



# Beginning Of Fracture Management: REVIEW ARTICLE

Dr Reema Sonkar

Medical Officer Ayurveda, State Ayurveda Hospital, Sanjay Nagar, Ghaziabad

## Abstract

Ayurveda is a complete science of life, where we get elaborate descriptions about prevention of disease in a healthy individual as well as the management diseases. One of the common problems and challenges to modern world is trauma and the management the skeletal system injuries which occur as the result of trauma in most of cases. Such skeletal injuries are well explained with their classification and treatment in classical Ayurvedic Literature. Such orthopedic conditions are well explained and documented in the literatures of Ayurveda in the name of Bhagna Chikitsa. This paper presents a historic perspective of fracture management in the Ayurveda tradition.

**Keywords:** Bhagna, Bandhana, Fracture, Skeletal injuries, Sukhchestaprasara.

## INTRODUCTION

Morbidity is as old as man himself and it attracting his attention since his first step on this planet. Trauma being the birth partner of man has always troubled him. However, he has faced it bravely, the witness is the long journey of the survival he has covered from his origin i.e. when he was quiet uncivilized, to the present highly civilized and sophisticated state. Surely he has worked hard and has attained success in every sphere of life. But in this advanced era with the increasing momentum of dynamic sophistication of present day life styles, the incidences of skeletal injuries are constantly increasing; affecting all age groups. This results into greater physical, psychological, social, and financial loss to the patients, their families and the state as well. Much of the country resources are being driven away in the management of these injuries.

Management of these injuries requires a judicious and holistic approach and not merely to fix or unite the fractures but functional and cosmetic recovery should be maximal possible at the earliest with minimal cost. But always this is not possible and variety of problems can creep up. A notable feature of the present management is that operative fixation is employed much freely than the case three or four decade earlier. Whatsoever the advanced means and methods have been attained by the modern science the basic principles of bone and joint injuries (reduction, immobilization and rehabilitation) are still at par with Ayurveda.

## **Aim and objective of presentation:**

The present review is aimed to compile the various concepts of fracture management as described in Ayurveda, their possible interpretation according to the modern science and to impress upon the practical utility of these principles in the management of the skeletal injuries. Classical texts of Ayurveda viz. Sushruta Samhita, Vagbhatta, Yogratnakara, Sharangdhara, Bhava Prakasha and contemporary modern texts were explored for the relevant literature.

## **Methodology**

Ayurvedic literature was searched from recent to past available in different libraries. For description fracture and its management described by out eminent scholars in their treatises. Computerized databases were also searched for this purpose. All the information on fractures and its management in Ayurvedic literature included in this review.

## **Results**

Surgery in India was in practice right from the pre-historic era, as references regarding are available in Vedas, particularly of orthopaedic surgery like prosthetic replacement of limbs, fixation of severed head etc. by “Ashvini Kumars” the divine physicians. But it was in its highest glory during the period of Sushruta, somewhere during the 5th century BC. For Bhagna (skeletal injuries) management unique principles of technical management Sthapna (reduction), Bandhana (immobilization) and Sukhchestprasara (Physiotherapy – a component of rehabilitation) have been described.<sup>[1]</sup> Along with this technical management a vast description of local, parenteral and oral medication, dietetic regimen, life style modifications have also been mentioned. All these principles stand to the test even in present time and can be beneficial to the patient if used solely or in combination of the modern treatment.

## **Treatment principles of Bhagna (Skeletal injuries)**

The word Bhagna has been derived from the root word ‘Bhanja’ after adding the suffix ‘kta’ which means to break or to grind down or to separate.<sup>[2, 3, 4]</sup> This word is considered in all the three genders but when used for a disease then used as a neuter gender. To denote a disease it pertains to bone, joint and associated injuries i.e. all the skeletal injuries. It has further been classified in to two categories i.e. Sandhimukta (joint injuries) and Kandbhagna (bone injuries).<sup>[5]</sup> So far as the treatment of these injuries is concerned in Ayurvedic texts a well planned management regimen is available. Basic concepts of the management of Bhagna (skeletal injuries) mentioned by Sushruta and other sages are so relevant and scientific that they are still standing the test of the day even in this scientifically highly advanced era. Brief description is as follows:

Initial management / First aid: As first aid measure, Yogratnakara has advised to sprinkle cold water over the injured area and then a layer of mud should be applied immediately after the injury or knowing that Bhagna (skeletal injury) has taken place.<sup>[6]</sup> But this measure is only applicable in Avrana (closed injuries) type of Bhagna (skeletal injuries). Application of the cold water or ice packs is a very important measure and even today it is abundantly used in general trauma and sports injury management.<sup>[7]</sup> when a tissue injures certain pathological processes and metabolic response of the body towards trauma immediately starts. Very important are the bleeding from the torn vessels resulting into

immediate local swelling, pain receptors stimulation resulting into pain at the injured site, increased local metabolic rate and setting up of the sterile inflammatory response. Cold water or ice pack application on the injured sites immediately after the injury constricts the blood vessels of that area resulting into less haemorrhage subsequently less swelling and less blood loss. By the application of cold water the inflammatory response is suppressed and metabolic needs of injured tissue are also reduced which further help to keep the swelling and pain minimal.<sup>[8,9]</sup> Cooling of the local tissues also reduces the irritation of local pain receptors resulting in to further reduction of pain. Second important thing which Yogratnakara has advised the application of a layer of mud. This is a very important measure however; today it may appear very much primitive. Layer of mud after application dries and become hard and acts as a very good temporary splint. Plaster of Paris is the refined form of that mud. Mud has another property that it is cold and further causes cooling over the injured site.

This prolonged cooling is further beneficial as above. So, mud acts as a temporary well contoured splint and a local cooling agent as well. In Astangahridaya also there is same protocol for the initial management with the difference that the cold water should be irrigated for longer duration. Sushruta is also of the same opinion.<sup>[10,11]</sup>

Basic Principles of definitive management: The aim of the treatment of skeletal injuries is to restore the normal or near to normal structural integrity and physiology of the fractured part, at the earliest, without any complications. Here, it is pertinent to mention that in Ayurveda the diagnosis of Bhagna (skeletal injuries) was based on the clinical features only and treatment mentioned is absolutely by closed methods. There is no reference of open treatment or internal fixation of any kind. For the treatment purposes Bhagna (skeletal injuries) has further been divided in to two types i.e. Avrana Bhagna (closed injuries) and Savrana Bhagna (open injuries). In both the conditions i.e. Avrana Bhagna (closed injuries) and Savrana Bhagna (open injuries) principles of management remain same except that in open injuries priority will be towards the management of Vrana (wound) to avoid the chances of infection. After the successful management of Vrana (wound), bone or joint injury should be tackled on the basis of common treatment principles. Permeation through the literature reveals that to achieve the aforesaid aim following plan of treatment has been mentioned:

Technical management<sup>[12]</sup>

- A. Bhagna Sthapana (Reduction)
- b. Bandhana (Immobilization or Retention)
- c. Sukhchestaprasara (Physiotherapy)

In modern medical science also the same principles are used to treat the fractures or joint injuries.<sup>[13]</sup>

## Medication

- a. Oral Medication<sup>[14]</sup>
- b. Local Medication<sup>[15]</sup>
- c. Parenteral Medication<sup>[16]</sup>

## Dos and Don'ts

- a. Dietetic instructions<sup>[17]</sup>
- b. Life style modifications<sup>[18]</sup>

