. Locking plates can only hold a reduction that has already been obtained. Plate designs vary, depending on the anatomic region and size of the bone the plate is used for. All plates should be applied with minimal stripping of the soft tissue.

Five main plate functions exist buttress (anti-glide) plates, compression plates, neutralization plates, tension band plate and bridge plates.

1. Buttress plates encourage compression and counteract the shear forces that commonly occur with fractures that involve the metaphysis and epiphysis. These plates are commonly used with interfragmentary screw fixation. The buttress plate is always fixed to the larger main fracture fragment but does not necessarily require fixation through the smaller fragment, because the plate buttresses the small fragment into the larger fragment. To achieve this function requires appropriate plate contouring for adequate fixation and support.
2. Compression plates counteract bending, shear, and torsional forces by providing compression across the fracture site via the eccentrically loaded holes in the plate. Compression plates are commonly used in the long bones, especially the fibula, radius, and ulna, and in nonunion or mal-union surgery.
3. Neutralization plates are used in combination with inter-fragmentary lag screw fixation. The inter-fragmentary compression screws provide compression at the fracture site. This plate function neutralizes bending, shear and torsional forces on the lag screw fixation, as well as increases the stability of the construction. Neutralization plates are commonly used for fractures involving the fibula, radius, ulna, and humerus.
4. Bridge plates are useful in the management of multi-fragmented diaphyseal and metaphyseal fractures. Achieving adequate reduction and stability without disrupting the soft-tissue attachments to the bone fragments may be difficult and requires skill in the use of indirect reduction techniques. Care should be taken to obtain correction of rotation, length, and alignment with bridge plating.
5. A tension band plate technique converts tension forces into compressive forces, thereby providing absolute stability. An example of this technique is when a tension band plate is used for a transverse olecranon fracture.

Intramedullary nails (without and with locking screws): Intramedullary nails operate like an internal splint that shares the load with the bone and can be flexible or rigid, locked or unlocked, and reamed or unreamed. Locked intramedullary nails provide relative stability to maintain bone alignment and length and to limit rotation. Ideally, the intramedullary nail allows for compressive forces at the fracture site, which stimulates bone healing. Intramedullary nails are commonly used for femoral and tibialdiaphyseal fractures and, occasionally, humeral diaphyseal fractures. The advantages of intramedullary nails include minimally invasive procedures, early postoperative ambulation, and early ROM. Mid-shaft femur fracture is managed with open reduction and internal fixation is performed with use of an intramedullary nail.

Compression screw-plate: The compression screw-plate (dynamic hip screw) is a standard method of fixation for fractures of the neck of the femur and for trochanteric fractures. The screw component, which grips the femoral head, slides telescopically in the barrel to allow the bone fragments to be compressed together across the fracture. This compression effect is brought about by tightening a screw in the base of the barrel.

Transfixion screws: The use of a transfixion screw has wide application in the fixation of small detached fragments—for instance the capitulum of the humerus, the olecranon process of the ulna or the medial malleolus of the tibia.

Tension band wiring: This technique of fixation is most commonly used in the patella and olecranon, but can be applied to other small metaphyseal fragments such as the medial malleolus. It uses the mechanical principle of converting the tensile stresses of the muscles acting on the bone fragment, into a compressive force at the fracture site. This is achieved by means of tightening an eccentric figure-of-eight cerclage wire across the two fragments, stabilized by

Kirschner wires or a screw inserted at right angles to the fracture line.

Screws or Kirschner wires: Kirschner wires, or K-wires, are commonly used for temporary and definitive treatment of fractures. However, K-wires resist only changes in alignment; they do not resist rotation, and they have poor resistance to torque and bending forces. K-wires are commonly used as adjunctive fixation for screws or plates and screws that involve fractures around joints. When K-wires are used as the sole form of fixation, casting or splinting is used in conjunction. The wires can be placed percutaneously or through a mini-open mechanism. K-wire fixation is adequate for small fragments in metaphyseal and epiphyseal regions, especially in fractures of the distal foot, wrist, and hand, such as Colles fractures, and in displaced metacarpal and phalangeal fractures after closed reduction. K-wires are also commonly used as adjunctive therapy for many fractures, including patellar fractures, proximal humerus fractures, olecranon fractures, and calcaneus fractures.

