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A REVIEW ON FRACTURES: AYURVEDIC CLASSIFICATION IN MODERN PERSPECTIVE

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ABSTRACT

In the modern times musculo-skeletal injuries have attained an international epidemic status. Classification of fractures is an integral part of general principles of fracture management. Analysis of fracture type is vital to decide the best treatment protocol, to predict outcomes and for surgical audit as well. Today numerous classification systems available are based on diverse parameters of assessment with their distinct merits and demerits. The most primitive classification systems have been mentioned in the treatises of Ayurveda like Sushruta Samhita, Astang Samgraha, Madhav Nidana, Bhavaprakasha, Shadangdhara Samhita, Harita Samhita and Yogaratnakara under the reference of Bhagna. Modern orthopedics has various advanced classification systems owing to the availability of refined diagnostic sophistication. In this article an effort has been made to interpret Ayurvedic classification of fractures in modern perspectives.

KEYWORDS: Bhagna, Fracture, Classification, Injuries, Open Fractures.

INTRODUCTION

Fracture classification systems have been in existence for nearly as long as people have identified fractures, much before the advent of radiology[1]. Fractures include a wide range of skeletal injuries from a hairline crack to a comminuted fracture. Sushruta Samhita, Astanga Samgraha, Madhava Nidana, Bhava Prakasha, Shadangdhara Samhita, Yogaratnakara and Harita Samhita are the main Ayurvedic treatises having the early references of fracture classification.

Edwin Smith Papyrus, the earliest written surviving medical text (written in Egyptian hieratic script around 17th century BCE) contains a rudimentary classification of fractures[2]. Modern classification systems have specific basis like type and pattern of fracture, type of bone involved, injury to adjacent joints and associated soft tissue injuries. Prior to the advent of modern diagnostic tools, classification of the Bhagna in Ayurveda, has incorporated a wide range of musculo-skeletal injuries involving bones, joints and soft tissues. Analysis of fracture pattern guides about the stability of fracture after reduction and alerts the surgeon to high risk patterns of injury. It helps a surgeon to monitor results and to compare treatment results with those of other surgeons and investigators. It also provides a basis for evaluation of new treatment methods[3].

HISTORY OF FRACTURE CLASSIFICATION

Sushruta Samhita (1000-1500 BC) is the first treatise of Ayurveda in which illustrative classification of musculoskeletal injuries under the context of Bhagna is available[4]. It is broadly based on the musculoskeletal elements involved in injury. Bhagna has been stated to be of two types Kanda Bhagna (injury to bones) and Sandhi Mukta (injury to joints). Each of them has further subtypes with Kanda Bhagna of twelve types and Sandhimukta of six types[5]. The meaning of 'Kanda' is stem or shaft of a long bone but here it should be considered as the whole substance of an intact bone. Any breach in its continuity has been stated as 'Kanda Bhagna' irrespective of the type of bone involved. Thus the term 'Kanda Bhagna' in Ayurveda has been used to describe fractures. The word 'Sandhi' means union and here should be considered as the site of articulation of bones, that means joints. The loss of congruity of articulating surfaces or dislocation and subluxation may be termed as Sandhi Mukta.

In Astanga Samgraha (6th century AD) a broad classification of Bhanga has been named as Sandhi Bhanga or Sandhi Mukta (injuries pertaining to joints) and Asandhi Bhanga (injuries pertaining to bones)[6]. Both have sub-classification with Sandhi mukta of six types and Asandhi Bhanga of twelve types[7].

Astanga Hridaya ((7th Century AD) has followed Astanga Samgraha and Bhanga have been classified as Sandhi Bhanga (injuries pertaining to joints) and Asandhi Bhanga (injuries pertaining to bones); collectively both are stated to be of numerous types[8, 9].

The first reference of classification system based on exposure of fracture site to the external environment has been stated in Madhav Nidana (7th century AD) as Svrana Bhagna (open fracture) and Avrana Bhagna (closed fracture)[10, 11]. Also the division of fractures as Kanda Bhagna (fractures) and Sandhi Bhagna (injuries pertaining to joints) is available. Kanda Bhagna (fractures) have been stated to be of eleven types where Chhinna Bhagna (incomplete fracture) has further two subdivisions viz. Anuvideerana and Bahuvideerana. Further this has been narrated that it is not the sole entity of classification. Kanda Bhagna (fractures) can be classified into many varieties and according to injury can be named[12].

