

**Comparative study of Asthi Sankhya (Bones) according to Ayurveda and Modern Science****-Vd. Tatyasaheb Deshmukh**

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**Introduction**

**A**yurveda is science of life which deals with prevention and treatment of disease. Ayurveda mentioned Seven Dhatu (Sapth Dhatu) Rasa, Rakta, Mamsa, Meda, Asthi, Majja, Shukra these seven dhatu holds the whole body structure and constituents. Out of these seven body constituents Asthi Dhatu provide shape, support and protection to body and body organs it means human bodies structural design is held by Asthi Dhatu. Human body is held by Asthi Dhatu.

All human organs and body elements are supported and protected by Asthi (Bones). Asthi are most important and hard element of human body. When we study any diseases we must know the anatomy first so it is very important to study human anatomical base i.e. Asthi (Bones).

Number of bones (Asthi) in different era and literature of Ayurveda are mentioned different. There is also difference of opinions in our Ayurveda Acharyas also. They mentioned the number of bones in Charaksamhita as 360, Sushrutacharya as 300, Unani as 244/240 and modern science as 206.

Sushrutacharya mentioned the number of bones (Asthi) in human body are 300 which excludes Nails (Nakh), Gums (Ulukhal).

Modern science mentioned the number of bones (Asthi) in human body are 206 which excludes Teeth (Dant), Nails (Nakh), Cartilages (Tarunasthi).

Considering all the above numbers of bones in human body still question remains why? There is a difference in a number of bones excluding common excludes? In this research topic we will study difference in a number of bones with its

scientific aspects and relative factors, to co-relate the actual number of bones in human body by dissection and literature study and try to overcome the difference.

**Need For Study**

1. To co-relate number of bones by Ayurveda & Modern Science.
2. To study difference in number of bones (Asthi Sankhya) according to Ayurveda & Modern Science.

**Aim And Objectives****Aim**

- 1) Comparative study of number of bones (Asthi Sankhya) according to Ayurveda & Modern Science.

**Objectives**

- Confirmation of number of bones (Asthi Sankhya).
- Scientific study of difference in number of bones (Asthi Sankhya) according to Ayurveda & Modern Science.

**Review of Literature****Asthi (Bones)**

Asthi is most hard and tough material (Dhatu) in human body. The structural design of body is supported by Asthi (Bones) only. Asthi (Bones) gives proper shape and support to body. All other dhatu like Mamsa, Meda, Rakta etc and many soft organ in human body are covered or supported by Asthi (Bones) only.

Our human body without bones will be like Ameba or jelly fish it will lose its proper shape and size. It is very important body element in human body.

**Definition :** Definition of Asthi (Bones) is pretended by different ancient Acharayas in many literatures like Shabda- kalpdrum Amarkosh and Vachaspati etc.

Structural design of body (Kankal) designed by vertebra's placed in column is called as Asthi (Kasheruk). Medo dhatu by its own metabolism (swa-agni) and with the help of Vayu produces dryness in it this sar material or digested material is called as Asthi. Inside this material sponginess is present which is filled by Prasad material, which holds the body structure and is covered by Mams dhatu like a cement in a pillar. Asthi does not easily decomposed or burned even body is burned or decomposed. Mams dhatu is held with the support of Asthi elsewhere it is converted in to Sira, Snayu, Dhamani. Asthi dhatu is only dhatu among the seven dhatu's which holds the body is strong and hard material in the body. Asthi is main body supporting material in human body as well internal organs also supported and protected by Asthi dhatu. It is a main body structure which gives shape to human body.

**Asthi Vivechan**

Bones (Asthi) is a most hard substance in human body. When we study Asthi in details we can't find the detailed description of composition and constituents of Asthi in Samhita. Very few information about the internal assessment and structure of Asthi is available in Ayurvedic literature.

According to Ayurvedic literature Prasadmedodhatu is further metabolized by Asthi-Dhatwagni and get solid or rigid state is called as Asthi. Due to Vayu Asthi gets sponginess (Sushir) and it is filled with Marrow (Majja) in long bones while short bones are filled with Sarakta Meda or Lohit Majja.

**Asthi Swarup**

Asthi Dhathu is 'Panchbhautik' still it is Prithvi dominant in nature. According to law of 'Vyapdeshtu Bhuyasa' asthi dhatu is called 'Parthiv'.

Due to Prithvi Mehaboota Asthi Dhathu gets in to solid stage. By Vayu and Akash Mahabhoota Asthi gets its sponginess (Sushir). Sushruta says Majja is inner part of Asthi that is in liquid stage. Asthi contains Pitta and Red marrow (Lohit Majja)

they are fixed inside by Agni Mahabhoota. Sushruta believes Asthi as 'Pitruj Bhav' (male character).

Asthi Dhathu is most solid constituents of body. It has heaviness (Gurutva), Stability (Sthiratva), Solidity (Stulatva), Reality (Murtiman) all these qualities of Asthi are peculiarities of Prithvi Mahabhoota. (Parthiva).

