



## Review Article

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### A REVIEW ON ANGULI BHAGNA: AN EXPLORATORY STUDY

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#### ABSTRACT

*Anguli bhagna* (phalangeal fractures) is a very common musculoskeletal injury. *Anguli bhagna* is commonly caused by falls, direct blows (ball sports) and various other reasons. Management of *anguli bhagna* requires sound techniques to provide the best functional outcome. To date, literature on *anguli bhagna* is scarce and unexplored. *Ayurvedic* treatises, especially '*Sushruta Samhita*', have provided excellent description of *bhagna* at different sites including *anguli bhagna*. The present article explores various etiological factors, classification, clinical features, treatment principles, prognosis, and complications specifically mentioned in the context of *anguli bhagna* along with modern surgical concepts. Various adjuvant therapies like oral medications, local applications, dietary regimes, *panchakarma* (five purification procedures) and other important modalities which are useful for better functional outcome are also explored. Even though sophisticated diagnostic procedures and treatment modalities are currently available for phalangeal fractures, the age-old concepts available in *Sushruta Samhita* still remain relevant and valid.

**Keywords:** *Anguli bhagna*, phalangeal fractures, musculoskeletal injury, ball sports, *Sushruta Samhita*, *Panchakarma*

#### INTRODUCTION

A fracture (*bhagna*) is a breach in the continuity of the bone. Every fracture is a grievous injury and is usually followed by a physical and/or an emotional damage to the individual. The hand of a human being is a unique body part as it performs numerous functions in one way or the other. An optimal hand function is inevitable for good quality of life and no other part of the body can substitute this. Unfortunately, the hand injuries resulting in fractures are very common and account for the second most common musculoskeletal injuries after elbow.<sup>1,2</sup>

*Anguli* (Finger), an extremely essential component of the hand, is one of the most used body parts in our daily life and is always in the firing line for injuries. Functional loss is often underappreciated and difficult to measure in cases of finger fractures. The fundamental goal of treatment in the fractures of fingers is to achieve sufficient stability of the bone to promote early motion rehabilitation without resulting in mal union of fractures. Modern science has advanced with possible answers in achieving good hand function while avoiding complications at the same time. Whatever methods modern science has introduced to combat the hand trauma, especially fingers, the roots of its principles can be traced back to *Ayurveda*. Many of the *Ayurvedic* treatises, including *Sushruta Samhita* have mentioned fracture and its principles under *bhagnaprakarana*. *Acharya Sushruta* has given etiology, classification, clinical features, treatment, complications and prognosis of *bhagna* which are equally applicable for *anguli bhagna* too.<sup>3,4</sup> His fracture management principles for closed and open fractures are so unique and technical that these are even practiced today (with minimal changes) in finger fractures.<sup>5</sup> In addition, he has also mentioned the use of oral and local formulations, indicated and contraindicated diet and other modalities which can be used as adjuncts to the modern treatment of phalangeal fractures.

The present article is aimed at reviewing and comparing the concepts of *anguli bhagna* in *Ayurvedic* literature and their modern interpretation. The practical utility of these principles in the management of finger fractures at the present time has also been discussed. To this goal, the relevant literature for both the classical and the modern texts has been explored. In addition, the study suggests the importance of *Sushruta Samhita* and other *Ayurvedic* treatises as the most ancient means of orthopedic learning. Furthermore, adjuvant therapies have also been briefly discussed which may be employed to get better results in finger fractures.

