

FRACTURE HEALING AND AYURVEDA: A REVIEW OF CURRENT AYURVEDIC DRUGS FOR TREATING FRACTURES

Neha Verma¹, Ankita Wal^{1*}, Pranay Wal¹, Ankur Agrawal², Pulagurtha Bhaskararao³, Pradeep Lalasaheb Bodake⁴

1. *Pranveer Singh Institute of Technology (Pharmacy), Kanpur, UP, India.*
2. *Jai Institute of Pharmaceutical Sciences and Research, Gwalior, MP, India.*
3. *Aditya Pharmacy College, Surampalem-533437, JNTU Kakinada-A.P., India.*
4. *S. B. Patil College of Pharmacy, Vangali, Indapur, India.*

ARTICLE INFO

Received:

28 Sep 2023

Received in revised form:

24 Jan 2024

Accepted:

03 Feb 2024

Available online:

28 Feb 2024

Keywords: Fracture, Asthi, Bhagna, Ayurveda, Hematoma, Trauma

ABSTRACT

A fracture is a crack or rupture in the body's bones. These are typical in those who do sports or stunts. Low bone density increases the risk of fracture. Traumatic events like injuries, accidents, or fights cause them. The bone break produces intense pain, inflammation, numbness, and tingling. It may potentially cause paralysis. The bone should be treated quickly if it is fractured. Ayurveda promotes bone strength and well-being to promote rapid mending of fractures. The goal of this research is to examine the current ayurvedic drugs that have been shown to be beneficial in the treatment of fractures. Several sources were used to acquire the material, including review articles published in various publications that had keywords such as fracture, Asthi, Bhagna, ayurveda, hematoma, and so on. The information was also gathered from the Internet. Ayurveda provides natural methods for quick fracture recovery. Various ayurvedic products have been produced that help in the acceleration of the healing process with minimal negative effects as compared to conventional medical treatment. The mending of a fracture is a complicated physiological action that occurs in four stages that overlap: hematoma development, swelling, healing, and remodeling. It is a time-consuming procedure, and modern medication has several negative side effects. It is shown in this research that the use of ayurvedic medications for treating fractures may shorten the healing time while simultaneously increasing bone density.

This is an open-access article distributed under the terms of the [Creative Commons Attribution-Non Commercial-Share Alike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non commercially, as long as the author is credited and the new creations are licensed under the identical terms.

To Cite This Article: Verma N, Wal A, Wal P, Agrawal A, Bhaskararao P, Bodake PL. Fracture Healing and Ayurveda: A Review of Current Ayurvedic Drugs for Treating Fractures. *Pharmacophore*. 2024;15(1):65-74. <https://doi.org/10.51847/lxjA73ISbg>

Introduction

Bones are a kind of tissue that has a very complicated metabolism as well as a high capability for healing itself. However, there are certain cases, such as congenital deformities, trauma, infectious diseases, and surgery, under which this tissue is difficult to heal on its own, and it is necessary to use a variety of treatments to cure the bone damage [1, 2].

A fracture is described as a total or partial detachment of the bone's continuity [3]. Fracture restoration is a complicated physiological event that includes the combined engagement of hematopoietic and immunological cells in the bone marrow [4, 5]. The fundamental concepts of fracture treatment are bone reduction, immobilization, and regeneration. Immobilization is beneficial for preventing the fractured pieces from moving or angling [6].

Direct fracture and indirect fracture repair are two fundamental forms of bone formation. Primary (direct) fracture recovery is characterized by relatively little callus development [7]. Primary recovery occurs seldom since the majority of fracture heals are secondary or indirect [8]. Secondary fracture recovery takes place in four concurrent stages, according to histological studies: hematoma formation, first inflammatory response (which lasts 2 to 4 weeks), mending (which involves proliferation and differentiation within a month or two), and late remodeling (months or years) [9]. Fractures have a significant clinical effect. Following a fragility fracture, there will be significant discomfort, impairment, and deformity. If the fracture does not heal properly, the sufferer may experience long-term impairment. Other known consequences include degenerative joint condition distal to the fracture and reflex sympathetic dystrophy [10]. In addition, the expense of

Corresponding Author: Ankita Wal; Pranveer Singh Institute of Technology (Pharmacy), Kanpur, UP, India. E-mail: walankita@gmail.com.

treatment procedures to treat bone abnormalities is continually growing, resulting in a considerable reduction in the patient's standard of life.

Ayurveda has been the founder of all global medicines since man first considered offering an appropriate solution to his illnesses. Matter and energy exist in all living creatures in the combination of Dosha, Dhatu, and Mala; however, the main vital supporting system of the body is Asthi (Bone tissue). The goal of orthopedic surgery is to "ensure stable mechanical function of the malformed bones." During the Vedic time, Ashwini Kumaras performed surgery such as limb replacement and head fixation. This aspect of the therapy in Ayurveda is called BhagnaChikitsa, and it was created, performed, and carefully recorded by the 'famous Indian sage the Acharya Sushruta.' Acharya Sushruta and others have extensively documented the etiology, clinical features, categorization, and care of numerous traumatic musculoskeletal diseases (soft tissue injuries, subluxations, dislocations, fractures, and so on) [11]. Ayurvedic system also includes a variety of plant spices that are used in the management of fracture healing.

