CONCEPTS OF ASTHI SHARIR (OSTEOLOGY) IN AYURVEDA

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ABSTRACT

Ancient seers of Ayurveda have classified the elements of the body under three fundamental components- Dosha, Dhatu and Mala. Among these basic elements Dhatus are especially meant for Dharana & Poshana of Sharira. When all the above factors act in harmony, it is defined as Swastha (health). Asthi is the hard part which forms framework of body, which supports the body just like trees stands on support of their inner wood. Knowledge of Asthi can be traced back from Vedas passing chronologically down to Samhitas. But the scholars preoccupied themselves with only hard parts of human skeleton. There is enough evidence of knowledge of Asthi Sharir (osteology) in the ancient India but in Sutra Rupa or in dispersed form. Starting from Pre-Vedic period, Vedic Period and Samhita-kalin period all have somewhat description of Asthi Sharir but not in mannered way. Due to different principles, faiths and way of learning, there may be some differences or lacunas from present day knowledge. Collection and critical analysis of various concepts related to Asthi Sharir as per modern headings like definitions, constituents, embryology, types, uses and clinical aspects. Thus an effort is undertaken to understand Asthi Sharir and its concepts in scientific way. Though there may be some differences or lacuna’s from now a day knowledge but, we can have proud on our glorified past of knowledge in every medicinal field especially in Asthi Sharir knowledge.

KEYWORDS- Asthi Sharir, Asthi Dhatu, Asthi Prakara, Osteology.

INTRODUCTION

Asthi is a hard substance which remains even after most part of body has been decayed. According to Susruta, Asthi is substance which remains even after else very part like flesh,
muscles etc. are shattered even after burying the body after death.\[^{[1]}\] It remains as last identity of person even after demise. According to Shabdstomkara, it is part of body which remains till long period even after death of body. [\(^{[2]}\) “Hada” is synonym of Asthi.] Amarkoshakara has given following synonyms of Asthi-“Keekas”, “Kulyamn”, meaning hard substance providing support to body. According to “Halayush kosa”, it is substance of body which remains till last and is in whole body.

**Asthi Dhatu-** Dhatus are the tissue-humoral systems of the body. They are always formed in a fixed sequence. In different permutations and combinations the Dhatus form various physical organs of the body according to the genetically coded information’s. It is one among the Saptadhatus which are present in the Sharira. Form of Dhatu which is present inside the Mansa Dhatu is known as Asthi.\[^{[4]}\]

**Panchabhaṭṭa Constituents-** Though every substance is made of all five Mahabhutas (Akasha, Vayu, Agni, Jala and Prithivi), but Asthi has predominance of Prithivi and Vayu Mahabhuta. \[^{[5]}\] As we have seen that Asthi has predominance of Prithvi and Vayu Mahabhuta, Asthi Dhatu thus comprises qualities of these two dominantly. As per qualities of Prithvi Mahabhuta, Asthi is strong and heavy and as per qualities of Vayu Mahabhuta, Asthi is dry and rough. Thus, both these Mahabhutas give characteristic qualities like toughness, roughness, dryness and hardness.\[^{[6]}\]

**Asthi Utpatti and Poshana-** As is told by Acharya Charak in Chikitsa Sthana \[^{[7]}\], after Rasa Rakta is formed. From Rakta Mansa is formed, from Mansa Meda is formed, from Meda Asthi is formed, from Asthi Majja is formed and from Majja Shukra Dhatu is formed, which when gets adequate conditions develops into Garbha.

Chakrapani details it as follows- For first three Dhatu –Rasa after being digested by Rasagni gets converted into Rakta and like this Rakta digested with its Raktaagni gets converted into Mansa. Like this all Dhatu gets converted into next coming Dhatu. Like as Dugdha to Dahi, Dahi to Navneeta, Navneeta to Grihta and from Grihta to Grhtamanda get converted step wise, same is concept for Dhatu formation.

