



## FRACTURES: AYURVEDIC AND MODERN PERSPECTIVES

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### ABSTRACT

The study explores the concept of Asthibhagna, the traditional system of fracture management, and compares it to the understanding of fractures and their treatment in the modern times. Today we are able to examine a fractured bone directly under radiological examination. In absence of this, Suśruta had evolved this useful and most logical method of determining the types of fractures by inference, and their management through traction, manipulation by pressure, by reduction and immobilization. Many of the principles of fracture treatment defined centuries ago are still relevant and used in the conventional fracture management. The modern medicine takes over in the management of complicated simple and compound fractures with the introduction of many surgical interventions like the intramedullary devices that hasten fracture union and healing potential. The use of specific types of splints in form of the barks of different trees, the use of decoctions and the role of diet are the distinguishing features of traditional treatment. It would be worthwhile to explore these unique features for use in the present times.

**Keywords:** Fracture, Bhagna, Sushruta, Asthi

### INTRODUCTION

Indigenous systems of medicine do not limit themselves to just fulfilling the needs of primary health care, but also reach out to certain specialised areas. One such popular but little known area is that of fracture management. Today we are able to examine a fractured bone directly under radiological examination. In absence of this, Suśruta had evolved extremely useful, logical and detailed methods of determining the types of fractures and their management. The principles laid down by Ayurvedic texts are so relevant that they are practiced even in the present times<sup>1</sup> by the modern orthopaedic surgeons.

In traditional Ayurveda practice, the fracture of bones and their treatment was first mentioned in Susruta samhita-nidana sthana and cikitsa sthana from the view of surgical management in 1500 B.C. Many interesting facts have been described in ancient Ayurvedic classics on the management and treatment of fractures including different kinds of bandages and slings to be used.

This study helps to explore the hidden skills, powers and methods of identification and treatment of fractures according to ancient times and simultaneously comparing it to the understanding and treatment of fractures according to the highly evolved and accepted modern medicine.

Such a study could potentially arouse interest as well as broaden the limited vision of main-field conventional medicine professionals to the little known ancient techniques and methods of treatment.

### Aim and Objectives

The aim of this study is to compare the concepts of diagnosis and management of fractures (Asthibhagna) from the points of view of modern medicine and Ayurveda.

- To understand the concept of Asthibhagna according to Ayurveda.
- To identify the similarities and differences between the classification, treatment and assessment of

fractures according to conventional medicine and Ayurveda.

### Ayurvedic Perspective

Fracture is termed as 'Bhagna' in Ayurveda which means breach/break in movements/continuity of bone. Bhagna is of two types Sañdhimukta or dislocation and Kāṇḍabhagna i.e. Bone fracture.

### Modern Perspective

Fracture is a break in the surface of a bone, either across its cortex or through its articular surface.

### Etiology

#### Ayurvedic Perspective

Breaches in movements of bone are of several types according to the nature of injury such as by slip (or fall), pressure, striking, excessive movements, bites of ferocious and other animals such as tiger etc.<sup>2</sup>

Breaking of bones (fractures) are said to be of many kinds caused by trauma of different types such as falling (from a height), squeezing hit/blow, pulling with force, and bite by wild animals etc. Its location is at two places viz. Sañdhi-at the joints, Asañdhi- at other places apart from joints<sup>3</sup>. Bones get broken (fractured) from a fall from height, assault etc. It is of two kinds as sañdhigata-localised in the joint and asañdhigata-in places other than joints<sup>4</sup>.

#### Modern Perspective

Fractures can happen in a variety of ways, but there are three common causes:

- When the force on the bone is too large and occurs suddenly as in road traffic accidents, fall etc.
- When a force on the bone is chronic and repetitive e.g. prolonged standing as in a policeman, nurse, etc
- When the natural resistance of the bone is eroded by a disease process (e.g. tumor, infection, osteoporosis etc.), that a bone succumbs to the insult and breaks. When the bone breaks, it is bound to injure the surrounding soft tissues like muscles, ligaments, etc<sup>5</sup>.

## Symptoms

### Ayurvedic Perspective

Excessive swelling, inability to bear shaking, movement and touch, crepitus on pressure, looseness of the part, appearance of various types of pain and no relief in any position<sup>2</sup>. Profound swelling, throbbing pain, twisting pain, intolerance to touch (guarding), sound produced on squeezing, drooping down of the part, severe pain in all positions and no relief in any position<sup>3</sup>.

Profound swelling and severe pain in all positions, inability to perform even slight movement, production of cracking sound on rubbing are the features of fracture in brief<sup>4</sup>.

In all these kinds general features found are; drooping of the part, swelling and severe pain, crackling sound on movement, tenderness, pulsating or pricking pain, without comfort in any position<sup>6</sup>.

Drooping down of the body part, swelling, pain increasing greatly, increase of discomfort day after day, slight sound coming up at the site of fracture when touched, intolerance to touch (guarding), pulsating and pricking pains, not feeling comfortable in any position – are the symptoms of fracture<sup>7</sup>.