#### Skeleton of *Anguli* (Finger)

According to *Sushruta*, each finger of a hand consists of 3 bones. As he has also included the thumb as a finger while counting the number of bones, therefore, a hand consists of 15 bones. Additionally, bones of finger are considered as "*nalakasthi*" (Tubular), i.e., the bones of fingers are miniature long bones. These are called Phalanges. Furthermore, he also added/emphasized that injury to a *nalakasthi* results in its breakage.<sup>3,6</sup>

#### Etiology of *Anguli bhagna*

*Acharya Sushruta* has given a common etiology of *bhagna* which includes trauma due to direct and indirect violence.<sup>3</sup> *Acharya Charaka* has categorized the diseases into *Nija* (resulting from internal causes such as vitiation of *doshas*) and *Agantuja* (resulting from external causes like trauma).<sup>7</sup> He has described *bhagna* as an *agantuja* disease.<sup>8</sup> *Anguli bhagna* can occur as a result of trauma due to *prapatana* (fall), *pidana* (compression of fingers), *prahara* (direct blow from an object), *vyalamriga-dashana* (teeth of ferocious/docile animals), and *prabhriti* (*balvadvigraha*- fighting with a stronger person).<sup>9,10</sup> The fractures of phalanges usually occur by similar mechanisms such as

crushing, catching a ball, fall on outstretched hand, punching, contact sports, etc.<sup>11</sup>

*Prapatana*, i.e., trauma due to fall can cause bending, twisting, axial compression or a combination of these to the finger. Bending may result in diaphyseal fractures (with or without angulation) or avulsion fractures. An axial load may lead to shearing articular fractures and metaphyseal compression fractures, whereas twisting may cause a spiral fracture, and axial compression with twisting usually leads to short oblique fractures.<sup>2,12</sup> *Pidana*, i.e., trauma due to compression causes crushing of fingers, thus resulting in comminuted fracture of the phalanges, specifically the Distal Phalanx.<sup>13</sup> *Prahara*, i.e., trauma due to a direct blow from an object is frequently seen in ball-sports injuries. A direct blow on the finger may result in transverse fracture with varying degrees of comminution.<sup>12</sup> *Vyalamriga-dashana*, i.e., trauma due to bites of ferocious wild animals may result in crushing of the finger and thus may cause comminuted fracture of any of the phalanges or unique patterns of skeletal injury with significant associated soft tissue damage. Moreover, a fracture occurring through this mechanism may be an open fracture.<sup>2</sup> *Prabhriti*, i.e., a fight with a stronger person may also result in bending or twisting of the finger, thereby causing transverse or spiral fracture of the phalanx.

#### Classification of *Anguli bhagna*

According to the fracture pattern, *Acharya Sushruta* has classified *kanda bhagna* (type of *bhagna* which involves a breach in the bone) into 12 types, namely, *karkataka*, *ashwakarna*, *churnitta*, *pichita*, *asthichhallita*, *kandabhagna*, *majjanugata*, *atipatita*, *vakra*, *chhinna*, *paatita* and *sphutita*.<sup>3</sup> *Ashtanga Samgraha* mentioned the term '*bhanga*' (instead of *bhagna*) and classified it into *sandhi bhanga* (6 types) and *asandhi bhanga* (12 types).<sup>14,15</sup> *Ashtanga Hridaya* followed *Ashtanga Samgraha* but stated that a *sandhi bhanga* is of numerous types.<sup>14,16</sup> *Madhava Nidana* classified *kanda bhagna* into 11 types and has mentioned two types of *chhinna bhagna* (*anuvideerana* and *bahuvideerana*). *Kanda bhagna* can be classified and named according to the injury.<sup>17,18</sup> *Sharangdhara Samhita* has mentioned 8 types of *asthibhagna* which includes fractures and dislocations.<sup>19,20</sup> *Bhava Prakasha* has classified *kanda bhagna* into 12 types including two types of *chhinabhagna* (*alpachhinna* and *atichhinna*).<sup>21,22</sup>