## Management of Avrana Bhagna (closed skeletal injuries)

Bhagna Sthapana (Reduction): This is the first principle of fracture treatment and is done if required.<sup>[19]</sup> It simply means realignment or correction of the fracture fragments or a dislocated / sub-luxed joint to their respective anatomical positions.<sup>[20]</sup> Acharya Sushruta has mainly emphasized upon the techniques of closed reduction as by the application of various forces like Aanchhana (traction), Peedana (compression), Sankshepana (reduction or compression), Unmanna (pulling upwards), Vinmanna (pressing downwards) etc.<sup>[21]</sup> By the judicious application of these forces the depressed bone should be elevated, elevated bone should be depressed, proximally displaced bone should be pulled and distally displaced bone should be brought out proximally. By these manipulations, the fractured parts are repositioned. The cardinal rule of reduction is to apply the opposite forces to that of the forces responsible for the injury or to reverse the mechanism of injury. Traction and counter traction methods have been advised for reduction and immobilization of fractures of pelvis.<sup>[22]</sup> Bandhana (Immobilization): After the injury has been corrected or reduced it needs immobilization or stabilization till it unites or fractured fragments become sticky. For this purpose of immobilization two methods have been advocated viz. Kushaand Bandhana (Splintage or external immobilization) and Kapaat Shayana (fracture bed). Kusha Bandhana: Before immobilizing the injured part by Kusha (splint) an alepa (paste) prepared from the drugs like Mnajishtha (*Rubia cordifolia* Linn), Madhuka (*Glycyrrhiza glabra* Linn), Raktachandna (*Pterocarpus santalinus* Linn), Shali (a type of rice) and Shat dhauta Ghrita (100 times washed clarified butter) should be applied on the affected part. Sushruta and Vagbhatta have also indicated to apply a bandage well soaked with ghee on the part before the application of Kusha (splint).<sup>[23-24]</sup> After applying the local medicaments the splints prepared from the barks or chips of the trees like Madhuka (*Madhuka indica* J.F. Gmel.), Udumbara (*Ficus glomerata* Roxb.), Palasha (*Butea monosperma* Linn), Arjuna (*Terminalia arjuna* Roxb.), Vansa (*Bambusa arundinacea* Wild.), Sarja (*Vateria indica* Linn.) etc. are to be applied and held with the appropriate bandages. While selecting a splint for the application it should be Prithu (broad or wide enough to cover the part), Tanu (thin or light weight), Suniveshtita (well invested or surrounded), Salakshana (smooth) and sapratishtambha (strong enough).<sup>[25]</sup> The bandaging should neither be too tight nor too loose, Sadharana bandhana (bandage with moderate pressure) has been advocated.<sup>[26]</sup> The unique concept of Ayurveda is to change the Kusha (splint) periodically till the Bhagna (injury) unites. This change is to be done as per the season, Dosha (body humor) predominance and nature of injury. This change of splint and medicaments is recommended weekly in normal



seasons, every fifth day in moderate seasons and every third day in extreme seasons.<sup>[27]</sup> Probably this has been advised to check the skin status, reduction status and to change the decomposed local medicaments applied over there. Kapaat Shayana (fracture bed): Kapaat Shayana (fracture bed) is basically the concept of a fracture bed which has a great relevance in the immobilization of fractures involving back, pelvis, chest clavicle and lower limbs. It achieves almost all the aims and objectives of the immobilisation.<sup>[28]</sup> It prevents all types of movements and gives complete rest to the injured part. The patient is laid down on the wooden board and the fractured limb is immobilized by fixing five pegs or stakes in five different places. The general principle is that two pegs are fixed on both the sides of the joint distal to Bhagna (skeletal injury) and two pegs are fixed on both the sides of the joint proximal to Bhagna (skeletal injury). One peg is fixed on the side of the sole of the injured limb e.g. in the case of fractures of tibia and fibula two pegs are fixed near the knee joint, two pegs are fixed near the ankle joint and the last peg is fixed near the sole. In case of the fracture of the femur and tibia seven pegs are used.

Sukhchestaprasara (Physiotherapy): It is vital to bring back the normal functions of the affected parts as soon as possible, mainly by gaining the strengths of bones and soft tissues. In Sushruta Samhita under the management of fractures of bones of palm (meta-carpals), gradually increasing weight bearing has been described.<sup>[29]</sup> It has been mentioned that the patient should hold Mritpinda (ball of clay) then Lavana (salt) and finally Pashana (a piece of stone) in his palm to regain the strength.