### Modern Perspective

#### Symptoms

- Pain: This is a very subjective symptom and is invariably the first and the most important complaint. It may be mild, moderate and severe and may be due to tearing of periosteum (which contains the nerve endings), soft tissue injury, vascular injury, nerve injury, etc.
- Swelling: it is due to soft tissue injury, medullary bleeding and reactionary hemorrhage. Swelling is usually more in fractures and less in dislocations for obvious reasons.
- Deformity: Patients with displaced fractures and dislocations usually present with deformity of varying severity.
- Inability to use the affected part is another frequent complaint.

#### Signs

- Tenderness: This is an important clinical sign in bone and joint injuries and is usually seen after trauma. Importance of tenderness, methods of elicitation and grading is mentioned in the box.
- Swelling: The swelling is examined for shape, size (mild, moderate, severe), consistency (cystic, soft, hard), tenderness (see the grades), fluctuation, etc.
- Deformity: This is usually seen in displaced fractures and dislocations. Un-displaced fractures, mild strains and sprains usually show no deformities. Some of the deformities are very characteristic and specific and help in making a spot diagnosis.
- Abnormal mobility between fracture fragments is a sure sign of fracture.
- Loss of transmitted movements: When one end of the limb is rotated, it automatically is transmitted to the other end. Due to the break in the continuity, this is no longer possible in displaced fractures.
- Crepitus: This is an abnormal grating sensation produced by the friction between two ragged surfaces

of the fracture fragments. Obviously, it is elicitable only in displaced fractures. It should be elicited very gently and at the end of the clinical examination.

- Shortening: Limb shortening of various degrees is common in bone and joint injuries<sup>5</sup>.

### Classification of Fractures

#### Ayurvedic Perspective

There are 12 types of fracture such as – karkāṭaka, aśvakarṇa, curṇita, piccita, asthicchallita, kaṇḍabhagna, majjanugata, atipatita, vakra, chinna, paaṭita and sphuṭita.

Features are as follows - At both ends of the bone there is hyperaesthesia and in the middle the fracture point is raised like a cyst. This is known as karkāṭaka. That projected like horse's ear is aśvakarṇaka. If there is sound on palpation, it is curṇita. In piccita, the affection is extensive and with severe swelling. When bone is lowered and projected in sides respectively it is asthicchallita. It is kaṇḍabhagna if it moves on shaking. When a portion of bone pierces the pith of the other end and digs out the other marrow it is known as majjanugata. When bone is divided completely it is atipatita. When a bone is bent but not separated it is vakra. If one of the sides remains intact it is known as chinna. Paaṭita is that which has many small cracks with pain. If the site is as if full of awns, inflated, large and having many cracks it is known as sphuṭita<sup>2</sup>.

Karkāṭa especially is caused by pressure from both ends of the bone making a tumour like swelling in the centre of the bone resembling a crab in appearance. Vakra is curvature of the bone without being dislocated. Bone swollen as though full of thorns, with many fissures is Sphuṭita. Bone broken in two parts hangs loose on touch is Vellitaka. Portion of bone being lost (torn away) at the sides is Asthicchallita. Bone bulged up like the ear of a horse is Aśvakarṇa. Bone becoming thick and having great swelling is Piccita. Thin multiple cracks on the bone associated with pain is Darita. That producing sound on touch is Curṇita. Broken bone getting into the centre (cavity) of another bone is Atipatita. Broken bone piercing another bone from the side is Śeṣita. The wound of the fracture when lifted sinking into the bone marrow is Majjanugata<sup>3</sup>.

Kaṇḍa Bhagna (fracture of shafts or body of bones) is of twelve kinds, namely, karkāṭaka, aśvakarṇa, vicurṇita, piccita, asthicchallita, kaṇḍabhagna, atipatita, majjanugata, sphuṭita, vakra and two types of chinna<sup>6</sup>.

Karkāṭaka, aśvakarṇa, vicurṇita, piccita, asthicchallita, kaṇḍabhagna, atipatita, majjanugata, visphuṭita, vakra and two kinds of chinna – these twelve are the kinds of kaṇḍa bhagna (fractures of shafts of bone)<sup>7</sup>.

#### Modern Perspective

Simple or compound: The bone can break within its soft tissue envelope and may not communicate to the exterior (simple or closed fractures) or it may rip through its soft tissues or the soft tissue itself may be damaged by the external forces, exposing the bone to the external atmosphere (compound or open fractures).

Based on the extent of fracture line

- Incomplete fractures: It involves only one surface or cortex of the bone.
- Complete fracture: Here the fracture involves both the cortices and the entire bone. A complete fracture could be un-displaced or displaced.

Based on fracture patterns

- Linear fractures: These could be transverse, oblique or spiral. Any fracture that forms an angle less than 30° with the horizontal line is called transverse. Angle equal to or more than 30° is termed oblique.
- Comminuted fractures: Here the fracture fragments are more than two in number. They are further sub classified into < 50% comminution or more than 50% comminution. Butterfly-shaped fractures are also included in this group and could be less than 50% or equal to or more than 50%.
- Segmental fractures: A fracture can break into segments and the segment could be two-level, three-level, and a longitudinal split or comminuted.
- Bone loss this could be a < 50 percent bone loss, more than 50 per cent bone loss, or a complete bone loss.