But many doubts\[^{[8]}\] arises here in this explanation of Dhatu development like.... when both Mansa and Meda Dhatu are Slakhana than how is Asthi Dhatu is kharatav (solid)? If Asthi Dhatu is kharatav than how does Majja Dhatu which resides in Asthi are Snighda and
Mrudu? These doubts popped up by disciples where satisfied by Archarya as he explains, it as every next coming Dhatu in series gets its nutrition from Dhatwagni of particular Dhatu and supply from earlier Dhatu. Ghanatava, kharatava are due to Vayu, Snighatava due to Jala etc.

According to Kasyapa- Asthi and Mansa of embryo are developed from this Sukra and from these two Snayu are developed in first two months of fetal development [9].

Though development of Asthivaha Srotas has not been described separately, yet Susruta describes it in description of Medodhara Kala [10]. Here Susrutha tells that Medodhara Kala is present in Udar (abdomen), Anuasthi (short bones) and Majja in Mahat Asthi (long bones).

**Time taken in formation of Asthi Dhatu**- There are two opinions regarding formation of Asthi depending upon the time factor. Like on the 6th day and 20th day. [11, 12]

**Relation between Vata Dosha and Asthi Dhatu**- According to the classics, Asthi is the seat of Vata and Asthi acts as Ashraya and Vata acts as Ashrayee. Even though the basic rule is that the materials which cause increase of Ashraya should also affect the increase of Ashrayee and materials that cause decrease of Ashraya cause decrease of Ashrayee. The reverse is true in the case of Vata and Asthi. A material which causes increases of Asthi will produce decrease of Vata and vice versa.

**Contribution of Asthi for body**- As the toy is made up of straws and threads and pasted with the wet clay from outside, similarly Snayu (ligaments) are tied with Asthi (bones) in body. Ligaments are covered by Mansa (muscles) which are nourished continuously by the Dhamani and Sira (vessels) and then whole body is covered by Twacha (skin). This indicates that Asthi is meant for playing anchor role of frame work of body and is supported effectively by Snayu, Mansa, Dhamni and Sira. [13]

**Asthidhara Kala**- Purisha dhara kala is the 5th Kala which exits in large intestine i.e. Pakvashaya. Functionally it separates constituents of Kitta or waste products in colon. Vayu which is produced in Pakvashaya (as Anna Mala) is Poshaka Vayu, which nourishes Poshya Vayu of body. As we know that Pakvashaya and Asthi, both are main seats of Vata Dosha. Therefore, increased or decreased formation of Vata and Purisha affects all sites of Vata, especially Asthi Dhatu. Hence Purisha-Dhara Kala is also called as Asthi-Dhara Kala. [14]
Asthi Karmas-The Asthi Karmas are as follows-Deha Dharana; Majja Pushiti and Asthi supports the Mamsa, Sira and Snayu.\\[15,16\\]

Asthi Upadhatu \[^{17}\] - The Upadhatu of Asthi is Danta (teeth’s.)

Asthi Malas- During the formation of any Dhatu it will produce their own Malas. Similarly Asthi also has Malas, as per different texts.

Table No.1: The Malas of Asthi \[^{18,19}\]

<table>
<thead>
<tr>
<th>S.No</th>
<th>Asthi mala</th>
<th>Ch.S.</th>
<th>Su.S.</th>
<th>B.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kesha</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Loma</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Nakha</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>Roma</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Asthi Sankhya- The numbers of Asthi in the Sharira according to different Samhitas are as follows.