In Modern Orthopedics, the phalangeal fractures are classified into proximal phalangeal (P1), middle phalangeal (P2) and distal phalangeal (P3) fractures. P1 and P2 fractures are classified as intra-articular and extra-articular according to the involvement of nearby joint. "Pilon" fracture of the base of P2 needs a special mentioning as it involves the complete articular surface combined with metaphyseal impaction. According to pattern, P1 and P2 fractures are classified into transverse, short oblique, long oblique or spiral in shaft; partial or complete in intra-articular fractures; and a special fracture pattern (fracture neck of P1) that risks extreme proximal inter-phalangeal (PIP) joint limitation, where a volar spike of the bone from the proximal fracture fragment impinges into the sub-capital recess.<sup>23,24</sup> P3 fractures are classified according to the site into tuft, shaft and base fractures; and according to the pattern into longitudinal shaft, transverse shaft, tuft, dorsal base avulsion (mallet finger), dorsal base shear, volar base (jersey finger) and complete articular fractures.<sup>13</sup>

All types of *bhagna* may not be found in each and every long bone. The various types of *kanda bhagna* which can occur in a finger along with their modern counterparts are discussed as follows.

*Karkataka bhagna* has been described by *Sushruta* as the one where the fractured ends of the fragments are "*Sammoodha*"

(*Avanata*—according to *Gaya das* and *Madhukosha*), i.e., raised like a knot or a cyst in the centre. The possible correlation is an angulated fracture.<sup>10,18,25,26</sup> The volar angulation is found in the fractures of the shaft of P1 and P2, and the dorsal angulation is found in the shaft of P2.<sup>12</sup> *Ashwakarna bhagna* refers to a fracture where the fractured ends are raised like ears of a horse. It can be considered as an oblique/spiral fracture of the phalanx and is mostly found in the shaft of the P1 and P2.<sup>9,23</sup> *Churnitta bhagna* is the one which produces crepitus/sound on palpation. It suggests a comminuted fracture of the phalanx (tuft fractures of P3).<sup>9,12</sup> Such comminution (with crepitus) is also found in Pilon fracture.<sup>23,27</sup> In *Kanda bhagna* (*Kanda* here refers to the shaft of the phalanx), the bony fragments move on shaking. This occurs in the transverse fracture of the phalanges (fractures of neck or shaft of P1 or P2).<sup>9,23</sup> In *Asthichhallita* (*chhallita* means 'split') *bhagna*, the fractured part is lowered on one side and elevated on the other side.<sup>9,10</sup> This may be regarded as the avulsion fracture or the longitudinal split fracture, both of which usually occur in P3. When a hard ball strikes the tip of the finger and the finger is hyper-flexed at distal inter-phalangeal (DIP) joint, it may cause the avulsion of a fracture fragment from the dorsal aspect of the base of P3. The condition is known as Mallet Finger. A similar injury with hyperextension of the finger results in Jersey Finger in which there is avulsion of the volar aspect of the base of P3.<sup>13</sup> A crush injury may result in excessive hoop stress within the tubular P3 leading to a longitudinal splitting fracture.<sup>28</sup> *Atipatita bhagna* is the one in which the bone is divided completely.<sup>9,10</sup> It must be regarded as a complete fracture of any of the phalanges. Such type of *bhagna* may lead to marked displacement of the fragments and may also be unstable.

According to the presence or absence of *vrana* (wound), a *bhagna* is classified into *Savrana bhagna* (fracture with overlying wound) and *Avrana bhagna* (fracture without any overlying wound). So, the fractured bone communicates with the external environment in a *savrana bhagna* while it does not communicate with the external environment in an *avrana bhagna*. *Sushruta* has mentioned the treatment principle of *asavrana bhagna* in the *Chikitsa sthana*. According to him, the wound associated with the fracture is addressed initially and then-after the fracture should be treated.<sup>4</sup> The phalangeal fractures are frequently open as fingers do not have a strong musculature over the bone. It should be remembered that although *Sushruta* had given the management principle of *savrana bhagna* but the fractures were classified as "*savrana bhagna*" and "*avrana bhagna*" for the first time in *Madhava Nidana*.<sup>18</sup> Modern orthopedics also classify the phalangeal fractures according to the soft tissue damage into open and closed fractures.<sup>12</sup>

#### Clinical features of *Anguli bhagna*

*Acharya Sushruta* has quoted a fine description of the general clinical features of the fractures. All the clinical features are found in the fractures of a finger. These are:

*Swayathubahulyam* (gross swelling), is a constant feature in almost all types of *anguli bhagna*. Moreover, it is directly proportional to the displacement of the fracture. *Spandana-vivartana-sparsha-asahishnutvam* (inability to bear movements, rotation or touch and extreme pain) is associated with the movement of the finger in probably each type of *bhagna*. *Avapeedyamaney shabda* (crepitus on palpation) is a typical feature in almost all the fractures of the finger, especially of *churnitta bhagna* (comminuted fracture of P3 and Pilon fracture of the base of P2). *Srastangta* (looseness of part/loss of transmitted movement) is also found in phalangeal fractures. *Vividhavedana* (different types of pain) is a cardinal feature of the phalangeal fractures. *Sarvasva avasthasu na sharmalabha* (no relief of pain in any posture) may or may not be a constant

feature.<sup>9</sup> Pain, swelling, stiffness, weakness, deformity, and loss of coordination are the major symptoms in a phalangeal fracture. There may be numbness and tingling sensation if there is associated nerve injury. On inspection, swelling, bruise and deformity may be seen while on palpation, tenderness, crepitus and instability may be elicited.<sup>2,29</sup> Deformity can be seen in *asthichhallita* as mallet finger (like a hammer); *atipatita* where a complete fracture is grossly displaced; or in *ashwakarna* as in long oblique or spiral fractures of the shaft of P2.<sup>23</sup> Examination of rotational deformity is done by noting the digital scissoring during active grasp or passive tenodesis.<sup>2,29</sup> Instability can be met in *asthichhallita* (volar and dorsal base fractures of P3);<sup>13</sup> *atipatita* (complete fracture is grossly displaced/rotated); *ashwakarna* (long oblique or spiral fracture of shaft of P2); *churnitta bhagna* (Pilon fracture);<sup>23</sup> and *kanda bhagna* (transverse fracture of P1 which is inherently unstable).<sup>30</sup> *Sushruta* has also mentioned “*nakhsandhimsamutpishitamraktanugatamaryaa*” (formation of a Sub-ungual hematoma when the nail–skin junction is subjected to a crushing injury) which usually occurs in a *churnitta bhagna* (comminuted fracture of the tuft of P3).<sup>31,32</sup> One should also assess if there is any wound (*vrana*) present with the fracture (*bhagna*), i.e., if it is a *savrana bhagna* or not.

### Treatment of Anguli bhagna

*Acharya Sushruta* has quoted that the fracture of the finger is corrected and reduced, and then the finger is wrapped up with a fine bandage. Then, irrigation with *ghritta* is carried out over it.<sup>31</sup> *Sushruta* and other *Acharyas* have mentioned excellent fracture management principles which are equally applicable in the fractures of fingers. These are summarized below:

#### First aid

Following injury, the fractured site is immediately sprinkled with cold water and the fractured site is covered with mud (*Panka*). This is a unique concept mentioned in *Yoga Ratnakara*.<sup>33</sup> *Acharya Vagbhatta* has also advocated the same measures, but the cold water is sprinkled for a longer duration.<sup>16</sup> *Acharya Sushruta* has also mentioned the application of cold pastes and irrigation immediately after the fracture.<sup>31</sup> Moreover, this is only done in case of closed fractures/sprains. In modern era too, the use of ice packs (Cryotherapy) in acute injuries is quite common.<sup>34</sup> This is done to counter the pain caused due to the inflammatory response occurring due to the insult. It also causes vasoconstriction of the vessels to stop the bleeding which is otherwise responsible for increase in swelling and blood loss. The application of *panka* (mud) works in two ways. It provides the function of an adequately strong temporary splint after drying and also gives a persistent cooling effect which is beneficial for pain management and reduction of local swelling.<sup>5</sup> In case of a Sub-ungual hematoma, *Sushruta* has mentioned that blood should be let out through a hole made by a drill/pin and then a paste of rice is applied on it.<sup>31</sup> Similar technique (Trephination) is advised in adults if the hematoma involves more than 50% of the nail plate. Decompression/Hematoma removal can be done with a sterile hypodermic needle, heated paper clip or electro-cautery.<sup>32,35</sup>