In Ayurveda as such there is no clear-cut description of the principle of re-habilitation which is now-a-days an important part of the treatment of the injuries and other diseases. Rehabilitation has been defined as 'the restoration of patients to their fullest physical, mental and social capability.'<sup>[30]</sup> For this purpose the involvement of various agencies like NGOs (Non governmental Organizations), Insurance companies, Governmental agencies, Social workers, Family, Physiotherapist and attending Trauma surgeons are required. Physiotherapy is one part of the re-habilitation and Ayurveda has clearly given this important principle.

#### Management of Savrana Bhagna (open fractures)

Savrana Bhagna (open fractures) are the injuries to the skeleton which are associated with wound over the injured site and are termed as open (previously compound) fractures or dislocations. These have been defined as injuries in which there is a breach in the soft tissue envelops over or near the fracture such that the underlying bone communicates with the outside environment.<sup>[31]</sup> Such injuries pose a serious threat of infection and demand a separate treatment plan. Wound care and treatment to provide healthy soft tissue and skin cover remains the priority in these cases. The primary objective in the management of an open fracture is union with prevention or eradication of woundsepsis.<sup>[32]</sup> In such injuries the wound is a presenting feature and should be treated on priority basis to provide early skin cover, prevent infection and other complications. Sushruta has well recognised this fact while discussing the treatment of open fractures and says that the wound should be cleansed with decoctions mixed with adequate quantity of Ghrita (clarified butter) and Madhu (honey).<sup>[33]</sup> The principles of Vrana (wound) treatment can be followed as described by Sushruta in Chikitsa Sthana Chapter 1 and 2.<sup>[34]</sup> Every effort should be made to check the hemorrhage and to improve the general condition of the

patient.<sup>[35]</sup> Due to profuse bleeding in Chhinna Vrana (incised wound or traumatic amputation), Bhinna Vrana (punctured wounds of the cavities), Viddha Vrana (punctured wounds of the limbs) and Kshata Vrana (lacerated wounds) Vata (a specific body humor) gets vitiated and causes more pain. So in such cases Snigdhopchara (a type of treatment with oleation locally or orally) or in the form of local, parenteral and oral medication should be performed. On the other hand in Pichchita (crush or compression injury) and Ghrista (abrasions) type of Vrana (wound), Daha (burning sensation) and Paka (suppuration) are the main features due to less bleeding. So, Sheetopchara (cold treatment) should be done.<sup>[36]</sup> Thereafter wound is cleansed with decoctions of certain plants and debridement is done. After proper debridement wound is closed by the suitable types of suturing techniques and suture materials.<sup>[37]</sup> While treating the wounds a clinician must be aware about the phases of wound healing and should alter the treatment according to the stage of wound healing.<sup>[38]</sup> Rest of the treatment of Bhagna (skeletal injuries) is done on the basis of the principles already described.

### Management of Vishmolvana Samhita Bhagna (Mal-united Fractures)

Each mal-united fracture presents a unique set of bony deformities. Deformities are described in terms of abnormalities of length, angulation, rotation, and translation. The location, magnitude, and direction of the deformity complete the characterization of the mal-union. Proper evaluation allows the surgeon to determine an effective treatment plan for deformity correction environment.<sup>[39]</sup> Mal-union of fractures particularly fractures of extremities, hamper the function of the limb and cause visible deformity also. For such mal-united fractures, Sushruta has told the principle of osteoclasia.<sup>[40]</sup> According to this principle the mal-united bones are re-fractured and treated just like the fresh fractures. This so important principle is still in practice today in modern science as such.