Atypical Fractures

- Greenstick fractures: it is seen exclusively in children. Here the bone is elastic and usually bends due to buckling or breaking of one cortex when a force is applied. This is called a greenstick fracture.
- Impacted fractures: here the fracture fragments are impacted into each other and are not separated and displaced.
- Stress or fatigue fracture: It is usually an incomplete fracture commonly seen in athletes and in bones subjected to chronic and repetitive stress (e.g. third metatarsal fracture, fracture tibia, etc.).
- Pathological fracture: it occurs in a diseased bone and is usually spontaneous. The force required to bring about a pathological fracture is trivial.
- Hairline or crack fracture: it is a very fine break in the bone that is difficult to diagnose clinically. Radiology usually helps or still better is CT scan.
- Torus fracture: this is just a buckling of the outer cortex<sup>5</sup>.

## Principles of Management

### Management of Closed Fractures

#### Ayurvedic Perspective

One should rise up the slipped down, press down the elevated one, retract the excessively thrown out and pull out that which has moved below. All joints, movable or immovable should be set to their normal position by these setting procedures – traction, compression, extension and bandaging by a wise surgeon. Barks of Madhuka, udumbara, aśvattha, palaśa, arjuna, vaṁśa, sarja and vata should be collected for use as splint. For paste, mañjiṣṭha, madhuka, rakta candana and flour of śali rice mixed with ghee washed hundred times should be collected. Bandaging should be done every week in saumya (cold seasons), on every five days in moderate seasons and on every third day in hot seasons or as required by the condition of bhagna. Well colled decoction of nyagrodhadi drugs should be used for sprinkling while in case of painful condition, milk cooked with (laghu) pañcamula

should be used for sprinkling. Or the learned surgeon should use lukewarm cakrataila (for sprinkling).

Sprinkling and paste should verily be cold and prepared of doṣa alleviating drugs according to time and doṣa<sup>2</sup>.

That (bone) which is drooping down should be lifted up; that raised up should be pushed down, that which has moved away (from its normal place) should be pulled (to its place), that which has sunk should be elevated; manipulations such as rotation, squeezing, elevating, restraining the part of the body with bandages etc should be followed. All joints of the body both moveable and immoveable should be placed firmly in their correct position and made immoveable for restraining methods. Then thick or thin, flat, smooth, pieces of either the bark or the wood of trees such as kadamba, udumbara, aśvattha, sarja, arjuna, palaśa or vaṁśa, are cut out (to the required size). These known as Kuśa (splint) are wrapped in cloth smeared with more of ghee, and inserted (on all sides of the joint) and over them bandaging done. Bandaging should be opened at the intervals of three days in summers, of seven days in dewy season and of five days in temperate/moderate seasons or at suitable time depending upon the predominant doṣa in the fracture. Afterwards (after removing the bandage) the area should be bathed with decoction of drugs of Nyagrodhadigana made cold or with milk boiled with drugs of pañcamula; this will relieve pain. Considering nature of the place and time the wise physician can make use of cakrataila added with drugs mitigating vata, comfortably warm. Application of drugs and pouring liquids should be done continuously and in very cold condition<sup>3</sup>.

The portion of bone which is displaced down should be raised up and that which is displaced up should be pulled down; that which has moved away to other places should be pulled to its normal place that which is displaced below should be brought up by pulling, kneading, raising, constricting the skin and bandaging. All joints whether moveable or immoveable should be placed in their normal position by these methods and immobilized by bands of cloth soaked in plenty of ghee. Hard, thick and smooth pieces of inner bark of kadamba, udumbara, aśvattha, sarja, arjuna and palaśa or even pieces of vaṁśa should be arranged evenly over the cloth bandage as kuśa (splints) and then bandaged again. In summer, bandage should be removed every third day, in cold season once in seven days, in moderate seasons once in five days, or at such intervals depending upon the condition of the fracture and the doṣa. It (fracture) should then be bathed either with cold decoction of drugs of Nyagrodhadi gaṇa and when there is pain with milk boiled with drugs of pañcamula. Or after carefully considering the nature of the land and seasons, cakrataila added with drugs which mitigate vata may be poured over the place comfortably warm, pouring decoctions and application of paste of drugs should be continuous both in very cold state<sup>4</sup>.

First of all the site of fracture should be bathed with cold water followed by application of mud plaster and bandaged inserting kuśa (splint) suitably. The bone, if slid down should be lifted up and if elevated should be pulled down, if broken ends are apart they should be pulled near and joined; and the broken end if found below the bone it should be lifted up and placed in proper position. Barks of

Madhuka, udumbara, aśvattha, kadamba, nicula, vamsā, sarja, arjuna etc. should be made use of as kuśa (splint). A thick bandage (of cloth) is tied over the splint tight but not loose. During cold and winter seasons the bandage should be removed once in seven days, and once in three days during summer; every five days after one month or at a suitable time depending on the condition (of healing of the fracture). Mañjiṣṭha and madhuka, macerated in water, added with śatadhautā ghr̥ta (ghee washed a hundred times in water or decoction of pañcavalkā) and flour of rice – all mixed well should be used for application over the area. Rice flour, saiṇdhava salt and juice of ripe fruit of amlīka made as a thin paste and applied subsides the swelling due to trauma (assault) and other external causes. Roots of amrātaka, amlīka phala, śigru patra, roots of punarṇava, vardhamāna and kembuka – all together macerated either with kañjīka (fermented gruel) and buttermilk and cooked over fire and applied as poultice relieves pain, swelling and helps quick healing. Decoction of either nygrōdādī gaṇa or pañcamulādī gaṇa added with milk and poured in lukewarm condition over the lesion is beneficial to relieve pain; or cakratāila (fresh oil from the oil mill) may be applied. He should be provided with foods that do not cause heart burn and food prepared from flour of grains. The fractured part which is also swollen should be carefully protected / prevented from assault etc. it should be bathed with cold liquids constantly if there is no wound on the part<sup>7</sup>.