#### Definitive management

The main goal of the treatment in finger fractures is restoring the normal or near to normal anatomy of the bone without any complications such as stiffness, mal-union, etc. So, a special emphasis is given on the soft tissues. The fractured part of the finger must not be considered in isolation instead the finger should be addressed as a whole. *Sushruta* has described the closed management of fractures in *Chikitsa sthana*. Moreover, the treatment principles would remain the same both for *avrana*

*bhagna* and *savrana bhagna* of the finger with the difference that the *vrana* in a *savrana bhagna* is addressed initially, after which the local treatment of the fracture is done.<sup>4,5</sup>

### Treatment in Avrana Bhagna (Closed fracture)

The various steps of treatment are *Bhagna Sthapana* (Reduction), *Bandhana* (Immobilization) and *Sukhcheshtaprasarana* (Physiotherapy).<sup>5</sup> These principles of *Sushruta* are basically the non-operative treatment which is followed nowadays. Although with the advancement in the modern investigation techniques, the operative treatment is another alternative but, even then, non-operative treatment is the most preferred treatment in phalangeal fractures (as it is least invasive and patient friendly).<sup>2,36</sup>

#### Bhagna Sthapana (Reduction)

The finger should be manipulated with forces such as *aanchhana* (traction), *pidana* (compression), *sankshepa* (to reduce/to make the fragments meet), *unmanna* (elevating upwards) and *vinmanna* (pressing downwards) according to the displacement of fractured fragments.<sup>5,31</sup> The force is always applied in a direction opposite to the mechanism of the injury with which the fracture occurred. So, with these maneuvers the bone is brought to its normal position and is thus reduced. The relevant reduction maneuvers in some phalangeal fractures are discussed in the section of *bandhana*.

#### Bandhana (Immobilization)

The reduced finger must be immobilized properly after successful reduction. *Sushruta* has advocated the application of a paste prepared from drugs like *manjishtha* (*Rubia cordifolia*), *madhuka* (*Glycyrrhiza glabra*), *raktachandna* (*Pterocarpus santalinus*), *shali* (a type of rice) mixed with *shatadhouta ghritta* (100 times washed *ghritta*) prior to immobilization. Alternatively, the fractured finger may be wrapped up all around with a cloth impregnated with *ghritta* or it may be first wrapped around the fracture with a fine cloth which is then irrigated with *ghritta*. This usually provides enough stabilization to the fracture. Apart from this, *Sushruta* has also mentioned the use of *Kusha Bandhana* (Splints) for immobilization. *Kusha* is usually made from the bark of trees like *madhuka* (*Madhuka indica*), *udumbara* (*Ficus glomerata*), *palasha* (*Butea monosperma*), *arjuna* (*Terminalia arjuna*), *vansa* (*Bambusa arundinacea*), *sarja* (*Vateria indica*), *vata* (*Ficus benghalensis*), etc. In case of fingers, it can be used but with care as it may impinge the skin. The bandaging should neither be too tight nor be too loose. A very loose bandage does not immobilize the fracture site and a very tight bandage may produce inflammation, pain and suppuration.<sup>31</sup> This is particularly important in phalangeal fractures as this may impede the circulation to the distal part of the finger.<sup>37</sup> So, *Sama bandha* (moderately tight bandage) is applied. Further, the *bandhana* is changed periodically to check the status of skin and reduction and to change the stale paste. The bandage is changed at weekly interval in cold weather; every 5<sup>th</sup> day in temperate weather and every 3<sup>rd</sup> day in hot weather.<sup>31</sup> The immobilization is continued till its union or until the time when the fracture fragments become sticky.