Table No.2: The Numbers of Asthi \[^{20}\][21][22][23][24]

<table>
<thead>
<tr>
<th>S.No</th>
<th>Text books</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Charaka Samhita</td>
<td>360</td>
</tr>
<tr>
<td>2.</td>
<td>Sushruta Samhita</td>
<td>300</td>
</tr>
<tr>
<td>3.</td>
<td>Astanga Hrudaya</td>
<td>360</td>
</tr>
<tr>
<td>4.</td>
<td>Astanga Sangraha</td>
<td>360</td>
</tr>
<tr>
<td>5.</td>
<td>Bhavaprakasha</td>
<td>300</td>
</tr>
<tr>
<td>6.</td>
<td>Kashyapa Samhita</td>
<td>360</td>
</tr>
<tr>
<td>7.</td>
<td>Bhela Samhita</td>
<td>360</td>
</tr>
</tbody>
</table>

The distributions of Asthi in the Shadanga of Sharira are as follows-

According to Sushruta Samhita \[^{25}\]
- Shaakha : 140
- Shroni, Parshva, Prushtha, Uras: 117
- Greevordhva : 63

According to Ashtanga Sangraha \[^{26}\]
- Shaakha :140
- Madhya Sharira:120
- Urdhva Sharira: 100
Asthi Bhedas (Types) - Depending upon size, shape, position \[^{27}\]\ of Asthi in the body total Asthi is divided into five types. These are tabulated below.

Table No.3: The Types of Asthi \[^{28}\][^{29}\][^{30}\]

<table>
<thead>
<tr>
<th>S.No</th>
<th>Types</th>
<th>S.S</th>
<th>A.S</th>
<th>A.H.</th>
<th>B.P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kapala</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Ruchaka</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Taruna</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>Valaya</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>Nalaka</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Kapalasthi \[^{31}\]\ - These are flat in nature. Literally it means bone which covers and protects the brain \[^{32}\].

Valayasthi \[^{33}\]\ - These are round in shape or particularly hemi circle in shape.

Tarunasthi \[^{34}\]\ - These are soft in nature. Literally it means which have either not fully developed i.e. ossified. Also the bones of child have come under same scenario. \[^{35}\]

Nalikasthi \[^{36}\]\ - These are long like tubes and hollow from within. They are reed shaped.

Ruchakasthi \[^{37}\]\ - The bones which are different from all and are utilized to chew food and enjoy the taste. These are for taste sensation \[^{38}\].

The locations of each type

1) Kapala- Asthi’s present in the Janu, Nitamba, Amsa, Ganda, Talu, Shankha, Vankshana and Madhyashira are known as Kapala Asthi. \[^{39}\][^{40}\]

2) Valaya- Asthi in Pani, Pada, Uru, Parshva and Prushtha are Valayasthi. \[^{41}\] Some commentator’s don’t agree with it as they count some other bones in this category as Pada, Hasta, Griva and Prishsta.

3) Taruna- Asthi’s present in the Ghrana, Karna, Greeva and Akshikuta are called as Tarunasthi \[^{42}\]. Bhoja also added Kantha \[^{52}\] in list.

4) Nalaka- Asthi’s which are left from above description is listed in this type.\[^{52}\] Commentators like Dalhana and Bhoja have specified some of bones like Hasta Anguli, Pada Anguli, Pada Tala, Kurcha, \[^{43}\] Bahu Asthi, Jangha Asthi etc in examples of this type.

5) Ruchaka- The Dashanas are known as Ruchakasthi. These are 28 or 32 in all. So, here Ruchaka i.e. Danta (teeth) are also regarded as Asthi along with various other stiff parts.
Asthivaha Srotas- Channels of circulation or tracts within the body are called Srotas. They are named so because of their tendency of trickling or oozing (Sru: ‘to flow’) of secretions through them. They are the pathways (Ayana) for the nutrient products; waste-products and Doshas during the process of metabolism. Srotas enable their products to reach their destination (viz. assimilation of nutrient substances by different parts of the body, or elimination of waste products from the body). They transport the Dhatus which are undergoing transformation. Srotas are entity which carries onward the converted products from Prokopa and Shamak Aahar in human body so is the definition and function of Asthivaha Srotas.\(^{[44]}\)

Asthivaha Srotas finds its identity only in Charaka\(^{[45]}\), Vagbhata\(^{[46]}\)\(^{[47]}\) but its description is missing from Susruta’s text\(^{[48]}\). As per Charaka its Moolasthana, Dusti karana and Dustilaksanas are described. Exclusion of Asthi Vaha Srotas from Susruta’s list is due to his surgeon’s vision upon anatomical structures described as Moolasthana that’s why he described Moola Viddha Lakshanam in reference to injury.