Medication or Adjuvant Therapy: Healing of the body tissues is a natural process and it can occur even in the absence of human assistance because every tissue has got a varied power of healing or repair.<sup>[41]</sup> But according to Ayurveda the process of healing can be influenced by so many factors. Healing can be accelerated by certain medications, appropriate diet and adopting recommended lifestyle. On the basis of Panch bhautika theory (theory of five basic elements), Rasa panchaka theory (Ayurvedic theory of five principles of drug actions), Dhatunirmaan theory (Ayurvedic theory of tissue nutrition) and Samanya vishesha theory (principle of similarity and dissimilarity), every event in the body may it be physiological or pathological can be altered by using external substances. On this basis various systemic and local formulations have been advocated in Ayurvedic texts. Few examples are:

Oral medication: At the morning time the boiled milk of primiparous cow mixed with Madhura Aushadha (herbal drugs of particular gana (group) named Kakolyadi Gana),<sup>[42]</sup> powder of Laksha (Lecca) and Ghrita (clarified butter) is given to the patients having skeletal injuries.<sup>[43]</sup> Powder of Arjuna (bark powder of *Terminalia arjuna* Linn), Laksha (Shellac powder), wheat (seeds of *Triticum aestivum*) and Asthishrinkhla (*Cissus quadrangularis* Linn) along with Ghrita (clarified butter) and milk is also given.<sup>[44]</sup> Combination of Rasona (garlic) and Laksha (Lecca) along with sugar, honey and Ghrita (clarified butter) is also useful. Certain formulations like Laksha Guggul and Abha guggul (Ayurvedic formulations) have also been advocated.<sup>[45,46,47,48]</sup>

Parenteral Medication: Bhagna (skeletal injuries) occurring in upper part of the body should be treated with Mastishkya (a type of Sirobasti or to keep a swab of cloth or cotton well soaked with oil over the head) injuries, Karanpurana (pouring of oil in the ear) and Nasya (nasal medication), and fractures of the extremities should be treated with Anuvasana Basti.<sup>[49]</sup>

For all these purposes Gandha Taila or Trapushadi Taila (Ayurvedic medicated oils) should be used.<sup>[50]</sup> Elsewhere in Yogratnakara for Bhagna (skeletal injuries) treatment Mahavishgarbha Tailamand Mahabala Tailam (Ayurvedic medicated oils) have also been advocated.

Local medication: Plenty of medications in the form of decoctions, pastes, oils or Ghritas (clarified butter) have been advocated for local use prior to the application of splints.

Dietetic Regimens for the patients having Bhagna (skeletal injury): Diet for a fracture patient should be well nutritious and balanced. For Sandhana (healing) purposes Guru, Snigdha, Sheeta and Kashaya properties (particular attributes) of Ahara (food) or Aushadha (drugs) substances are expected. Indicated diets are Shali variety of rice, meat soup (mansrasa), milk, ghee (clarified butter), soup of Satina (a specific pulse) and all other Brimhana (nutritious) food and drink items.<sup>[51]</sup>

Do's and Don'ts for Bhagna (skeletal injury) patients (avoidable diet and lifestyles): All food items containing Lavana, Katu, Kshara and Amla Rasa (particular tastes) and Ruksha guna (particular attribute of a substance) are contraindicated to Bhagna (skeletal injuries) patient. Direct exposure to sun, excessive exercises and sexual activities are also contraindicated.<sup>[52]</sup>

Criteria for Samyaka Bhagna Sandhana (clinical Features of ideal fracture union): In Sushruta Samhita a good clinical criteria of Bhagna Sandhana (fracture union) has been given viz. Anavidham (non-tender) means there should not be any pain or tenderness, Aheenangam (no shortening) means no shortening or gaping, Anulabnam (no swelling or deformity) means there should not be any irregularity or swelling and Sukhchestaprasara means full and pain free movements or full functional recovery.<sup>[53]</sup>

Factors influencing fracture healing: In Sushruta Samhita and other ancient Ayurvedic texts a cascade of factors influencing prognosis of fracture healing viz. age, physical status, nutritional status, type of bone involved, techniques of management, seasonal variables, Prakriti (Psycho-somatic constitution), anatomical factors etc. have been described. Judicious knowledge of these factors can improve the outcome of such injuries.