#### Modern Perspective

Simple fractures are managed by conservative and operative methods.

##### Conservative Methods

- For un-displaced fractures, incomplete fractures, impacted fractures:
- Cuff and collar sling for upper limb fractures.
- Strapping for fracture clavicle, fracture ribs, finger or toe fractures etc.
- Plaster slabs: Plaster of Paris slabs can be used to support the injured limb usually as a first aid measure
- Rest and nonsteroidal anti-inflammatory drugs (NSAIDs) for pain relief and to reduce the inflammation.
- Masterly inactivity in certain cases like impacted fracture neck of femur, etc.

For displaced fractures here the aim is to restore back the normal anatomy of the bone by either closed or open reduction.

##### Management of Fractures by Closed Reduction

- This consists of resuscitation, reduction, retention and rehabilitation (4Rs).
- Resuscitation: Resuscitation is the topmost priority if the patient is in shock following a fracture.
- Reduction of the fracture fragments if it is displaced. Usually it is done under general anesthesia after adequate radiographic study.

Reduction methods are:

- Closed reduction it is adopted usually for simple fractures. The technique followed is traction and counter traction method. It is a blind technique and needs considerable skill and expertise. It commonly results in malunion.

- Continuous traction Certain examples where continuous traction can be used for reduction of fractures are Gallows traction for fracture shaft femur in children, balanced skeletal traction for adult shaft femur fractures, etc.

- Open reduction. It is done when the above methods fail or if there are specific indications such as:

Displaced intra-articular fractures

- Type III and IV epiphyseal injuries
- Major avulsion fractures
- Nonunion
- Replantation of extremities

Relative

- Multiple fractures
- Delayed union
- Loss of reduction
- Pathological fractures
- For better nursing care
- To avoid prolonged bed rest

Retention: Once the fracture fragments are reduced, it has to be retained in that position till the fracture unites, otherwise it tends to get displaced due to the action of muscles, gravity and inherent factors.

Retention methods after closed reduction are:

- By plaster of Paris splints this is the most common splint employed. It could be a slab (encircles half the limb) or a cast (encircles the whole limb) or a functional brace (which permits mobility while the fracture is still under the cast)
- By continuous traction to overcome the muscle forces after closed reduction. The traction could be skin or skeletal traction and is employed as fixed, balanced or combined types of tractions
- Use of functional braces this can be used after three weeks, once the fracture becomes sticky).

4. Rehabilitation is by way of physiotherapy and exercises (both active and passive).

##### Methods of Open Reduction

After the exposure, the fracture is reduced by direct methods and in the indirect methods the fracture is reduced without exposing by positioning and traction over the fracture tables, skeletal traction, tensioner, lamina spreader, etc.

Principles of open reduction (known after Lambotte) suggested by Lambotte includes:

- Exposure: The fracture is adequately exposed through a proper approach.
- Reduction: of the fracture fragments under direct vision is carried out.
- Temporary stabilization: of the fracture fragments by K-wire is done first if necessary.
- Definitive stabilization: of the fracture using plate and screws or intramedullary nail, etc. is done later.

Retention after open reduction:

After open reduction the fracture fragment invariably needs to be fixed internally by various implants such as K-wire, Screws, Intramedullary nails, Plate and Screw, Interlocking nails, Hip implants, Spine implant, Steel Wires.

The rehabilitation process is the same as for closed management of fractures<sup>5</sup>.

## Management of Compound Fractures

### Ayurvedic Perspective

In case of compound fracture, the wound should be treated with paste of plants mixed with plenty of ghee and honey. The remaining regimen should be as in fractures<sup>2</sup>.

In case of fractures associated with a wound, the wound should be treated first with honey and ghee and astringent drug pasted on it. Later the treatments of fracture adopted. Muscles of wound which are hanging loose are smeared with honey and ghee and pushed into the wound and bandaged. Noted that they are in good shape and correct place, the wound should be dusted with the powder of either phalini, lodhra, katphala, samañga and dhataki or of pañcavalkala added with honey and śukta (sour gruel) or with powder of dhataki and lodhra. By this the wound heals quickly<sup>3</sup>.

In case of fracture with wound, the wound should be bathed with decoction of drugs of astringent taste added with more of honey and ghee. Remaining treatment is like that described for fractures. Muscles which are hanging loose in the wound should be smeared with honey and ghee and then cut, sutured and bandaged appropriately. Observing that these are well adhered, fine powder of either phalini, rodhra, katphala, samañga and dhataki; or of dhataki and rodhra should be sprinkled over them; by this the wound heals quickly<sup>4</sup>.

If fracture is having a wound, the wound should be smeared with mixture of ghee and more of honey, then decoction of drugs poured on it warm and then treatment indicated for fractures adopted. Medicated fats described in the treatment of vatavyadhi may also be used here<sup>7</sup>.