Most of the phalangeal fractures are functionally stable (before or after closed reduction), so these can be treated with the non-operative treatment quite effectively.<sup>12,36</sup> The main aim of treating P3 fractures is to care for soft tissue injury. This is accomplished just by splinting the finger for 2-3 weeks.<sup>11,37</sup> Repair of the nail bed is indicated in a nail bed laceration. Taping around the tip should not be too tight as it may impede the blood supply. Mallet finger is treated by splinting the finger for about 8 weeks in extension or slight hyperextension.<sup>37</sup> Surgeries like trans-articular

pinning or extensor block pinning is required in which splinting is not tolerated.<sup>13,38</sup> Jersey Finger mostly requires the repair of flexor digitorum profundus.<sup>37,38</sup> The un-displaced and stable P2 fractures (intra-articular or extra-articular) without impaction can be treated by dynamic splinting or “buddy taping” for 2-3 weeks.<sup>12,37,39</sup> In an angulated (volar/dorsal) mid-shaft fracture (potentially unstable), closed reduction is accomplished by traction with or without flexion of distal fragment.<sup>12,37</sup> Dorsal splinting technique with the wrist in slight extension, the Metacarpo-phalangeal (MP) joint in 70° flexion, and the PIP joint in 45° flexion is used for immobilization.<sup>37</sup> The fractures of P1 are mostly treated with dynamic splinting. The fracture of the shaft having volar angulation requires closed reduction which is accomplished with longitudinal traction and flexion of MP joint, and then, followed by longitudinal traction and flexion of the distal fragment. The reduction and stability in such a fracture is essential as it may lead to adhesions (leading to stiffness) during healing because the tendons are very near to the periosteum at this site. Splinting is done with the wrist in slight extension and MP joint in 70° flexion. Early motion is also of the utmost importance. Alternatively, the wrist may also be set free for unrestricted motion.<sup>37,40</sup> It is evident from the above discussion that Splinting is the modern counterpart of *Kusha Bandhana* as described by *Sushruta*.

According to *Sushruta*, a fracture becomes stable in 1 month, 2 months and 3 months in children, middle aged and elderly people, respectively.<sup>31</sup> This is in accordance with the modern orthopedics as most of the fractures of phalanges take about 4-6 weeks for healing (exceptions include some P2 fractures which can take a little longer).<sup>12,13</sup>

Operative methods for closed fractures are employed only for unstable fractures (intra-articular or extra-articular) where closed reduction is not possible. These include closed reduction with extra-articular K-wire pinning (transverse K-wire, crossed K-wires) or trans-articular pinning or screw fixation,<sup>41,42</sup> and open reduction for oblique, spiral patterns of shaft with lag screws and intra-articular fracture like Pilon fracture with screws,<sup>39,41,43</sup> plates,<sup>41</sup> tension band wiring and transverse K-wire pinning.<sup>41,44</sup> In contrast, no *Ayurvedic* treatise has ever mentioned the operative technique of reducing or immobilizing the finger fractures.

#### ***Sukhcheshtaprasarana* (Physiotherapy)**

Although, no *ayurvedic* treatise has given a separate procedure regarding physiotherapy or rehabilitation but *Sushruta* has advocated physiotherapy methods for strengthening of hand like holding of a lump made of soil, salt, etc.<sup>31</sup> Likewise, physiotherapy maneuvers should also be done in finger fractures. This is essential for regaining the normal function of fingers (thereby the hand) by strengthening the bone and soft tissues. Nowadays, special emphasis is given on Rehabilitation (restoration of patients to their fullest physical, mental and social capability) and this has come out to be a different branch altogether. The success of rehabilitation of finger fractures depends on the achievement of fracture stability, introduction of soft tissue mobilization as soon as possible and prevention of the post-surgical contracture. Therefore, emphasis should be given to all the three tissues (bone, soft tissue, and scar) in the phalangeal fractures.<sup>41</sup> Rest, ice, compression and elevation (R.I.C.E.) are emphasized for edema control. Exercises like finger range of motion, fist making, grip strengthening, etc. should be done.