Asthivaha Sroto Moola- The Asthivaha Sroto Moolas which are mentioned in different Samhitas are listed below.

Table No.4: The Sroto Moolas of Asthi\(^{[49]}\)\(^{[50]}\)\(^{[51]}\)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Sroto moola</th>
<th>Ch.S.</th>
<th>As.H.</th>
<th>As.S</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Medo Dhatu</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Jaghna</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Asthi sandhi</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Asthivaha Srotas Dusti karana\(^{[52]}\) - Excessive exercise, excessive stretching, trauma or excessive Vata Dosha Pradhan Aahar and Vihar can cause Asthivaha Srotas Dusti.

Asthivaha Srotas Dusti Lakshana\(^{[53]}\) - These includes Adhyaasthi, Abhidanta, Dantabheda, Dantshoola, Asthibheda, Asthishoola, Asthi Vivaranta , Danta Vivaranta, diseases of hair, nails and beard.

ASTHI MARMA- In Adhyaya six of Susruta Samhita description of Marma is given in very detail.\(^{[54]}\) Total number of Marmas is 107. \(^{[55]}\) Which are uniform in all Samhitas. Sushruta clearly indicates that a surgeon should be careful enough during operation of any patient to avoid these vital points. Total no of Marmas according to anatomical matrix are divided in 5 categories\(^{[56]}\)
Here we are concerned only with Asthi Marma\textsuperscript{[57]} which is Katikataruna (2), Nitamba (2), Amsaphalaka (2) and Sankha (2).

**Katikataruna**\textsuperscript{[58]} - This is situated in back. Kati means waist + Taruna means Cartilagenous

- Number - 2
- Type - Pristha, Asthi and Kalantarapranahara Marma
- Size - Half finger breadth.
- Location - Marma is near upper margin or pelvic bone (few centimeters from lumbo-sacral joints).
- Anatomy – Sacroiliac joint each side the underlying structures are – iliac bone iliac artery and sacroiliac joint and ligaments.
- On injury- Hemorrhage and death.

**Nitamba**\textsuperscript{[59]} - This Marma refers sciatic nerve cord before entering the femoral region.

- Type - Pristha, Asthi and Kalantarapranahara Marma.
- Size - Half finger breadth.
- Location - Above pelvic crest, pelvis and both united flanks are together known as Nitamba Marma.
- Anatomy - The Marma lies on half the distance between sacral bone and femoral greater trochanter.
- On injury- Edema and Weakness on legs.

**Amsaphalaka**\textsuperscript{[60]} - This refers to scapular blade.

- Types - Pristha, Asthi and Vaikalyakara Marma.
- Size - Half finger breadth.
- Location - Upper medial edge of scapular blade.
- Anatomy – This area is very important as nerve and vascular supply under it, like thoraco-cervical nerve fibers supplying the scapular muscles and reaches brachial plexus.
On injury- Disfigurement of upper limb

*Sankha*[^61^] - This refers to anatomical temporal bone.

- **Types** - *Sira, Asthi, Sadyah Pranahara Marma*
- **Site** - It is in between parietal, frontal and maxillary portion of skull.
- **Anatomy** - Underneath this lies a temporal lobe of cortex arterial branches.
- **Location** - Above the end of eyebrow and between ear and forehead.
- **Size** - Half finger breadth.
- **On injury** - Death

**ASTHI PRADOSHAJA VIKARAS**

*Dalhana* mentioned the reason behind explaining the *Dhatu Pradosaja Vikara* separately, these are - *Chikitsa Vishesa Vijnanartha* and *Sukhasadhyatvadi Karma Bodhartham*.