### Modern Perspective

Compound fractures are usually serious injuries and are due to high-velocity trauma. They may be associated with multisystem and multiskeletal injuries. The approach should be more cautious and the following protocol is recommended.

- General physical examination: this is of vital importance since the patient is usually in shock. Levels of consciousness, pulse, blood pressure, breathing, etc. should be recorded.
- Examination of other systems: Examinations should be carried out for head injury, neck and face injury, chest injury, blunt injury abdomen, pelvic fractures and spine fractures.
- Examination of the compound injury: this usually proceeds in the same line as mentioned in examination of closed fractures but here the assessment of the general physical condition of the patient assumes great importance. In addition to the usual clinical features, one should look for soft tissue injury and wound, bone loss, absence of bone pieces, distal neurovascular status of the limb, etc.

### Investigations

General investigations Laboratory tests like Hb percentage, blood group, bleeding time and clotting time, HIV, HbS Ag, routine urine examinations, etc. are carried out.

X-ray of the part as for other fractures and in addition look for missing pieces of bone in open fractures.

### Aims of Treatment

- To convert a contaminated wound into a clean wound and thus help to convert an open fracture into a closed one.
- To establish union in a good position.
- To prevent pyogenic and clostridial infections.

### Considerations

1. First to stabilize the general condition of the patient as the patient is usually in shock. This consists of resuscitation, blood transfusion, intravenous fluids, antibiotics, oxygen administration, etc.
2. To keep the wound covered with proper sterile bandages until the patient is ready for surgery.
3. Open fractures are surgical emergencies and surgery is to be done as soon as the patient is fit.

### Treatment Plan

After stabilizing the general condition of the patient, surgical debridement is planned under strict aseptic measures in a major operation theatre.

It is a team work and involves a battery of specialists like the vascular surgeon, plastic surgeon, thoracic surgeon, general surgeon, faciomaxillary surgeon, and of course the orthopaedic surgeon. Once these specialists manage the injuries to the vital organs and the general condition of the patient is stabilized, the fractures are dealt by the orthopaedic surgeon.

Debridement (known as unbridling) this is the most important step in the management of compound fractures. It consists of the following steps (4 Es)

**Exploration** of the wound: the wound should be sufficiently explored proximally and distally to have a proper assessment of the extent of the damage.

**Excision** of all nonviable structures is important to prevent infection. The recognition of nonviable tissue before excision is of paramount importance. The tissues are dealt with as follows:

- Skin: here the plan is to excise all the dead skin and yet be conservative.
- Muscle: Nonviable muscles should be removed.
- Bones: Small bits of loose bones devoid of soft tissues are removed. Large fragments with their soft tissue attachments are preserved.
- Nerves and vessels: Primary repair is done if the wound is clean. In contaminated wounds, they are dealt with at a later stage.

**Evacuation** of foreign bodies like dirt, glass, stones, pebbles, etc. These foreign bodies are a source for infection and may invite a foreign body reaction. Hence, they have to be removed by a thorough irrigation (normal saline is used)

**External fixators** are used to fix the fracture fragment after debridement. Plaster of Paris and internal fixation devices have little and controversial role in the fracture management of compound fractures. External fixator's help to stabilize fracture fragments, allow daily wound inspection and dressing, permit procedures like skin grafting to cover the wound, allow soft tissues to heal apart from providing early mobilization. In open tibial fractures, external fixator can be safely exchanged to internal fixation within 3 weeks with only 5 per cent incidence of deep infection.

### Definitive Wound Care

After resuscitation, debridement and application of external fixator's attention is now given to the definitive wound care. This is an extremely important step as the primary objective of treatment in open fracture is to convert an open wound into closed wound. The wound closure could be primary or secondary.

Criteria for Primary Closure

- All necrotic material should be removed.
- Circulation should be normal.
- Nerve supply should be intact.
- The patient's general condition should be stable.
- Wound should be closed without tension.
- No dead space should be left after closure.
- There should be no multisystem injuries.

If all the above criteria are met, primary suturing is preferred to close a wound. The following alternative measures are considered in the event of the above criteria not being met:

- Split skin graft.
- Pedicle or flap graft.
- Secondary suturing after 2 to 3 weeks.
- Relaxing incisions to mobilize the neighboring skin.
- Biological dressings (homologous or heterologous skin).
- To leave it open and to follow by regular dressings, wound inspection and closure later.

Role of antibiotics It will not replace the wound debridement. Topical antibiotics have very little role. Parenteral administration is recommended. The choice of antibiotics is usually a broad spectrum, bactericidal hypoallergenic agent with adequate serum concentration.

Role of AGGS and ATS The patient has to be protected against tetanus and gas gangrene by effective immunization against them. Role of primary amputation in open fractures. This is controversial but can be considered in type IIC with neural injury and if the warm ischemia is more than 6 hours<sup>5</sup>.