#### **Treatment of *Savrana Bhagna* (Open fracture)**

A *Savrana Bhagna* of a finger needs prompt attention. In this condition, the wound is the main presenting entity. Wound care

to provide healthy tissue and skin cover remains the mainstay of the treatment. The wound sepsis needs to be prevented at any cost. *Sushruta* knew the importance of this and mentioned the use of decoctions mixed with adequate quantity of *ghritta* and honey for cleansing of the wound. Prior to this, he has mentioned to trim the dried and projecting bone carefully to the margin of the wound.<sup>31</sup> Any dust, hair, loose bone pieces, etc. if present in the wound, should be removed by wound toileting.<sup>45</sup> Hemorrhage should be stopped by any of the four methods (*sandhana*, *skandana*, *pachana*, *dahana*) whichever is suitable.<sup>46</sup> Finally, the wound is closed with the help of suitable suture materials.<sup>45</sup> After managing wound, the fracture is treated with the same principles, viz., *bhagna sthapana*, *bhagna bandhana* and *sukhcheshtaprasarana*.<sup>31</sup>

Open fracture management in the modern times follows the same principles with special emphasis on wound toileting, debridement, infection control, early definitive fracture stabilization, and early wound cover, all focused at restoring the function as soon as possible.<sup>47</sup> The unstable open fractures of fingers are treated with closed reduction and external fixation.<sup>41</sup> With the advancement in the grafting techniques, both thin and supple tissue coverage in a finger can be attained.<sup>2</sup>

#### **Other measures for fracture union**

According to *Ayurveda*, the process of healing can be improved by certain medications, proper dietary regime and recommended lifestyle. *Ayurvedic* treatises have advocated various oral and local formulations which may enhance fracture healing in fingers too. For oral use, patient should take cold milk of primiparous cow processed with “*Madhura aushadha* group” of drugs along with *ghritta* and powder of *laksha* in the morning.<sup>4,31</sup> *Asthishrinkhalakanda swaras*, *laksha guggulu*, *abhaguggulu*, etc. have been proved to be beneficial and should be taken in finger fractures.<sup>48-50</sup> *Anuvasana basti* (enema of medicated oil) may enhance the fracture healing. In addition, local use of decoctions, pastes, oils or *ghritta* can be done prior to splinting. Diet should include (*Pathya*) *shali* rice, meat soup, milk, *ghritta*, pea soup, and nourishing food and drinks. Contra-indicated food items (*Apathya*) include salty, pungent, alkaline, dry and citrus substances. Sexual intercourse, exposure to the sun and physical exercise should be avoided.<sup>4,31</sup>

#### **Features of a sound union**

According to *Sushruta*, a fracture (thus, a finger fracture) is said to be united well if the union is *anavidham* (painless), *ahenangam* (without any shortening of the part), *anulbanam* (without any unevenness), and *sukhcheshtapracharam* (allows free and easy movements).<sup>31</sup>

#### **Prognosis of *Anguli bhagna***

According to *Sushruta*, the *churnitta*, *chhinna*, *atipatita* and *majjanugata bhagna* are curable with difficulty.<sup>3,9</sup> Among these, the *churnitta* and *atipatita bhagna* are encountered in the fingers quite frequently. The *churnitta bhagna* in fingers occurs due to crushing of the fingers resulting in varying degree of comminution. This results in a varying degree of soft tissue damage which may occasionally result in an open fracture. Soft tissue damage with an open fracture, may lead to a delay in the fracture healing by reduction of the blood supply and increased tendency of getting infected, thereby, having bad prognosis. In *atipatita bhagna* too, there may be gross displacement of the bony fragments which may also breach the skin. Because of gross displacement, the periosteal stripping and soft tissue damage will also be huge. All these factors may lead to compromised bone healing. Moreover, it is also difficult to reduce such fractures.