The *Asthi Pradoshaja Vikaras* which are mentioned in different classics are *Vyadhi – Adhyasthi, Adhidanta, Dantabheda, Dantashoola, Asthibheda, Asthishoola, Vivarnata, Kesa, Loma, Nakha, Smashru Dosha, Kunakha and Asthi toda*.[^62^][^63^] *Yogendranath Sen* in commentary of *Charaka Samhita* mentioned that *Kesha, Loma* and *Smashru* are *Malas* of the *Asthi Dhatu*. This is the reason to consider *Keshadi Doshas* as one among the *Asthi Pradoshaja Vikaras*.

**EFFECT OF TRAUMA ON BONES**

The bones sustain trauma in different ways. *Acharya Susruta* has paid due attention to this fact and observed that all the bones[^64^] do not show similar type of effect due to trauma.

1. *Tarunasthi* (Cartilage) – Bend
2. *Nalkasthi* (Long bones) – Break
3. *Kapalasthi* (Flat bones) – Crack
4. *Ruchkasthi* (Teeth) – Fragmented
5. *Valayasthi* (Curved bones) - Crack or Break

**Classification**[^65^] - On the basis of structure involved the skeletal injuries have been divided in two types - *Sandhimukta* (Joint Dislocation) and *Kandabhagna* (Bone Fracture).
The Kandabhagna further is of following twelve types- Karkataka, Ashwakarana, Churnitam, Pichhitam, Asthichallita, Kanda bhagna, Majjanugatam, Atipatitam, Vakra, Chinnam, Patitam and Sputita. [66]

CLINICAL FEATURES
The clinical signs described in Ayurvedic texts stand as mentioned in any modern surgical text book. The Susruta’s contribution in this aspect is so perfect that it has hardly any room for alteration even today. He has mentioned signs and symptoms as general and specific features.

General Features of Kandabhagna [67]
Shvyathubahulyam (marked swelling), Sparshasahisnutvam (tenderness), Avapidyamaneshabda (crepitus), Vividhavedanapradurbhavah (Different types of pains) and Sarvasuavasthasu Na Sharmalabha (Inability to get comfort in any position).

BHAGNA CHIKITSA- The ancient Ayurvedic texts have described ‘Asthibhagna Chikitsa’ thoroughly. This includes: Principles of Bhagna Chikitsa, general management of Bhagna, specific management for different types of fractures, medicinal preparations for different kinds of fractures, Pathya- Apathya and clinical criteria of fracture healing.

Four Principles [68] of Treatment
1. Anchan- To apply traction
2. Pidana- Manipulation by local pressure

The above mentioned classification of fractures is described by Susruta. This indicates his accuracy in clinical diagnosis. He has classified those varieties merely on clinical assessment, such as according to position of broken fragments, site of fracture, direction of force, and from the deformity caused by broken fragments.

CONCLUSION
Such a detailed knowledge of bones necessarily presupposes a careful study of human skeleton since the Vedic period. This shows the that the knowledge of osteology was fairly advanced in ancient period, but the scholars preoccupied themselves with only hard parts of human skeleton, i.e. the stuff which remains after the softer tissues of the body have been disintegrated and thus not only the bones, but the cartilages and ligaments too.
Literal and fundamental work has sole aim to relate and convert the age old knowledge into more clinician friendly as per terms of this new era but to retain its principles and their basics. Thus in this article we have collected various concepts related to Asthi Sharir as per modern era like definitions, constituents, embryology, types, uses and clinical aspects. Though there may be some differences or lacuna’s from now a day knowledge but, we can have proud on our glorified past of knowledge in every medicinal field especially in Asthi Sharir knowledge.

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