### Complications and Detrimental Factors

#### Ayurvedic Perspective

Out of them (fractures) Curṇita, chinna, atipatita and majjanugata are curable with difficulty. Dislocation and fracture are also so in case of weak, old, children and those suffering from wasting due to chest wound. If pelvic bone is cracked, dislocated, drooped and rubbing the pubic region, it should be discarded. If skull is not unified, forehead is smashed and there is fracture in intermammary region, temples, back and vertex, it should be discarded. Fracture or dislocation mismanaged from the very beginning or even if set properly gets damaged due to faulty position and bandaging or jerking should be discarded. The surgeon should remain vigilant and take all necessary steps so that it does not suppurate because in case of suppuration of muscle, vessels and ligaments it becomes difficult to cure. Bhagna is cured with difficulty if patients eat little, has no self control, is of vaatika constitution or is afflicted with complications (fever, flatulence, retention of urine, faeces etc.) The patient of bhagna should abstain from salt, pungents, alkali, sour, coitus, sun-heat, physical exercise and rough food<sup>2</sup>.

Darita, Curṇita, Atipatita, Śeṣita and Majjanugata are difficult to cure in the emaciated, the very young or very old, who cannot withstand/tolerate the therapies, who eats too much, who have predominance of vata, who are suffering from leprosy and complications (of fractures). Bhinna kind of fracture of katikapala (pelvic bones) or dislocation (of pelvic bones), uptiṣṭa fracture of the bone of the jaṅghana (pubis), vivartita kind of kurpara (elbow joint), curṇita kind at lalaṭa (forehead), that causing separation of the kapala (skull bones) and that happening between the head and the back of (upper border of) the temples- all these are incurable. By loose bandaging immobility of the joint is not achieved and by tight bandaging there will be severe pain, burning sensation, ripening (suppuration) and swellings<sup>3</sup>.

The bone which has been crushed into very small pieces, that which causes sound on touching, in which pieces of bone have entered into the marrow cavity, the condition where, by trauma very little portion of bone is left inside the body, that condition in which raising the fracture portion makes it sink into the marrow – all these kinds are difficult to cure; so also those found in persons who are emaciated, debilitated, having predominance of vata in their body and who consume very little food. Fracture of the pelvic bone in its flat portion, dislocation, of joints of the waist and crushing fracture of pubic bone should be refused. Skull bones not knit together, the forehead bone broken to pieces and that fracture which has occurred in the middle of the temples, head back and breasts should be rejected. That bone, which in spite of proper control (by the use of splints etc) becomes irregular (distorted) by improper joining, bandaging and exertion (functioning of the affected part) should be refused treatment, so also the bone and the joint which is ill-formed from the beginning itself. By loose bandaging stability (immobility) of the joint is not achieved and by very tight bandaging there is the possibility of pain, burning sensation, ripening, ulceration/suppuration, or swelling manifesting. The physician should not allow ripening in the fracture site; since muscle, veins, tendons, joints which develop pus do not stick together. Exertion (over activity of the fractured part) is not good for him; for, it will produce dislocation of the joint. The patient of fracture should not indulge in things which are salty, pungent, alkaline and sour; copulation, exposure to sunlight, exercise and dry (non-fatty) foods<sup>4</sup>.

Fractures of the hip bone, fracture at the sutures of the hip bone, uptista type of fracture at the pelvis in its interior are to be rejected. Likewise the bones of the forehead, chest, back, temporal and vault of the head cracked or broken to pieces are also to be rejected for treatment. Fractures which have once healed but happening again and again due to bad position, bandaging or violent activity and creating loss of function is also to be refused treatment. Fractures heal with difficulty in persons who take very little quantity of food, who indulge in unsuitable foods and activities, and in those associated with complications<sup>6</sup>.

Conditions in which the flat bones have cracked, hip joint dislocated and descended down, buttocks (pelvis bones) are pushed up should be refused treatment by the physician. The flat bone of the shoulder driven inside, the

bone of the forehead being crushed, bones of the breasts, rectum, back, temples and head being fractured should be rejected. That bone which has healed once becomes broken again due to improper position, bandaging, or sudden (violent) movement should also be refused treatment. Utmost care should be taken not to allow the fractures undergoing paka (pus formation); if muscles, veins and tendons undergo pus formation then it is very difficult to treat. The patient of fracture shouldn't indulge in foods which are salty, pungent, alkaline and sour, exertion, copulation, physical exercises and dry foods. Fractures occurring in persons who partake little quantity of food, who do not control themselves, in person of vata predominant constitution and that associated with complications get cured with difficulty<sup>7</sup>.

#### Modern Perspective

##### Chronic Complications of Fracture due to Healing

- Delayed Union: Healing does not advance at the average rate for location and type of fracture.
- Non Union: When a minimum of 9 months have elapsed since the injury and the fracture shows no radiologically visible progressive signs of healing continuously for 3 months. In simple fractures, It could be due to infection, segmental fractures, distraction of fracture fragments and soft tissue interposition.
- Mal Union: When fracture fragments heal in an abnormal position. It could cause shortening, alteration in posture and balance in lower limb fracture, cosmetically unsightly deformity, interference with joint function, altered weight bearing that could lead to pre-mature osteoarthritis.
- Shortening of Long bones
- Avascular necrosis: is a rare but severe complication of certain fractures. It occurs when the blood supply to a segment of bone is affected.
- Joint Stiffness: This is due to improper technique of fracture immobilization. This can be fairly a troublesome problem. Intra-articular fractures periarticular adhesions of soft tissues, capsules and muscle contractures are some of the other important causes of joint stiffness
- Post Traumatic Arthritis: It is commonly seen in intra-articular fractures, malunion, etc.