Rehabilitation

Rehabilitation purpose is twofold: first, to preserve function so far as possible while the fracture is uniting and second, to restore function to normal when the fracture is united[23]. The two essential methods of rehabilitation are active use and active exercises. While a limb is immobilized in a plaster or splint, exercises must be directed mainly to the preservation of muscle function by static contractions [24]. Except in cases of minor injury, the patient should, ideally, be under the supervision of a physiotherapist throughout the whole duration of treatment. The following three steps are involved in repair of bone fracture.

Formation of fracture hematoma: Blood vessels crossing the fracture line are broken. As blood leaks from torn ends of the vessels, a mass of blood (usually clotted) is formed around the site of the fracture. This mass of blood, called a **fracture hematoma** (*hemat*menas blood and -oma means tumour), usually forms 6 to 8 hours after the injury. Because the circulation of blood stops at the site where, the fracture hematoma forms, nearby bone cells die. Swelling and inflammation occurs in response to dead bone cells, producing additional cellular debris. Phagocytes (neutrophils and macrophages) and osteoclasts begin to remove the dead or damaged tissue in and around the fracture hematoma. This stage may last up to several weeks. *Fibrocartilaginous callus formation*: Fibroblasts from the periosteum invade the fracture site and produce the collagen fibers. In addition, cells from the periosteum develop into chondroblasts and begin to produce fibrocartilage in this region. This event leads to development of fibrocartilaginous callus formation, a mass of repair tissue consisting of collagen fibers and cartilage that bridges the broken ends of the bone. Formation of the Fibrocartilaginous callus takes about 3 weeks.

Bony callus formation: In areas closer to well-vascularized healthy bone tissue, osteogenic cells develop into osteoblasts, which begin to produce spongy bone trabeculae. The trabeculae join living and dead portions of the original bone fragments. In time, the fibrocartilage is converted to spongy bone and the callus is referred to as a bony callus. The bony callus lasts about 3 to 4 months. The final phase of fracture repair is bone remodelling of the callus. Dead portions of the original fragments of broken bones are gradually resorbed by osteoclast. Compact bone replaces spongy bones around the periphery of the fracture. Sometimes, the repair process is so thorough that the fracture line is undetectable, even in radiograph (x ray). However a thickened area on the surface of the bone remains as evidence of a healed fracture. Calcium and phosphorous needed to strengthen and harden new bones are deposited only gradually, and bone cells generally grow and reproduce slowly.

Hormone replacement therapy

Hormone replacement therapy restores calcium balance, further bone loss is prevented and excess fracture risk is nullified. 0.625 mg/day doses of conjugated estrogens increase bone marrow mineral density in postmenopausal women. Calcium, vitamin D supplements and exercise aid the beneficial effect of Hormone replacement therapy [25].