Substances found in plant species, such as phytochemicals, vitamins, and a multitude of other nutrients, have been known to cure and prevent illness since ancient times. These components were used to cure illnesses as well as to prevent a variety of diseases. Bone fractures that are caused by injury, infection, or tissue inflammation may be repaired by the proliferation and regeneration of cells, which are cell-based processes. Plants may contain compounds that, in addition to promoting bone recovery, may also reduce bone loss by suppressing osteoclast cells, increasing osteoblast cell proliferation, and decreasing inflammatory processes, without generating the severe adverse effects associated with synthetic drug treatments [12-16].

The Impact of Trauma on Asthi (Bones)

Bhagna is created from the words bhanj-dhatu and Katupratyaya, both of which signify break. Bhanj implies motion, which further indicates breaking. Trauma to the bones manifests itself in several ways. Acharya Susruta paid close attention to this issue and discovered that not all bones have the same sort of damage response [17]. He then divided these impacts into several categories and associated them with the kinds involved, as shown below

- Tarunasthi (Cartilage) – Bend
- Nalkasthi (Long bones) –Break
- Kapalasthi (Flat bones) – Crack
- Ruchkasthi (Teeth) – Fragmented
- Valayasthi (Curved bones) - Crack

Classification of Fracture According to Ayurveda

Susruta's, Madhavakara's, Chakradatta's, Bhavaprakash's, and Gadanigraha's classifications of Bhagna (meaning to break) are similar. Vagbhata has a different point of view on this. Charaka has not been assigned a classification.

Susruta's Classification

Skeletal injuries are classified into two groups based on the structure damaged [18].

- Sandhimukta (Joint Dislocation)
- Kandabhagna. (Bone Fracture)

Vagbhata's Classification

Vagbhata has used several terminologies to describe the same categorization [19], such as -

- Sandhibhagna
- Asandhibhagna.

Madhukoshvyakhya Classification

Aside from these categories, Madhukoshvyakhya further categorized the Bhagna based on their clinical manifestations [20] as follows:

- SavranaBhagna (compound fracture)

Breakage of bone associated with the wound, i.e., bone that emerges from the site soon after damage [21].

- AvranaBhagna (closed fracture)

When a bone is broken yet there is no apparent wound on the skin

Clinical Features of Kandabhagna (Bone Fracture)

History and clinical symptoms might reveal the existence of a fracture. The clinical indicators reported in Ayurvedic texts are the same as those presented in any current medical textbook. Susruta's work in this regard is so flawless that it leaves little space for improvement even now. He also described effects and symptoms as both common as well as specific qualities (**Figure 1**).

Shvyathubahulyam (Marked Inflammation) -a hairline or comminuted fracture will usually be accompanied by mild to serious inflammation.

Sparshasahisnutvam (Tenderness) - tenderness is a common symptom that may be seen in many kinds of cracks in bone without exception.

Avapidyamaneshabda (Crepitus) - the occurrence of crepitus is a clinically confirmed indication of cracks in bones.

Vividhavedanapradurbhavah (Different Varieties of Pains) -The broken bone creates a variety of pains until it is reduced and immobilized, this is dependent on the form of the trauma, the number of bone fractures, the displacements of the pieces, and the type of the soft tissue damage sustained.

SarvasuAvasthasu Na Sharmalabha (Having Difficulty Finding Relaxation in Any Posture) - A crack in the bone causes ache and discomfort to the sufferer until the fracture is immobilized. The pain is such that the sufferer feels restless in any position in which the broken component is present [22].

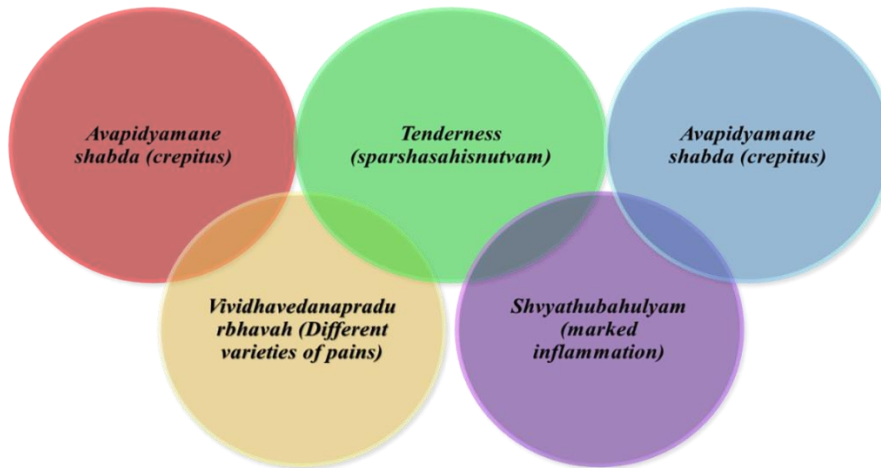


Figure 1. Clinical features of Kandabhagna

Complications (Upadrava)

The complications of a bone injury have been described by Acharya Dalhana as local and systemic [23] (**Figure 2**).

Local complications Malunion and fracture fragmentation are two local consequences. Swelling, discomfort, and vascularisation, which may lead to gangrene, are some of the complications that can arise as a result of heavy bandaging. systemic complications Fever, abdominal discomfort, and the cessation of excreta routes such as urine and feces are examples of systemic problems.



Figure 2. Complications emerge at various stages of the fracture healing process

Four Principles of Avurvedaare Used in the Healing of Bone

Ayurvedic principles are applied in the treatment of fractures in four ways (**Figure 3**).

- Anchan- the act of applying traction.
- Pidana- Local pressure adjustment.
- Sankshep- Opposition and stability of a shattered bone segment.
- Bandhan- Immobilization [24].