In Shadangdhara Samhita (13th century AD) a very concise classification has been described. It includes eight types of Asthi Bhagna involving fractures and dislocations both[13, 14]. Descriptive illustration regarding these eight types is missing in the original text.

In Bhava Prakasha (16th Century AD) Bhagna has been classified according to Sushruta Samhita viz. Kanda Bhagna (fractures) and

Sandhi Bhagna (joint injuries), the latter being of six types[15]. Kanda bhagna have been stated to be of twelve types including two types of Chhinna Bhagna (incomplete fracture) viz. Alpa-Chhinna and Ati-Chhinna[16].

In Charaka Samhita (1000 BC) only a few points of general management of Bhagna (bones and joints injuries) have been described[17]. Classification of Bhagna is not available in it[18].

In Harita Samhita (10th -12th Century AD) Bhagna has been described as one of the eight types of injuries[19, 20].

In the modern orthopedics, prior to the discovery of radiographs, the earliest history of fracture classification has been given by Edmund Smith Papyrus (17th century BC) as open and closed fractures and treatment guidelines have been provided based on the same. In 18th and 19th century, fracture classification based on clinical appearance of the limb was accepted and used viz. Colles' fracture, Pott's fracture. After the advent of radiography, the fracture classification systems expanded in numbers. A good number of bone specific classification systems came into practice like Garden classification of femoral neck fracture, Schatzker classification of proximal tibia fractures, Neer classification of proximal humeral fracture and Lauge-Hansen classification of malleolar fracture of ankle etc.[21].

The AO (Arbeitsgemeinschaft fur Osteosynthesefragen) / OTA (Orthopaedic Trauma Association) is the only generic or universal classification system in wide use today. This classification system is based upon major five factors viz. bone involved (Humerus or Femur or any other), location of fracture in the bone (proximal, mid or distal of diaphysis or end of bone), fracture type (A,B,C types depending upon extent of injury, comminution or involvement of articulating surfaces), fracture group (specific for each fracture type) and fracture subgroup (bone specific). The most modern fracture classification systems in use today are based on the description of location, number, and displacement of fracture lines viewed on modern diagnostic tools like radiographs and CT Scan. The non-radiographic factors like concomitant soft tissue injury and medical comorbidities have a large effect on treatment decisions and on the outcomes of the same[22]. Evaluation of associated soft tissue injuries is equally important to be considered in fracture classification for management and to validate the results for comparative studies. In 1976 Gustilo and Anderson described the grading system for open fractures that offered prognostic information about the outcome of infected fractures.

In 1984, a modified classification system based on size of wound, periosteal soft tissue damage, periosteal stripping and vascular injury; came into practice. In 2010, the classification committee of OTA (Orthopaedic Trauma Association) recommended a classification scheme for open fractures that includes five categories of assessment: skin injury, muscle injury, arterial injury, contamination and bone loss. Like other classifications, the complexity of this classification system has rendered it less reproducible for general use[23, 24].

FRACTURE CLASSIFICATION SYSTEMS

In Ayurveda, the term 'Bhagna' incorporates in itself a wide range of musculoskeletal injuries. Bhagna are of two types viz. Kanda Bhagna (fractures) and Sandhimukta (subluxations/dislocations). Asandhi Bhagna is another term given to fractures in Astang Samgraha.

Classification Based On Pattern Of Fracture

Karkata: The word 'Karkataka' is of Sanskrit language that means 'crab'[25]. Fracture pattern that resembles a crab is called as Karkataka. Sushruta has described that the fractured ends of the fragments are 'Sammoodha' and in the center it is raised like a knot or cyst[26]. 'Sammoodha' word has been explained by Acharya Dalhan as 'Atishyen Sparsha Jaanati' means there is hyperaesthesia at both the ends of fractured part. Acharya Gayadasa and Madukosha commentary has described 'Sammoodha' as 'Avnata'means depressed[27,28]. According to them, in this type of fracture pattern, the sides of bone are depressed and in the center raised like knot. In Astanga Samgraha 'Samvyudha' word has been used in lieu of 'Sammoodha'. It has been explained as the fractured bone fragment without contact on either ends[29].