##### Acute Complications (Open Fractures)

- Shock
- Acute Respiratory Distress Syndrome
- Neuro-Vascular injuries
- Volmann's Ischaemia/Compartmental syndrome
- Deep Vein Thrombosis
- Crush syndrome

##### Peculiar Complications

- Infection
- Chronic Osteomyelitis
- Gas gangrene
- Tetanus
- Hypovolaemic shock

##### Detrimental Factors

- Poor circulation
- Infection
- Segmental fractures

- Comminution
- Osteoporosis
- Soft tissue interposition
- Inadequate and improper immobilisation<sup>5</sup>

#### Unique Features of Ayurvedic Treatment for Fracture Healing

##### Special Decoctions

For paste, mañjiṣṭha, madhuka, rakta candana and flour of śali rice mixed with ghee washed hundred times should be collected. Well cooled decoction of nyagrodhadi drugs should be used for sprinkling while in case of painful condition; milk cooked with (laghu) pañcamula should be used for sprinkling. Or the learned surgeon should use lukewarm cakrataila (for sprinkling). Sprinkling and paste should verily be cold and prepared of doṣa alleviating drugs according to time and doṣa. In fracture of upper part of the body, mastiṣkya (a kind of siroasti), ear-filling, intake of ghee and snuffing are useful while in that of extremities unctuous enema is applicable. This is oil which unifies fracture known as gañdhataila which alleviates all diseases caused by vata and is suitable for king. The wise should apply only to kings. Oils of trapusa, bibhitaka and priyala mixed with muscle fat should be cooked with (the paste of) kakolyadi drugs along with ten times milk. This excellent oil unifies fracture quickly and is used as intake, massage, snuffing, enema and sprinkling<sup>2</sup>.

Afterwards (after removing the bandage) the area should be bathed with decoction of drugs of Nyagrodhadigana made cold or with milk boiled with drugs of pañcamula; this will relieve pain. Considering nature of the place and time the wise physician can make use of cakrataila added with drugs mitigating vata, comfortably warm. Application of drugs and pouring liquids should be done continuously and in very cold condition. Medicated fats (oils and ghee) prescribed in the treatment of vata vyadhi should be used for four therapies (drinking, oil enema, nasal drops and anointing), in patients of fracture, so also drugs which are strengthening, and enemas. This known as Gañdha taila is best to promote strength of the bones, cures all diseases caused by vata and pitta spread everywhere, quickly by its use in many ways<sup>3</sup>. It (fracture) should then be bathed either with cold decoction of drugs of Nyagrodhadi gaṇa and when there is pain with milk boiled with drugs of pañcamula. Or after carefully considering the nature of the land and seasons, cakrataila added with drugs which mitigate vata may be poured over the place comfortably warm, pouring decoctions and application of paste of drugs should be continuous both in very cold state. Medicated fats described in the treatment of vata vyadhi should be made use of for the four therapies (drinking, nasal drops, anointing and enema), recipes which give strength to the body and enema therapy should be adopted. This oil known as Gañdha taila is good to bestow sturdiness to the bones, cure diseases produced by vata and pitta though powerful and spread all over the body by using it in different methods therapies<sup>4</sup>.

Mañjiṣṭha and madhuka, macerated in water, added with śatadhauta ghṛta (ghee washed a hundred times in water or decoction of pañcavalkala) and flour of rice – all mixed well should be used for application over the area. Rice

flour, saiñdhava salt and juice of ripe fruit of amlika made as a thin paste and applied subsides the swelling due to trauma (assault) and other external causes. Roots of amrataka, amlika phala, śigru patra, roots of punarava, vardhamana and kembuka – all together macerated either with kañjika (fermented gruel) and buttermilk and cooked over fire and applied as poultice relieves pain, swelling and helps quick healing. Decoction of either nygrodadi gaṇa or pañcamuladi gana added with milk and poured in luke warm condition over the lesion is beneficial to relieve pain; or cakrataila (fresh oil from the oil mill) may be applied. He should be provided with foods that do not cause heart burn and food prepared from flour of grains. Paste of amalika phala, sauvira (fermented rice-wash) mixed with oil – all boiled well and the site of fracture given fomentation with this, helps to mitigate pain and swelling, so also in inflammatory swelling after the usual treatment. Gañdha taila- this oils is always beneficial for all purposes in fractures<sup>7</sup>.

#### Special Dietary and Herbal Supplements

The learned surgeon should provide śali rice, meat-soup, milk, ghee, pea-soup and weight promoting food and drinks to that suffering from bhagna. The patient of bhagna should drink in the morning; milk of primiparous cow mixed with ghee, processed with sweet (kakolyadi) drugs, well cooled and added with lakṣa<sup>2</sup>.

The patient of fracture should drink grīṣṭikṣira (milk of the cow which has calved within a week) added with ghee and boiled with drugs of sweet taste, every morning, mixing it with lakṣa. Patient of fracture should be treated with foods such as rice, milk, meat soup, ghee etc which are strength promoting, not causing burning sensation during digestion, such others will help union of broken parts, and used in proper quantity<sup>3</sup>.

The patient of fracture should drink grīṣṭikṣira (milk of the cow which has delivered a calf within seven days) every morning added with ghee and boiled with drugs of sweet taste, and lakṣa and then cooled. The patient of fracture should consume in proper quantities foods such as rice, ghee, juice of meat, milk etc. which are nourishing the body which do not cause heart-burn and which bestow sturdiness to the joints<sup>4</sup>.