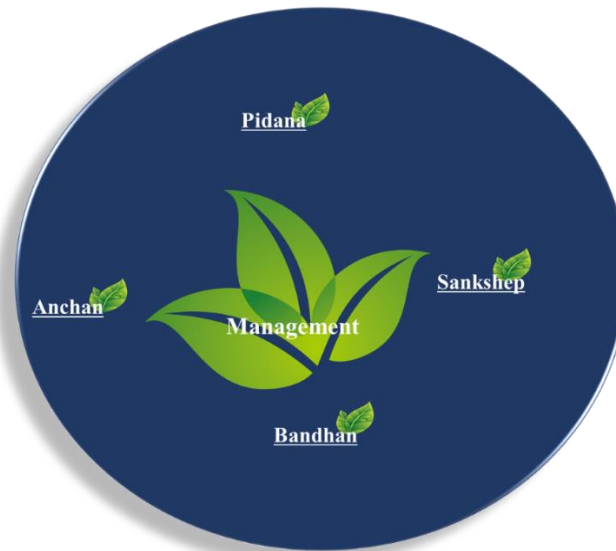


Figure 3. Ayurveda uses four principles to treat fractures

Sushruta established the theory of fracture reduction, which is being used today. He believes that the doctor should first apply pressure to both sides of the fragments (Anchana), then raise the depressed pieces (Peedana). By adjusting the dislocated parts independently, they should be brought into direct connection with one another. (Sankshepana). These four concepts focus on achieving appropriate alignment of shattered fragments prior to complete immobilization (Bandhana).

Immobilization: One of the most important approaches in healing is the effective immobilization of the fractured limb, and Sushruta has properly detailed the use of splints for this phase. He has been chosen several significant tree barks for this reason. He has been advised to use tree bark such as *Ficus religiosa*, *Bambusa*, *Terminalia Arjuna*, and others for support [25].

Initial Management

Yogratnakara has recommended that cold water should be sprayed on the damaged region as a first aid technique, followed by the application of a layer of mud soon after the incident or upon becoming aware that Bhagna (skeletal injury) has occurred [26]. However, this method is only appropriate in the case of Avrana (closed injuries) kind of Bhagna (skeletal injuries). In the management of general trauma and sports injuries, the use of cold water or ice packs is a very effective technique that is still extensively used today [27]. When a body is injured, different pathophysiological mechanisms and the metabolic response of the body to the trauma are triggered almost instantly. The bleeding from the damaged arteries, which results in rapid local swelling, the activation of pain receptors, which results in discomfort at the wounded location, the rise in local metabolic rate, and the induction of the sterile inflammatory response are all very significant. Immediate use of cold water or an ice pack to the damaged areas reduces hemorrhage and swelling in the region, resulting in decreased blood loss and swelling [28].

Ayurvedic Management of Different Kinds of Fracture

AvranaBhagna (Closed Skeletal Injuries)

BhagnaSthapana (Reduction)

This is the fundamental concept of fracture treatment, and it has been carried out when it is necessary. It refers to the repair of fractured parts or a displaced joint to their locations after a fracture or dislocation. It has been emphasized by Acharya Sushruta in particular that the methods of closed reduction should be practiced through the application of different forces such as Aanchhana (traction), Peedana (compression), Sankshepana (reduction and compression), as well as Unmanna (pulling upwards) and Vinmanna (pressing downwards), among others [28].

Bandhana (Immobilisation)

It is necessary to immobilize or stabilize the injured area until the damage has healed or the fractured fragments have become sticky after the injury has been repaired. Two types of immobilizations have been promoted for this purpose: Kusha and Bandhana (Splintage or external immobilization) and KapaatShayana (fracture bed).

Sukhchestaprasara (Physiotherapy)

This is important to return the injured portions of the body to their pre-injury state as soon as possible, primarily through strengthening the bones and soft tissues. Slowly raising weight bearing has been described in the SushrutaSamhita for the treatment of cracks in the bones of the palm (metacarpals) [29]. In order to regain stability, the sufferer first holds Mritpinda (a lump of clay), then Lavana (salt), and last Pashana (a piece of stone) in his hand.

SavranaBhagna (Open Fractures)

They are skeletal injuries that are linked with a wound over the damaged region, and they are termed "open" (formerly "compound") fractures. These were characterized as damages in which the soft tissue that envelops the fracture is ruptured, allowing the deeper bone to connect with the external area [30]. A specialized treatment strategy is required for such injuries, which offer a high risk of infection. In these situations, tissue care and therapy to maintain healthy soft tissue and skin cover continue to be the top focus. If a fracture is open, the major goal of treatment is to bring the fracture together while also preventing or eliminating wound infection [31].

When Sushruta addressed the healing of open fractures, he understood the importance of this element, suggesting that the lesion should be cleansed using decoctions coupled with a proper quantity of Ghrita (clarified butter) and Madhu (honey) [32].

Vishmolvana Samhita Bhagna (Mal-united Fractures)

Mal-union of fractures, especially fractures of the extremities, impairs limb function and causes visual deformity. Sushruta explained the theory of osteoclasia for such misaligned fractures. According to this theory, mal-united bones are re-fractured and treated in the same way as new fractures. This fundamental notion is still used in current science today [33].