The possible correlation may be the angulated fracture as defined in modern orthopedics.

Ashwakarna: The fractured part of the bone is projected like horse ears just like an oblique pattern of fracture[30].

Churnita: Crepitus or sounds on palpation at fractured site and is suggestive of comminuted fracture[31].

Pichchita: Compression fracture where the affection is extensive associated with marked swelling. The bone gets crushed and becomes flattened[32]. These are compression fractures.

Asthi Chhallitam: 'Chhallitam' means to split off. In such fractures one chip of the bone gets splitted off from the rest of the bone. In this pattern, the fractured part on one side is lowered and on the other side is projected like an avulsion fracture [33, 34]. Bhava Prakasha has termed it as 'Khallitam'[35].

Kanda Bhagna: The word 'Kanda' here means shaft of long bone. The fractured bone moves on shaking simulating a complete transverse fracture of the shaft of a long bone[36]. There is loss of transmitted movements. Astanga Samgraha has termed this type of Bhagna as 'Vellita'[37]. Dalhana has explained the word 'Vellita' as 'Chalti' pertaining to movement of the bone at the fracture site[38].

Majja-anugata: When one fractured end pierces the pith of other fracture fragment and digs out the marrow[39]. This is suggestive of impaction of one fracture fragment into the other. In the opinion of Astanga Samgraha it is a compound injury[40].

Atipatita: When the bone gets divided completely like a complete fracture[41]. Astanga Samgraha has described the features of Atipatita Bhagna as stated by Sushruta under Majja-anugata type of Bhagna[42].

Vakra: At the fractured site bone is bent but not separated suggestive of green stick fracture or plastic deformity. This commonly results in fractures of children[43, 44].

Chhinna: Incomplete fracture where bone breaks at one side (cortex) but remains intact at the other side[45]. In Madhav Nidana and Bhava Prakasha this type of Bhagna has been further subdivided into two varieties[46, 47]:
Anuvideerana: Bhava Prakasha has used the term 'Alpachhinna' Bhagna, the features are similar to Chhinna Bhagna described in Sushruta Samhita. There is small single crack on one side (cortex) of the bone.
Bahuvideerana: Bhava Prakasha narrates it as 'Atichhinna' Bhagna. Here the crack is complete through the mass of bone.
It has been termed as 'Sheshita Bhagna' in Astanga Samgraha[48].

Patita: many small cracks in the bone associated with pain[49]. In Astanga Samgraha, this has been named as 'Darita Bhagna'[50].

Sphutita: In Sphutita type of Bhagna, according to Sushruta, three features are observed: special type of pricking pain as if the fractured site is full of awns, fractured site gets swollen and there is a single large fissure in the bone[51]. As per Madhukosha, in this variety of Bhagna, small and different types of cracks are seen[52]. Sphutita Bhagna occurs in teeth, Kapal asthi (skull bones) and Valaya asthi (ribs).

Under the context of Sandhimukta six subtypes have been described viz. Utpishta, Vishlishta, Avakshipta, Atikshipta, Triyak kshipta. These include the injuries to joints and ligaments[53].

In Shadangdhara Samhita, based on pattern of injury, eight types of Bhagna (fractures and dislocations) have been described with some different nomenclature like Sandhi bhagna, Urdhavagata, Adhogata, Prishtha, Vidarita, Vishlishta, Triyakakshipta and Vivartita[54].

Classification Based On Extent Of Bony Tissue Involved

Fracture is rendered as incomplete if it involves only one surface or cortex of the bone. The fracture does not involve the whole breadth of the shaft and a portion remains intact. In contrary to this, complete fracture involves both the cortices and the whole thickness of bone is discontinued[55].

The terms like Atipatita Bhagna, Chhinna Bhagna, Alpa-Chhinna, Ati-Chhinna and Sheshita Bhagna are suggestive of extent of fracture line[56, 57, 58].