For patients of fracture, foods which are nourishing (stoutening) should be prescribed. The patient of fracture should drink grīṣṭikṣira (milk of cow which has delivered a calf within a week) added with ghee boiled with drugs of sweet taste and mixed with lakṣa every day in the morning. Asthisamhara together with ghr̥ta, lakṣa, godhuma and arjuna should be consumed with milk every day by the patient of dislocation of joints and fractures. By consuming the paste of rasona, madhu, lakṣa, ghee and sugar, fractures like chinna, bhinna and cyuta gets united quickly. Powder of pura (guggulu) added ghr̥ta and paste of arjuna bark and consumed; the fractured bone gets united if the patient consumes more of milk and ghee in his diet. Powder of sṛgalavinna (pṛṣniparñi) consumed along with soup of meat every day heals the fracture within three weeks. Powder of abha (babbula) added with honey and consumed for three days, it helps to unite the fractures making the bone similar to diamond (in hardness). Abha (babbula), triphala, vyoṣa – all equal parts added with equal quantity of guggulu are pounded

well and made into pills; this consumed, is going to unite fractures. Lakṣa, asthisahamkara, kakubha, aśvagañdha, nagabala and pura (guggulu) all powdered and consumed, in suitable doses heals fractures, dislocations, pain of the bone and makes body part strong as diamond<sup>7</sup>.

#### Fracture Bed

For those having fracture and dislocation of leg and thigh, wooden cot is suitable. In this, for stabilising, five nails are provided so that there should not be any movement in the affected part. For this, two nails on each side of the joint and one at the sole are fixed. This procedure should be adopted in cases of fracture and dislocation in hip, vertebral column, chest and clavicles too<sup>2</sup>.

For persons having fracture, of the waist, forelegs and thighs, making them lie on a kapāṭa (hard wooden plank) is ideal, for restraining him, it should be equipped with five pegs, two each for the forelegs cum thighs and flanks and one for the sole ( the parts of the body are tied to these pegs and thus immobilised). The same procedure should be adopted in cases of dislocation and fractures of the pelvis, vertebral column, chest and collar bone<sup>3</sup>.

For fractures of the waist, forelegs and thighs it is beneficial to lie on a hard wooden box fitted with five pegs to control (immobilize the leg) two each for the forelegs (calves) and thighs and one for the sole. In the same way (in fractures) of the pelvis, vertebral column, chest or the collar bone. This method may be followed in cases of fracture-dislocation of the joints<sup>4</sup>.

#### CONCLUSION

Many similarities can be found in both Ayurveda and Modern medicine in the understanding and treatment of fractures as both the fields hold excessive force and pressure on the bone, whether caused by a slip or fall, sudden assault by the animals in ancient times, or a road traffic accident in the modern times, as the main reasons why fractures happen. The symptoms of fracture as understood according to modern medicine have been mentioned centuries ago in the Ayurvedic texts. Today we are able to examine a fractured bone directly under radiological examination. In the absence of this, the ancient system had evolved extremely useful, logical and detailed methods of determining the types of fractures and their management. Special techniques like management of compound fractures have been dealt with separately. The wounds are dressed before immobilising the fracture. There is also an indication of the use of practical physiotherapy in the traditional texts. This could be compared to the rehabilitation post fracture section in Modern medicine. An interesting feature in Suśruta's technique of dealing with fractures is the method of immobilising the injured limbs by using fracture bed "Kapāṭaśayana". The modern medicine takes over in the management of complicated simple and compound fractures with the introduction of many surgical interventions like the intramedullary devices that hasten fracture union and healing potential. Diet and application of appropriate herbal pastes and decoctions play an integral role in accelerating fracture healing. The favouring and the contra-indicated diets influence the time and quality of healing. These are indeed the unique features of Ayurvedic treatment. Properly united fracture

must satisfy the conditions such as absence of gaps between the broken fragments, shortening deformity and return of painless, easy movements. If only, the surgeon is convinced that these four features exist clinically, should the bone injury be declared as ideally healed.

It can therefore be concluded that the principles laid down by ayurvedic texts are extremely relevant and many of them are practiced by the modern orthopaedic surgeons even in the present times. It would also probably be worthwhile, in the time to come, to explore the role of diet and the decoctions mentioned in ayurveda for accentuating fracture healing.

#### REFERENCES

1. Radhika M. The tradition of bone setting. The Hindu, Indian health traditions, Sunday Magazine. 2000 October 8.
2. Murthy KRS. Suśruta Saṃhita. Chaukhamba Orientalia2004. p. 559-62.
3. Murthy KRS. Aṣṭaṅga Saṃgraha by Vagbhata. Chaukhamba Orientalia, Varanasi; 2005. p. 285-93.
4. Murthy KRS. Aṣṭaṅga Hṛdayam by Vagbhata. Krishnadas Academy Varanasi; 2006. p. 255-64.
5. Ebnezar J. Textbook of Orthopaedics. Third ed: Jaypee; 2006.
6. Murthy KRS. Mādhava Nidāna. Chaukhamba Orientalia2005. p. 148-9.
7. Murthy KRS. Bhavaprakasha of Bhavamishra. Krishnadas Academy Varanasi2002. p. 568-75.