Treatment with Medication or Adjuvant Therapy

Many things may impact the healing process, according to Ayurveda. Certain drugs, a proper diet, and following the appropriate lifestyle may all help to speed up the healing process. The Panchbhautika theory (theory of the five basic elements), the Rasa panchaka theory (Ayurvedic theory of five principles of drug actions), the Dhatunirmaan theory (Ayurvedic theory of tissue nutrition), and the Samanyavishesha theory all hold that external substances can influence any event in the body, whether physiological or pathological (principle of similarity and dissimilarity). Ayurvedic texts have suggested a number of different ways to treat this problem, both on a systemic level and on a local level. Here are a few examples:

Oral Medication

Patients suffering from skeletal injuries are given boiling milk from a primiparous cow combined with Madhura Aushadha (herbal medications from a specific gana (group) called KakolyadiGana) [33]. First thing every morning, take a powder of Laksha (Lecca), and Ghrita. Arjuna powder, Laksha powder wheat (seeds of *Triticumaestivum*), and Asthishrinkhla (*Cissusquadrangularis* Linn) are also included, as well as Ghrita (clarified butter) and milk [34].

Parenteral Therapy

Bhagna (skeletal injuries) found in the top part of the body must be handled with Mastishkya (put cotton well immersed in oil over the head injuries), Karanpurana (putting oil into the ear injuries), and Nasya (nasal therapy).

Local Medication

Before the implantation of splints, a variety of remedies, including decoctions, pastes, oils, and Ghritas (clarified butter), were suggested for local use.

Dietary Recommendations from Ayurveda during the Healing of a Fracture

The sufferer should take meals that are nutritious to the body and do not cause heartburn, such as rice, ghee, meat juice, milk, and so on, in appropriate proportions. This is true even in current orthopedics, where calcium-rich meals such as milk and meat are recommended to aid in the healing of fractures. According to the Bhavaprakasha, Avidahiannam, and pishtaannam (items that are difficult to digest) are also prohibited from consumption.

In such conditions, lavana [salty], katuka [pungent], kshara [alkaline], amla [sour], maithunam [copulation], aathapaseva [exposure to sunshine], ruksha [dry meals or non-fatty foods] are not recommended [35].

The Importance of Plants in Ayurvedic Fracture Treatment

Different types of plants are used in Ayurvedic medicine to treat fractures and other injuries each plant shows a variety of mechanisms (**Table 1**).

According to current estimates, around 80% of people in underdeveloped nations still depend on ancient medicine, which is mostly based on herbs and wildlife spices, for their primary medical care. A growing number of people are turning to herbal remedies, and their popularity is growing by the day. Because of their efficacy, few complications, and comparatively cheap, Medicinal herbs are often favored over pharmaceutical treatments. It also has great potential in the global segment. Herbal remedies are expected to grow at a rate of 20% each year, according to estimates. In response to some of the negative side effects or ineffectiveness of modern medicine, the therapeutic benefit of herbal remedies has attracted the attention of medical researchers, who are now turning to herbal remedies for the cure of some serious illnesses, such as osteoporosis [36] and bone fractures.

The word "Ayurveda" may be described as "lifespan knowledge (Veda)" or "lifestyle knowledge" (ayu). However, this information has been preserved in ancient Indian literature, which is referred to as the Veda collectively [37].

In the search for new active metabolites, compounds derived from plants are a valuable source of information. Many researchers have focused their attention on compounds obtained from nature because they have the potential to enhance bone regeneration processes while also avoiding negative side effects. Because of the existence of antioxidant and anti-

inflammatory qualities, these chemicals may have a variety of particular pharmacological actions on osteoclast activity and differentiation, which may help to improve the overall health of the bone [38].

Bone-cell growth was increased by *Gendarus vulgaris* ethanol extract, whereas *Drynaria quercifolia* was shown to have no impact on bone-cell growth in rat bone marrow stroma cells [39]. Herbal extracts have also been shown to promote the growth of osteoblast-like cells [40].

Table 1. Different parts of the plant are employed in the healing of bone fractures.

Plant	Part used	System
<i>Ficus religiosa</i>	Young bark and stem bark	Ayurveda
<i>Cissus quadrangularis</i>	Stems	Ayurveda
<i>Cryptolepis buchananii</i>	Stems and leaves	Ayurveda
<i>Aloe vera</i>	gel and latex	Ayurveda
<i>Crocus sativus</i>	Stigma	Ayurveda
<i>Curcuma longa</i>	Rhizome and tuberous	Ayurveda
<i>Bambusaarundinacea</i>	stems and leaves	Ayurveda
<i>Terminalia arjuna</i>	Bark	Ayurveda
<i>Psoralea corylifolia</i>	Seeds and flowers	Ayurveda
<i>Achyranthes bidentata</i>	Roots	Ayurveda

Ficus religiosa

In Ayurvedic culture, the young bark of *Ficus religiosa* (family: Moraceae) has long been used to treat fractured bones [41].

Action: It has been shown that the leaf extract of *F. religiosa* contains significant concentrations of tannins, phenols, triterpenoids, glucosides, and sterols. Flavonoids, steroids, and tannins have all been shown to have analgesic and anti-inflammatory properties. There has been evidence that excessive releases of nitric oxide (NO) may have detrimental consequences on tissue damage and inflammation. Several studies have shown that tannic acid and polyphenols are effective inhibitors of NO synthetase activity and NO generation, which is independent of their antioxidant properties. As a result, the reported properties such as reducing swelling and analgesic effects are due to the tannin concentration of this plant [42].

Cissus quadrangularis

Cissus quadrangularis (family: Vitaceae), is an Indian herb that has been used for thousands of years [43]. It has been shown to accelerate the recovery phase in dogs with experimentally broken radius-ulna fractures, as shown by radiographic and histological investigations [34].

Action: *Cissus quadrangularis* contains a significant amount of anabolic steroidal compounds, as well as calcium and phosphorus. The steroidal compounds derived from *C. quadrangularis* have been found to have a significant impact on the rate of fracture healing as well as increase the mineralization of the callus [44].