In the modern orthopedic practice depending upon the extent of fracture line, the fracture may be classified into two types viz. complete fracture and incomplete fracture. In complete fracture, the whole thickness of the bone is discontinued. The complete fracture may be impacted or Non-impacted. Non-impacted fractures may be of displaced or undisplaced variety. Incomplete fractures does not involve the whole breadth of the shaft and a portion remains intact. It may be Greenstick fracture or torus or buckle fracture[59].

Classification Based On Exposure Of Fracture Site To External Environment

This type of classification has a great role in predicting outcomes. In Madhav Nidana, the first definition of Bhagna is available along with its classification into two major types: Svrana Bhagna (open fractures) and Avrana Bhagna (closed fractures)[60]. Earlier in Sushruta Samhita the management principle of Svrana Bhagna has been described where he has advocated the management of associated wound prior to the management of fracture proper that holds true and practicable till date[61]. Open fractures may significantly involve the associated soft tissue injury. For open fractures, modern orthopedic classification by Gustilo et al has taken into account the skin wound, extent of local soft tissue injury, contamination and severity of fracture pattern. The severity of closed fracture has been graded under Oestern and Tscherne Classification[62].

Classification Based On Prognosis

Based on a number of factors like type of fracture, type of bone involved, age of patient, body built, nutritional status, concomitant diseases, presence of complications and Prakruti (psycho-somatic constitution) etc.; the skeletal injuries have been classified into three major groups

Sukh Sadhya Bhagna (Easy To Manage / Good Prognosis): Fractures of young patients heal early[63]. The fractures involving Manibandha (wrist), Koorpara (elbow), Janu (Knee), Kati (lumbar region) and Prushtha (back region) get cured easily, as has been stated in Harita Samhita[64].

Krichha Sadhya Bhagna (Difficult To Manage / Bad Prognosis): Fracture patterns of Churnita, Chinna, Atipatita, Majja-anugata; fracture site adjacent to joint, fractures of emaciated, old aged or of children and of the patients with concomitant diseases like Kshata ksheena (wasting disease due to chest wound), Kushtha (skin diseases/ leprosy), Shwas Roga (Breathing disorders/Asthma) have been mentioned under this category[65]. The patients with poor nutritional status (Alpa-ashina), lack of self control or unstable psycho-somatic constitution (vataja prakruti) and with affliction of complications like suppuration of soft tissues like muscles, blood vessels and ligaments have been stated to pose difficulty in healing[66].

Asadhya Bhagna (Incurable / Worst Prognosis): These include fractures and dislocation of pelvic bones, fractures of skull, sternal fractures and fractures of spine. Also the fractures or dislocations that are mismanaged and the resultant of congenital skeletal anomalies have been put under this category[67]. In Harita Samhita the fractures related to 'Greeva Deshe' (cervical region), Indrabasti (a vital point or Marma), below Koorpara (elbow joint), in between Skandha (shoulder) and Koorpara (elbow joint), Trika-asthi (sacral region), near to heart and involving Kukshi (pelvic region) have been mentioned under Asadhya Bhagna[68].

Classification Based On Type Of Bone Involved

In Ayurveda, bones have been classified into five types according to shape and composition. These are Kapala (flat bones of skull, pelvis, palate etc.), Ruchaka (teeth), Taruna (soft bones or cartilages of nose, ear, neck etc.), Valaya (circular bones like ribs) and Nalaka (long bones of extremities) types[69]. Injury to these bones result in different type of fracture pattern[70]:

Taruna Asthi fractures: soft bones or cartilages got bent like green stick fractures.

Nalaka Asthi fractures: long bones show breaking fracture pattern.

Kapala Asthi fractures: flat bones elicit a torn pattern.

Ruchaka & Valaya Asthi fractures: teeth and circular bones get cracked when injured.

Classification Based On The Cause Involved

Traumatic fractures: In Charaka Samhita, the diseases have been divided into two major types based on etiology: Nija (resulting from internal causes like vitiation of Doshas, the vital components of physical constitution) and Agantuja (resulting from external causes viz, trauma)[71]. Acharya charaka has described Bhagna as Agantuja disease[72].