## CONCLUSION

In Ayurveda the principles of closed management of bone and joint injuries have nicely been mentioned (however, there is no reference of open reduction and internal fixation). The concept of Savrana Bhagna (open injuries) is unique in the sense that the management of wound has been given the priority over the Bhagna (skeletal injuries) and clinician should always strive to prevent infection at the injury site. Not only the technical management but other modalities like oral, parenteral and local medication, dietetic instructions and various other life style modifications have also been described. These drugs or formulations may enhance the fracture healing process as some scientific studies have proved these facts.

## REFERENCES

1. Ambikadatta Shastri, Ayurvedatvatvasandeeepika Hindicommentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/70, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan, Varanasi, 2014, p17-19.
2. Ambikadatta Shastri, Ayurvedatvatvasandeeepika Hindicommentary, Sushruta Samhita, Nidana Sthana, Chapter15/1, 3, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p376, 377.
3. Raja Radha Kant Deva, Sanskrit Dictionary, Shabdkalpadruma, 3rd edition 1967, Chaukhamba Sanskrit Sansthan Varanasi 1985, p 432.
4. Monier Williams, Sanskrit English Dictionary, 4th edition 1989, Motilal Banarasi Das publishers New Delhi, Reprint 1990, p. 389.
5. Ambikadatta Shastri, Ayurvedatvatvasandeeepika Hindicommentary, Sushruta Samhita, Nidana Sthana, Chapter15/4, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p377.
6. Shri Laxmipati Shastri, Vidyotini Hindi commentary, edited by Shri Brahmshankar Shastri, Yogratnakara, Uttarardha, Bhagnachikitsa/3, 8th edition, Chaukhamba Sanskrit Sansthan, Varanasi, 2004, p 190.
7. Knight KL. Cryotherapy in sports injury management, IntPerspect Physiotherapy 1989; 4:163.
8. Knight KL. Cryotherapy in sports injury management, IntPerspect Physiotherapy 1989; 4:163-185.
9. Knight KL, Brucker JB, Stoneman PD et al. Muscle injury management of Soft Tissue (Musculoskeletal) injury with Protection, Rest, Ice, Compression and Elevation (PRICE) during the first 64 hours, Chartist Society of Physiotherapy –London, 1999.
10. Hari Sadashiv Shastry Padarakara, Ashtanga Hridaya, Uttarsthana 27/20, Chaukhamba Sanskrit Sansthan, Varanasi; 2009, p 875.
11. Ambika datta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/47, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p31.
12. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/17-21, 34-35, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p28-30.
13. A Graham Apley, Louis S. Apley's System of Orthopaedics and fractures. 6th edition, English Language Book Society, Butterworths; 1985, p 339.
14. Ambikadatta Shastri, Ayurvedatvatvasandeeepika Hindicommentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/55-56, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p32.



15. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/7, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p27.
16. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/54,67-70, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p32-33.
17. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/5, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p27.
18. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/4, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p27.
19. A Graham Apley, Louis S. Apley's System of Orthopaedics and fractures. 6th edition, English Language Book Society, Butterworths; 1985, p 339.
20. Mohan Primlani, Dorland's Pocket Medical Dictionary, 23rd edition, published by Oxford & IHB Publishing Co; 1983, p589.
21. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/17-19, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p28.
22. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/28, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p29.
23. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/6,17,21, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p27, 28.
24. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/21, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p28.
25. Brahmanand Tripathy, Ashtanga Hridaya, Uttarthana 27/15, Chaukhamba Sanskrit Pratishtan, Delhi, 2003, p1087.
26. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/10 Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p27.
27. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/8, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p27.
28. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/48-50, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p31.
29. Ambikadatta Shastri, Ayurveda tatvasandeeepika Hindi commentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/35, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p30.
30. Mair A, Report of Sub-Committee of the Standing Medical Advisory Committee, Scottish Health Services Council, on medical re-habilitation. H.M.S.O. Edinburgh, 1972, p25.
31. Robert P Dunbar, Michael J. Gardner, Robert W. Bucholz, Charles M. Court Brown, James D. Heckman, Paul Tornetta, editors. Rockwood and greens Fractures in Adults. Vol.-I, 7th ed. Philadelphia, USA: Lippincott Williams & Wilkins; 2010; p283.
32. Gustillo R B, Simpson L Nixon R, Ruiz A, Indek W, Analysis of 511 open fractures. Clinical Orthopaedics, 1969, 66: p148.

33. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/14, 53, Reprint 2nd edition, Chaukhamba Sanskrit SansthanVaranasi, 2014, p28,32.
34. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Chikitsa Sthana, Chapter1,2, Reprint 2nd edition, Chaukhamba Sanskrit SansthanVaranasi, 2014, p1-27.
35. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Sutra Sthana, Chapter14/37, 38, 44, Reprint 2nd edition, Chaukhamba SanskritSansthan Varanasi, 2014, p72,73.
36. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Chikitsa Sthana, Chapter2/23-27, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p20,21.
37. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Chikitsa Sthana, Chapter3/14, 53, Reprint 2nd edition, Chaukhamba Sanskrit SansthanVaranasi, 2014, p28,32.
38. Monika Guleria, Kuldeep R. Choudhary, Sanjeev Sharma.An Ayurvedic appraisal on concept of wound healingmechanism. Int. J. Res. Ayurveda Pharma. Jan-Feb 2016; 7(Suppl 1): p11-16.
39. Robert P Dunbar, Michael J. Gardner, Robert W. Bucholz,Charles M. Court Brown, James D. Heckman, Paul Tornetta,editors. Rockwood and greens Fractures in Adults. Vol.-I,7th ed. Philaladelphia, USA: Lippincott Williams & Wilkins;2010; p664.
40. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Chikitsa Sthana, Chapter2/52, Reprint 2nd edition, Chaukhamba Sanskrit SansthanVaranasi, 2014, p31, 32.
41. J.N. Wilson, editor, Watoson and Jones Fractures and Jointinjuries, Vol. I, 6th edition (1st Indian edition), B.I. ChurchilLivingston Pvt. Ltd. New Delhi, 1992, p 15.
42. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Sutra Sthana, Chapter38/35, 38, 44, Reprint 2nd edition, Chaukhamba SanskritSansthan Varanasi, 2014, p186.
43. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Sutra Sthana, Chapter 3/13,Reprint 2nd edition, Chaukhamba Sanskrit SansthanVaranasi, 2014, p28.
44. Deepanshu Kumar, Suman Sharma, Sanjeev Sharma andVK Gupta, Effect of Asthishrinkhla Kanda Swarasa (CissusQuandrangularis Linn) as Fracture Healing Herb inExperimental Rat Model, The Journal of Research andEducation in Indian Medicine; July-Dec, 2011, p 75-81.
45. Kaviraj Ambikadatta Shastri, editor, Bhaishyaratnavali,Bhagnarogchikitsaparakarnam, 49/113-14, Published byChaukhamba Prakashan, Varanasi 1st edition – Reprint2013, p 859.
46. The Ayurvedic Formulary of India, Govt. of India, Dept. ofAYUSH, Part-I, 2nd revised edition, Group No. 5 Gugglu;2000, p70.
47. Ramesh Kaundal, Suman Sharma, Sanjeev Sharma and VKGupta, Analysis of the Effect of Laksha Guggulu (AnAyurvedic Formulation) on Fracture Healing in a Rat Model,The Journal of Research and Education in Indian Medicine,Jan-March, 2014; p 1-8.
48. Kaviraj Ambikadatta Shastri, editor, Bhaishyaratnavali,Bhagnarogchikitsaparakarnam, 49/113-14, Published byChaukhamba Prakashan, Varanasi 1st edition – Reprint2013, p 860.

49. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Sutra Sthana, Chapter 3/54, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p32.
50. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Sutra Sthana, Chapter 3/54, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p32.
51. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Sutra Sthana, Chapter 3/5, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p27.
52. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Sutra Sthana, Chapter 3/4, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p27.
53. Ambikadatta Shastri, Ayurvedatatvasandeeepika Hindicommentary, Sushruta Samhita, Sutra Sthana, Chapter 3/70, Reprint 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi, 2014, p33.