Cryptolepis buchanani

Cryptolepis buchanani (Ganglong, Asclepiadaceae) is a climbing tree that is frequently utilized in Southeast Asian traditional remedies. And it has historically been used to cure broken bones.

Action: *Cryptolepis buchanani* have antimicrobial properties [45]. *Cryptolepis buchanani* extract has been demonstrated to have analgesic, swelling-reducing, and chondroprotective effects. The stem of *Cryptolepis buchanani* has been shown to reduce muscular and joint discomfort. Depending on the type of fracture, various portions of the herb are employed in certain ways, such as local treatment and systemic usage [46].

Aloe vera

Aloe vera is a medicinal herb that has been used to treat many ailments since ancient times and belongs to the Liliaceae family.

Action: The active ingredients in this plant include anthraquinone, polysaccharides, superoxide dismutase, glycoprotein, lectin, vitamins C and E, and minerals, which have anti-inflammatory and wound-healing properties [47].

It also contains the proteins (alloktin), that stimulate the progenitor osteoblasts from skeletal stem cells, increase osteoblast cell differentiation, stimulate Activator of Nuclear Kappa B Ligand (RANKL) signaling, increase Vascular Endothelial Growth Factor (VEGF), Bone Morphogenic Protein (BMP), and osteoprotegerin (OPG), and inhibit osteoclast genesis in order to accelerate bone remodeling process [48].

Crocus sativus

It is a blooming plant belonging to the genus *Crocus*, and it is often referred to as Saffron crocus. *Crocus sativus* is also widely used in folk medicine to treat a broad range of diseases, including as an antispasmodic, expectorant, stomachic, aphrodisiac, and emmenagogue [49].

Action: Crocin, the primary constituent of saffron, is a water-soluble carotenoid with significant health advantages [50].

Crocin may also protect against bone diseases such as osteosarcoma and articular cartilage degradation, according to new research. This is because crocin is antioxidative, which means that it can help repair damaged cartilage and keep bones from weakening because of oxidative damage and inflammation [51] also shows an anti-inflammatory effect [52].

Curcuma longa

Curcumin has long been used in herbal medicine due to its many pharmacological effects [53]. Although research on the use of curcumin in bone damage therapy has been limited, findings show that curcumin may have a positive impact on bone remodeling [54].

Action: Curcumin is the main constituent of turmeric. Curcumin treatment was shown to reduce the concentration of numerous proinflammatory cytokines such as IL-1, IL-2, IL-6, TNF-, and MIP1[55]. as well as NF-B activity, resulting in a reduction in inflammatory processes [56].

Bambusa arundinacea

Bambusa arundinacea (Bamboo, family Poaceae), popularly referred to as bamboo, is a plant that helps to reduce swelling, which in turn aids in the repair of fractures.

Action: It contains benzoic acid, traces of cyanogenic glycoside, and silicon compounds, all of which aid in the healing of fractures. In addition, it contains calcium, phosphorus, and zinc. Fracture healing is accomplished by the administration of a paste made from stems or leaves by orally or application to the skin of the paste [57].

Terminalia arjuna

The plant *Terminalia arjuna* is a member of the Combretaceae family. Its ayurvedic virtues and many applications were discussed in the Charaka Samhita and the Ashtang Hridayam. According to Charakdatta, the consumption of arjuna with milk is beneficial in treating illnesses such as heart problems, upset stomach, pyrexia, hemorrhages, and bleeding as well as fractures and associated injuries [58].

Action: Because of its astringent properties, it aids in the healing and joining of wounds. The bark paste is applied topically to wounds and ulcers, and it is very effective in facilitating the alliance of fractures. it also contains Anabolic steroids that promote fracture healing [59].

Psoralea corylifolia

It is a vital plant in the Tamil (Indian), as well as Chinese medicine and Indian Ayurvedic systems of medicine. It is also known as Vakuchu in India and is a member of the Fabaceae family.

Action: Psoralen (PSO) is an active chemical found in *P. corylifolia* extract that stimulates the production of new bone tissue. *P. corylifolia* is also used as a tonic and food additive in Chinese medicine to treat joint problems, bone fractures, leukoderma, and psoriasis, among other ailments. *P. corylifolia* seeds show properties of inhibiting oxidation, reducing swelling, and antibacterial effects [60].

Achyranthes bidentata

It is a member of the Amaranthaceae family and is frequently known as Chaff-flower. It is widespread across the tropical globe. *A. bidentata* contains active phytoconstituents such as oleanolic acid glycosides, saponins, ecdysterone, ketosteroids, and flavonoids, which have benefits such as liver and kidney improvement, bone and muscle strengthening, improving blood flow with the discharge of blood stasis, and greater durability [61-63].

Action: *A. bidentata* has five unique oleanolic acid glycosides that have bone-stimulating activities by blocking the production of osteoclasts. The flavonoid quercetin found in *A. bidentata* has been shown to inhibit osteoclast development [64].

Recent Ayurvedic Products used in Bone Healing Treatment

Several plant-derived drugs, including Boniheal Tablet, Ossigen Capsule, and Hadjod, have been documented and used in Ayurvedic medication for the treatment of fractures [65] (**Figure 4**).