According to *Sushruta*, fractures in the weak, the elderly and the children are difficult to treat so are the fractures of the people suffering from emaciation or diseases like *kshatakshheena*, *kushtha* and asthma.<sup>9</sup> The patients with poor nutritional status associated with other co-morbidities are vulnerable for non-union of fractures including phalangeal fractures.<sup>51</sup> Treatment of the finger fractures in a child is extremely challenging due to lack of cooperation. According to *Sushruta*, the fractures involving the joints are also difficult to treat.<sup>9</sup> This is exactly in accordance with the fractures of fingers. The intra-articular fractures require perfect reduction which needs high skills. "Pilon" fracture is considered as the most functionally devastating injury of the PIP joint of the hand. This is highly unstable injury and refractory to standard surgical techniques and thus has a poor prognosis.<sup>23</sup> *Sushruta* has cautioned that the surgeon should keep a vigilant look on the fracture so that it does not suppurate, as suppuration of muscles, vessels and ligaments makes it curable with difficulty.<sup>31</sup> This may occur in open fractures of fingers as the integument in fingers is easily damaged. The open fractures require meticulous debridement which in itself is a difficult job. Moreover, these are associated with neurovascular and tendon injuries which require additional attention. These structures may need debridement followed by reconstruction with autogenous grafts or adjacent transfers which undoubtedly increases the burden both on the surgeon and the patient.<sup>2</sup> *Sushruta* has stated that a patient, intemperate in habits and having predominance of *vata* (unstable *prakriti*) has delayed fracture healing. Same is true for *anguli bhagna* too.<sup>31</sup> Finally, *Sushruta* has also mentioned that the fracture which occurred in an already diseased bone/joint (pathological fracture) or a fracture which is mis-managed also have poor prognosis.<sup>9</sup> The pathological fractures in a finger due to tumors (e.g., chondro-sarcoma) are mostly found in P1, P3 may rarely be involved.<sup>52</sup> The complications like mal-union, non-union, etc. caused while treating finger fractures also end up with poor prognosis.

It is evident from the above discussion that the prognosis of the fracture largely depends on the fracture pattern, presence or absence of the wound, patient factors, a previous pathology and a faulty management.

### Complications of *Anguli bhagna*

*Sushruta* has mentioned that the '*Vishamolvanasamhita bhagna*' (mal-united fracture), should be re-fractured and then treated as an ordinary fracture.<sup>4,31</sup> The procedure is known as osteoclasia and is employed even today (when the fracture is relatively new and can be manipulated from outside). However, mal-union of fingers in the modern times can even be treated with surgical methods (transverse extra-articular transverse or step-cut osteotomies, closed wedge osteotomy, opening wedge osteotomy, tenolysis or capsulolysis).<sup>52</sup> *Acharya Dalhana* has explained the meaning of "*sammoodha*" as "*atishyensparshajaanati*" (hyperesthesia) in *karkataka bhagna*.<sup>10</sup> Hypersensitivity is frequently seen in phalangeal fractures as there is very little padding between the surface and the large number of small caliber nerve branches. Other complications include stiffness, non-union, residual instability, deformity, post traumatic arthritis, tendon rupture, nail deformities and hardware complications.<sup>53</sup>

### CONCLUSION

*Anguli bhagna*, i.e., the phalangeal fractures are very common injuries pertaining to the skeletal trauma. In *Ayurveda*, the etiology and clinical features of *anguli bhagna* have been described well. Most of the fracture patterns found today (*karkataka*, *ashwakarna*, *churnitta*, *kandabhagna*, etc.) had been described so many years back without any radiological investigations. The management of finger fractures mentioned in

*Ayurveda* (*bhagna sthapana*, *bandhana*, *sukhcheshtraprasara*) is basically the non-operative treatment which is still the preferred treatment in finger fractures. With advanced diagnostic techniques, the operative procedures are nowadays gaining popularity, but are still accompanied with complications. The concept of treating *savrana bhagna* and mal-united fractures in fingers holds true even today. In addition, adjuvant therapies like, oral medications, local applications, *panchakarma* procedures, etc. can be used with the definitive treatment for better functional outcome.

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