As per Acharya Sushruta twelve types of Kanda Bhagna (fractures) and six types of Sandhimukta (dislocations or joint injuries) have been described to be the resultant of various types of trauma[73]. Under Adhibhautika types of diseases, it belongs to Sanghata Bala Pravritta subtype as described in Sushruta Samhita[74]. Acharya Sushruta and Vagbhatta has described various types of trauma that may lead to Bhagna.

A comparative review of traumatic fractures described in various Ayurvedic treatises has been given the table as under:

SUMMARY OF TYPES OF KANDA BHAGNA (FRACTURES)

S. No.	Name of Type of Kanda Bhagna (Fracture)	Sushruta Samhita	Astanga Samgraha	Madhav Nidana	Bhavaprakasha
1	Karkataka	+	+	+	+
2	Ashwakarna	+	+	+	+
3	Churnita	+	+	+	+
4	Pichchita	+	+	+	+
5	Asthichhalita	+	+	+	+
6	Kandabhagna	+	-	+	+
7	Majjanugata	+	+	+	+
8	Atipatita	+	+	+	+
9	Vakra	+	+	+	+
10	Chhinna	+	-	+	+
11	Patita	+	-	+	-
12	Sphutita	+	+	-	+
13	Vellita	-	+	-	-
14	Sheshita	-	+	-	-
15	Darita	-	+	-	-
16	Savrana	-	-	+	-
17	Avrana	-	-	+	-
18	Avnata	-	-	-	-
19	Unnata	-	-	-	-
20	Anuvideerana	-	-	+	+
21	Bahuvideerana	-	-	+	+

Pathological Fractures: These are the fractures occurring in bone at an area of weakness caused by pathologic process like infection, tumours or secondary to some other disease etc.[75]. In Ayurvedic texts, pathologies related to bones have been described at various places mainly under the context of Asthi Vidradhi, Asthi Granthi, Asthi Kshaya, Majja Kshaya etc.[76, 77, 78].

In Harita Samhita the term 'Asphalita Asthi' denotes abscess formation in the bone and its management has been advocated like that of Bhagna (fracture)[79]. The congenital affection of skeletal tissues leading to pathological fractures and dislocations has been described by Sushruta under Asadhya Bhagna (incurable)[80].

Stress fracture/fatigue fractures: Excessive physical stress and strain may lead to vitiation of Asthivaha Srotasa[81]. Stress fractures or fatigue fractures are the resultant of repeated loads applied to the skeleton at the same site[82].

ADVANTAGES OF FRACTURE CLASSIFICATION

As an educational tool, the best advantage of fracture classification is to describe the fracture pattern. Fracture management depends upon fracture pattern. Not only it helps in devising treatment strategies but also guides about the prognosis[83].

LIMITATIONS OF FRACTURE CLASSIFICATION

The most primitive and basic fracture classification is available in Ayurveda. It is a general classification that is concise and non-descriptive. No bone specific classification systems are available in Ayurveda and there are no well defined parameters of classification. All this limits its usefulness in modern times. Today, despite the availability of a wide range of diagnostic tools, still a good number of limitations related to the interpretation are there.

Quality of radiographs, variability in making measurements on radiograph, complexity of decision making in applying a standard fracture classification system, inherent variability in human observation and variability in consideration of non-radiographic factors are the main limitations, that, till date there is no fracture classification system that can be rendered as gold standard. Most of the modern classification systems in use, lack formal validation[84].

CONCLUSION

In Ayurveda a wide range of fracture patterns have been described in the ancient treatises. It has served the purpose of guiding the management and prognosis but at the same time it is deprived of the required illustrations. The advent of refined diagnostic tools like X Ray and CT Scan have definitely helped in development and understanding of advanced classification systems. In Ayurveda not only the fractured part but the patient as a whole is treated, taking into consideration a cascade of factors like the overall health status, Prakruti (Psychosomatic constitution), age, seasonal influence, dietary habits and comorbidity status. All these factors if combined with radiographic appearance of fracture pattern can help a lot to guide treatment, to predict outcomes of fracture care and for clinical research as well. By adopting a combined approach, the main purpose of fracture classification can be served in a better way.

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