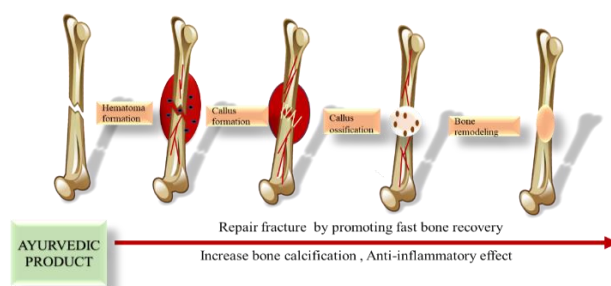


Figure 4. Effect of different ayurvedic products on fracture healing

Boniheal Tablet

It is a Phyto-Mineral Ayurvedic medication used to cure fractures and other bone problems. It supports bone strength and

aids in the maintenance of proper bone density. This Ayurvedic herb aids in the repair of fractures by promoting quicker bone recovery. It also has the additional effect of increasing osteoblastic function and promoting bone calcification. Boniheal tablets are prepared from plants and minerals that have been organically collected. Natural calcium, magnesium, and other minerals abound in its potent ingredients.

Ossigen Capsules

They are a natural Ayurvedic solution that helps to mend fractures while also strengthening bone structure. It stimulates the production of osteoblasts, which are responsible for the build-up of calcium in the bones. Ossigen Capsules are well-known for their effectiveness and safety. They are the most often used kind of medication for bone regeneration. This Ayurvedic medication boosts growth hormone and raises blood calcium levels. Ossigen Capsule is most often used to cure fractures, osteoporosis, and osteopenia.

Hadjod

Hadjod are Ayurvedic tablets, that help in the strengthening of bones and the recovery of fractures. It possesses anti-inflammatory effects that are beneficial in the treatment of fracture pain. Hadjod is a natural compound that is both safe and efficacious. It is most often prescribed for bone and joint health.

Conclusion

Fracture healing is a complicated physiological action that involves four continuous stages. Hematoma production, swelling, recovery, and remodeling are the four overlapping stages of the fracture healing process. As a complicated condition, fracture demands a strategy that is both logical and comprehensive in order to be effectively managed. Various drugs are being recommended for the healing of bone fractures and other bone-related consequences, having varying degrees of success in various studies. Extensive safety considerations are paramount in therapy since currently available medications (bisphosphonates, pain relievers, and anti-inflammatory pharmaceuticals) in treating bone fractures are linked with several negative side effects. Ayurvedic treatment, as well as medications and their respective phytoconstituents, have a significant potential function in modifying bone health, as well as in improving the recovery time of bone formation and significantly reducing inflammation. These phytoconstituents have many benefits over current conventional pharmaceutical formulations, including a lower cost and fewer unwanted side effects. These features of phytoconstituents make them acceptable for use in herbal medications as alternatives to many existing synthetic treatments in the industry, that are expensive and associated with negative effects.

Acknowledgments: This review essay was inspired by the pharmacy professors at PSIT, and I am thankful to them for their support.

Conflict of interest: None

Financial support: None

Ethics statement: None

References

1. Borgiani E, Duda GN, Checa S. Multiscale modeling of bone healing: Toward a systems biology approach. *Front Physiol.* 2017;8:287.
2. Majidinia M, Sadeghpour A, Yousefi B. The roles of signaling pathways in bone repair and regeneration. *J Cell Physiol.* 2018;233(4):2937-48.
3. Piermattei DL, Flo GL, Brinker WO. *Handbook of small animal orthopedics and fracture treatment.* WB Saunders; 1990.
4. Gullberg B, Johnell O, Kanis JA. World-wide projections for hip fracture. *Osteoporos Int.* 1997;7(5):407-13.
5. Li X, Quigg RJ, Zhou J, Ryaby JT, Wang H. Early signals for fracture healing. *J Biochem Cell Biol.* 2005;95(1):189-205.
6. Adams JC, Hamblen DL. Outline of fractures: Including joint injuries. In *outline of fractures: Including joint injuries* 1999 (pp. 324-324).
7. Giannoudis P, Tzioupis C, Almalki T, Buckley R. Fracture healing in osteoporotic fractures: Is it really different? A basic science perspective. *Injury.* 2007;38(1):S90-9.
8. Jahagirdar R, Scammell BE. *Principles of fracture healing and disorders of bone union.* Surgery (Oxford). 2009;27(2):63-9.
9. Harwood PJ, Newman JB, Michael AL. (ii) An update on fracture healing and non-union. *Orthopa Trauma.* 2010;24(1):9-23.
10. Riggs BL, Melton III LJ. The prevention and treatment of osteoporosis. *N Engl J.* 1992;327(9):620-7.