CONCLUSIONS

Fracture, any break in a bone is defined as a disruption in the integrity of a living bone, involving injury to the bone marrow, periosteum and adjacent soft tissues. A bone may fracture without visible breaking in stress fracture. Stress fractures are quite painful and also result from repeated, strenuous activities such as running, jumping or aerobic dancing in healthy adults and disease processes that disrupt normal bone calcification, such as osteoporosis. Muscles, bones and joints are affected by the ageing process. Fall is one of the most common geriatric problems threatening the independence of older persons. Elderly patients tend to fall more often and have a greater tendency to fracture their bones.If closed fracture is left untreated it can develop into an open fracture, homeostasis is achieved as rapidly as possible by placing a sterile pressure dressing over the injury site. Commiunted fracture is the most difficult fracture to treat. The repair of bone fracture involves formation of fracture hematoma, fibro-cartilaginous callus and bony formation (remodelling). Immediate antibiotics (cefazolin for type I and II, gentamicin, tobramycin for severely contaminated type III and penicillin for contaminated with soil contained anaerobes or water-type injury) as supplementary intravenous treatments within 3 h of injury provide six-fold reduction of infection risk in open fracture. Treatment of pediatric femoral fractures has changed from mostly non-operative to more operative. The fractured ends of a bone are brought into alignment by a surgical procedure in which internal fixation devices are used to minimize soft tissue stripping. Elastic pull of muscles, which tends to cause overriding of the fragments, may be balanced by sustained weight traction. The ultimate goals of fracture treatment are realignment of the broken bone segment, immobilization in a splint to maintain realignment, and restoration of function, if grossly deformed. If a patient sustains an open fracture, achieving hemostasis as rapidly as possible at the injury site is essential; this can be achieved by placing a sterile pressure dressing over the injury site. Movement can move the broken bones further, which may damage internal organs so it should be avoided. 0.625 mg/day doses of conjugated estrogens increase bone marrow mineral density in postmenopausal women. The general aim of early fracture management is to control hemorrhage, provide pain relief, prevent ischemia-reperfusion injury, displacement or angulations of the fragments, movement that might interfere with union, remove foreign body and non-viable tissues, potential sources of contamination. Splinting is critical in providing symptomatic relief for the patient, as well as in preventing potential neurologic and vascular injury and further injury to the local soft tissues. Proper positioning of a patient during cast-splitting, with the saw in the nondependent, safe aspect of the limb, can significantly increase the safety distance and minimize skin injuries. Elder persons have an impaired ability to recover from disuse muscle atrophy and thus, they may need longer time to recover from periods of disuse or disease compared to younger ones. Patient age is an important consideration in treatment of a fracture. A principle-based treatment regimen of fracture can help to improve patient outcomes and avoid complications and adverse events.

ACKNOWLEDGMENTS
Author wishes to express his gratitude to Prof. D. V. Rai, Vice-Chancellor, Shobhit University, Gangoh, Saharanpur (U. P.), India for his motivation to this work.

COMPETING INTERESTS
The authors have declared that no competing interests exist.

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About Author

Dr. Vrish Dhwaj Ashwlayan, recipient of *Al-ameen College of Pharmacy Award* 2013 for best research paper earned his Bachelor of Pharmacy degree from the Ch. Charan Singh University, Meerut in 1998 and Master of Pharmacy (Pharmacology) degree from the Punjabi University, Patiala, Punjab in 2003 and Ph.D. degree entitled "Investigation on Memory Enhancing Effect of *Asparagus racemosus* and *Phyllanthus emblica*"from the Uttar Pradesh Technical University, Lucknow in 2012. He took up academic pursuit as Lecturer in Pharmacology from June 2003 at Meerut Institute of Engineering and Technology (M.I.E.T) Meerut, as Senior Lecturer at S. D. College of Pharmacy and Vocational Studies, Muzaffarnagar, from August 2005 at Translam Institute of Pharmaceutical Education and Research (T.I.P.E.R.), Meerut, as a Reader from August 2007 at T.I.P.E.R. Meerut, Assistant Professor (presently known as Associate Professor) from August 2008 at School of Pharmaceutical Sciences, Shobhit University, Meerut and was involved in teaching and research tasks. Presently, He is working as Associate Professor from August 2012 at department of Pharmaceutical Technology, Meerut Institute of Engineering and Technology (M.I.E.T), Meerut, Uttar Pradesh, India. With 15.6 years of both academic and industrial experience in the field of Neurobiology of Learning and Memory processes and Phytopharmacology, Dr. Ashwlayan has 05 books, 30 publications, 8 review articles in reputed national, international journals and conferences to his credit and guided 25 Master of Pharmacy P.G. students. He received First prize for poster presentation entitled "Antipsychotic Potential of Herbal Compounds in Mice'' on October 31, 2015 and Guest of Honour Award on May 31, 2014 by Science and Engineering Research Board (SERB)-Department of Science and Technology (DST) New Delhi. He delivered Guest lecturers as Invited Speaker (Resource Person) through oral presentation on "Pesticide and its impact on human health'', theme of National Seminar at Innovative College of Pharmacy, Greater Noida on March 27, 2015, "Neuroscience : Neurodegenerative diseases'' and "Role of Biomarkers in Cardiotoxicity'' in International Conference on ''Recent Advances in Developing Biomarker Technology & Application of NGS in Pharmacogenomics'' on March 29 to 30, 2014 at Shobhit University, Meerut.