11. Kaur V, Upadhyay S. Study of trauma on asthiwsr to asthibhagna. *Int J Res Ayurveda Pharm.* 2021;9(5):98-102.
12. Fernandes EE, Pulwale AV, Patil GA, Moghe AS. Probing regenerative potential of *Moringa oleifera* aqueous extracts using in vitro cellular assays. *Pharmacogn Res.* 2016;8(4):231.
13. Hasan NM, Al Sorkhy MK. Herbs that promote cell proliferation. *Int J Herb Med.* 2014;1(6):18-21.
14. Siddiqui S, Arshad M. Osteogenic potential of *punica granatum* through matrix mineralization, cell cycle progression and *runx2* gene expression in primary rat osteoblasts. *Daru.* 2014;22(1):72.
15. Konar N. Non-isoflavone phytoestrogenic compound contents of various legumes. *Eur Food Res Technol.* 2013;236(3):523-30.
16. Sharan K, Mishra JS, Swarnkar G, Siddiqui JA, Khan K, Kumari R, et al. A novel quercetin analogue from a medicinal plant promotes peak bone mass achievement and bone healing after injury and exerts an anabolic effect on osteoporotic bone: The role of aryl hydrocarbon receptor as a mediator of osteogenic action. *J Bone Miner Res.* 2011;26(9):2096-111.
17. Belorkar G, Pawar KV, Pasarkar PM. Conceptual study of asthibhagna in relation to ayurvedic and modern views. *Himal J Health Sci.* 2020;5(4):69-73.
18. Shivhare U, Shekhar M, Shailendra, Singhal T. Orthopaedics in ayurveda - BhagnaChikitsa- A review. *Ayushdhara.* 2021;8(6):3712-6.
19. Shastri PHS. *Astanga Hrdaya - A compendium of the Ayurvedic system of Vagbhata with the commentaries of Sarvangasundara of Arunadatta & Ayurvedarasyana of Hemadri.* Varanasi: Chaukhamba Surbharati Prakashan; 2016.
20. Meulenbeld GJ. *The mādhanidāna: With 'madhukośa', the commentary by Vijayarakṣita and Śrīkaṇṭhadatta (Chapters 1-10).* Delhi: Motilal Banarasisdass; 2008.
21. Sharma S, Sharma S, Singh M. Fracture management principles in Ayurveda with current interpretation: A review. *Int J Res Ayurveda Pharm.* 2016;7(4):14-9.
22. Sharma P.V. *Susruta-Samhita with Dalhana's commentary along with critical notes.* 5th Ed. Chaukhambha visvabharati, Varanasi; 1992.
23. Acharya VYT. *Susruta Samhita nibandhasangraha commentary Sri dalhanacharya.* Chaukhamba Surbharati Prakashan; 2014.
24. Nandurkar ND, Shahane VC. An insight of Asthisharira according to Ayurveda. *Int J Ind Med.* 2021;2:20-2.
25. Jamnik AA, Pirkle S, Chacon J, Xiao AX, Wagner ER, Gottschalk MB. The effect of immobilization position on functional outcomes and complications associated with the conservative treatment of distal radius fractures: A systematic review. *J Hand Surg Glob Online.* 2021;4(1):25-31.
26. Knight KL. Cryotherapy in sports injury management. *Human Kinetics. J Athl Train.* 1996;31(3):277.
27. Anantkumar S, Borkar K. Ayurveda approaches towards the management of sport injury WSR to sport medicine. *Himal J Health Sci.* 2018;3(3):5-8.
28. Block JE. Cold and compression in the management of musculoskeletal injuries and orthopedic operative procedures: A narrative review. *Open Access J Sports Med.* 2010;1:105-13.
29. Rockwood CA. *Rockwood and Green's fractures in adults.* Lippincott; 1991.
30. Gustilo RB, Simpson L, Nixon R, Ruiz A, Indeck W. Analysis of 511 open fractures. *Clin Orthop Relat Res.* 1969;66:148-54.
31. Basumatary K, Bhatta C, Boro V. A brief mention of kaya chikitsa (general medicine) in susrutasamhita by Maharshi susruta. *Ayushdhara.* 2018;5(2):1657-63.
32. Muley RS, Vishwakarma VN. Understanding the concept of meda dhatu (adipose tissue) through Ayurveda classic. *World J Pharm Res.* 2021;11(1):2057-65.
33. Yadavji T. *Hindi commentary, Sushruta Samhita, Sutra Sthana.* 2nd edition, Chaukhamba Sanskrit Sansthan Varanasi; 2014. pp.1-907.
34. Brahmkshatriya HR, Shah KA, Ananthkumar GB, Brahmkshatriya MH. Clinical evaluation of *Cissus quadrangularis* as osteogenic agent in maxillofacial fracture: A pilot study. *Ayu.* 2015;36(2):169-73.
35. Abd Jalil MA, Shuid AN, Muhammad N. Role of medicinal plants and natural products on osteoporotic fracture healing. *Evid Based Complement Alternat Med.* 2012;2012:714512.
36. Nader T. *Human physiology: Expressions of Veda and the Vedic literature.* 2001.
37. Barbalho SM, Araújo AC, Penteadó Detregiachi CR, Buchaim DV, Guiguer ÉL. The potential role of medicinal plants in bone regeneration. *Altern Ther Health Med.* 2019;25(4):32-9.
38. Poon CT, Abas WA, Kim KH, Pinguan-Murphy B. Effect of herbal extracts on rat bone marrow stromal cells (BMSCs) derived osteoblast-preliminary result. In 5th Kuala Lumpur International Conference on Biomedical Engineering 2011: (BIOMED 2011) 20-23 June 2011, Kuala Lumpur, Malaysia 2011 (pp. 819-822). Springer Berlin Heidelberg.
39. Li F, Wang D, Jiang Z, Gao X, Zhao H. Activity stimulating osteoblast-like cells proliferation of some traditional Chinese medicinal herbs and other plants. *Pharmacol Biol.* 2001;39(5):351-6.
40. Kirtikar KR, Basu BD, Blatter E. *Indian medicinal plants periodical experts.* Delhi. 1975;2:999.
41. Gulecha V, Sivakumar T, Upaganlawar A, Mahajan M, Upasani C. Screening of *Ficus religiosa* leaves fractions for analgesic and anti-inflammatory activities. *Indian J Pharmacol.* 2011;43(6):662-6.

42. Chopra SS, Patel MR, Awadhiya RP. Studies of *Cissus quadrangularis* in experimental fracture repair: A histopathological study. *Indian J Med Res.* 1976;64(9):1365-8.
43. Deka DK, Lahon LC, Saikia J, Mukit A. Effect of *Cissus quadrangularis* in accelerating healing process of experimentally fractured radius-ulna of dog: A preliminary study. *Indian J Pharmacol.* 1994;26(1):44-5.
44. Khond M, Bhosale JD, Arif T, Mandal TK, Padhi MM, Dabur R. Screening of some selected medicinal plants extracts for in-vitro antimicrobial activity. *Middle-East J Sci Res.* 2009;4(4):271-8.
45. Tayung K, Saikia N. *Cryptolepisbuchanani*—A less-known medicinal plant used in bone fracture. *Indian J TraditKnowl.* 2003;2(4):371-4.
46. Akgül KT, Doğanekin E, Özer E, Kotanoğlu M, Gökkurt Y, Hücümenoğlu S. Histopathological effects of aloe Vera on wound healing process in penile fracture model: An experimental study. *Turk J Med Sci.* 2021;51(4):2193-7.
47. Rahayu RP. The fabrication and characterization of chitosan-ethanol extracted aloe Vera scaffold for alveolar bone healing application. *J Int Dent Med Res.* 2019;12(4):1376-81.
48. Rios JL, Recio MC, Giner RM, Manez S. An updated review of saffron and its active constituents. *Phytother Res.* 1996;10(3):189-93.
49. Alavizadeh SH, Hosseinzadeh H. Bioactivity assessment and toxicity of crocin: A comprehensive review. *Food Chem Toxicol.* 2014;64:65-80.
50. Hemshekhar M, Sebastin Santhosh M, Sunitha K, Thushara RM, Kemparaju K, Rangappa KS, et al. A dietary colorant crocin mitigates arthritis and associated secondary complications by modulating cartilage deteriorating enzymes, inflammatory mediators and antioxidant status. *Biochimie.* 2012;94(12):2723-33.
51. Hong YJ, Yang KS. Anti-inflammatory activities of crocetin derivatives from processed *Gardenia jasminoides*. *Arch Pharm Res.* 2013;36(8):933-40.
52. Qian Y, Zhong P, Liang D, Xu Z, Skibba M, Zeng C, et al. A newly designed curcumin analog Y20 mitigates cardiac injury via anti-inflammatory and anti-oxidant actions in obese rats. *PLoS One.* 2015;10(3):e0120215.
53. Safali S, Aydin BK, Nayman A, Ugurluoglu C. Effect of curcumin on bone healing: An experimental study in a rat model of femur fracture. *Injury.* 2019;50(11):1915-20.
54. Liu Y, Chen L, Shen Y, Tan T, Xie N, Luo M, et al. Curcumin ameliorates ischemia-induced limb injury through immunomodulation. *Med Sci Monit.* 2016;22:2035-42.
55. MachovaUrdzikova L, Karova K, Ruzicka J, Kloudova A, Shannon C, Dubisova J, et al. The anti-inflammatory compound curcumin enhances locomotor and sensory recovery after spinal cord injury in rats by immunomodulation. *Int J Mol Sci.* 2015;17(1):49.
56. Jaiswal S, Singh SV, Singh B, Singh HN. Plants are used for tissue healing of animals. *Nat Prod Radiance.* 2004;3(4):284-92.
57. Tilak JC, Devasagayam TP, Adhikari S. Radioprotective and antioxidant properties of Indian medicinal plant, *Terminalia arjuna*. *BARC Newsletter.* 2003;249:167-76.
58. Reena G, Kiran G, Kamlesh P. Effect of anabolic steroid in accelerating healing process of experimentally fractured tibia of rats and compare its fracture healing property with *Terminalia Arjuna*. *Int J Curr Microbiol App Sci.* 2016;5(5):788-95.
59. Azam Z, Pandey V, Gupta N, Sapra L, Dar HY, Shokeen N, et al. Phytoconstituents as novel osteo-protective agents: Implications in bone health. *Front Biosci (Landmark Ed).* 2020;25(7):1259-96.
60. Han SB, Lee CW, Yoon YD, Lee JH, Kang JS, Lee KH, et al. Prevention of arthritic inflammation using an oriental herbal combination BDX-1 isolated from *Achyranthes bidentata* and *Atractylodes japonica*. *Arch Pharm Res.* 2005;28(8):902-8.
61. Chen Q, Liu Z, He JH. *Achyranthes bidentata* polysaccharide enhances immune response in weaned piglets. *Immunopharmacol Immunotoxicol.* 2009;31(2):253-60.
62. Cheng J, Di LQ, Shan JJ, Zhao XL, Kang A, Bi XL, et al. Studies on effects of *Achyranthes bidentata* on tongssaimai pellets main active ingredients chlorogenic acid, isoliquiritin, harpagoside and glycyrrhizin in vivo pharmacokinetics. *Zhongguo Zhong Yao Za Zhi.* 2014;39(8):1502-8.
63. Li JY, Tawfeek H, Bedi B, Yang X, Adams J, Gao KY, et al. Ovariectomy disregulates osteoblast and osteoclast formation through the T-cell receptor CD40 ligand. *Proc Natl Acad Sci U S A.* 2011;108(2):768-73.
64. Wattel A, Kamel S, Prouillet C, Petit JP, Lorget F, Offord E, et al. Flavonoid quercetin decreases osteoclastic differentiation induced by RANKL via a mechanism involving NF kappa B and AP-1. *J Cell Biochem.* 2004;92(2):285-95.
65. Ayurvedic medicine for fracture healing. Available from: https://ayurcentralonline.com/en/blogs/399_AYURVEDIC-MEDICINE-FOR-FRACTURE-HEALING.html (assessed 1 March 2022).