After fertilization initial stages of embryological development Vayu divides the embryo cells into multiples of Asthi numbers in body. 'Kashapa' believes prominence of Vata during the cell divisions of embryo in initial stage. Charkacharya believes the main shelter of Vata is Asthi. Vaghabhatcharya also believes Vata in Asthi as a main 'Asharayasthan'.

Human height is mainly depends upon development of length of Asthi (Bone) only.

**Asthi Sankhya (Bone numbers)**

Since long back there is a difference of opinions about number of bones in human body. There is a major difference in number of bones in Atreya believers and Dhanwantri followers. Atreya believers are mainly medicinal physicians while Dhanwantri followers are surgery persons. Acharya Sushruta believed number of bones are 300 while Vedic believers stated 360 as number of bones in human body. Stating the number of bones Sushruta says Ved Vedic believes the number as 360 but surgical believers says the number as 300.

**Modern Review**

**Functions of Bones:-**

The functions of bones are as follows-

- It supports soft tissue and provides attachments for skeletal muscles.
- It protects internal organs from injury.
- It assists in movement together with skeletal muscles.
- It stores and releases minerals.
- It contains red bone marrow, which produces blood cells.
- It contains yellow bone marrow, which stores triglycerides i.e. fat.

**Structure of Bone :-**

• **Macroscopic structure of bone :-**

Macroscopically living bone is white in colour, with either texture like ivory i.e. compact bone or honeycombed by large cavities, the bone being

reduced to a latticework i.e. cancellous or bars and plates (trabeculae), in which it is called trabecular, cancellous or spongy bone.

#### **Microscopic structure of bone :-**

Bone is composed of cells embedded in stiff calcified matrix. These consists of a number of different components as follows-

- Osteoprogenitor cells which give rise to various other bone cells.
- Osteoblasts which lay down bone.
- Osteocytes within bone.
- Bone lining cells on its surface.\
- Osteoclasts which erode it.

#### **Matrix-**

The inorganic substance is made up of calcium, phosphorus & traces of magnesium etc and the ratio between the calcium and phosphorus is almost constant in normal conditions. The organic part of matrix is made up mostly of substances which resemble collagen of the connective tissue and is known as ossein. Mucoïd & albumoid substances are also present in traces and are known as Osseomucoïd and Osseoalbumoid substances respectively.

#### **Nail (anatomy)**

##### **Human nails**

A **nail** is a horn-like envelope covering the dorsal aspect of the terminal phalanges of fingers and toes in humans, most non-human primates, and a few other mammals. Nails are similar to claws in other animals. Fingernails and toenails are made of a tough protein called keratin.

##### **Human anatomy**

The nail consists of the nail plate, the nail matrix and the nail bed below it, and the grooves surrounding it.

#### **Teeth Anatomy**

##### **Dental anatomy**

Dental anatomy is a field of anatomy dedicated to the study of tooth structure. The development, appearance, and classification of teeth fall within its field of study, though dental occlusion, or contact among teeth, does not. Dental anatomy is also a taxonomic science as it is concerned with the naming of teeth and their

structures. This information serves a practical purpose for dentists, enabling them to easily identify teeth and structures during treatment.

#### **Gingiva**

The gingiva ("gums") is the mucosal tissue that overlays the jaws. There are three different types of epithelium associated with the gingiva: gingival, junctional, and sulcular epithelium. These three types form from a mass of epithelial cells known as the epithelial cuff between the tooth and the mouth. The gingival epithelium is not associated directly with tooth attachment and is visible in the mouth. The junctional epithelium, composed of the basal lamina and hemidesmosomes, forms an attachment to the tooth.

The sulcular epithelium is nonkeratinized stratified squamous tissue on the gingiva which touches but is not attached to the tooth.

#### **Materials & Methods**

Being subject of comparison based on subject like bone number (Asthi Sankhya) especially in Ayurvedic literature and modern science having difference in number of bones in a human body. It's a small try to study difference on the following levels -

- Literary study
- Dissection study
- Comparative study
- Comparative charts of number of bones.

#### **Materials**

- Dissection kit
- Cadaver

#### **Literature -**

- Ayurvedic Literature
- Modern Literature
- Previous research papers.

#### **Methods**

##### **Literary Study**

This study was carried out on the basis of Ayurvedic literature regarding the concept of bone (Asthi) in general and bone number (Asthi Sankhya) in particular with the references of specially Charak Samhita, Sushrut Samhita and Waghbhat Samhita i.e. Asthang Sangrah.



**Modern literature**

As the topic of number of bones in human body the modern literature is reviewed in detail from different angles and many topics.

Sushrutacharya in Sushrut Samhita mentioned the number of bones 300 in Sharir sthan according to six regions (Divisions) of body.

**Upper extremities (Urdhwa Shakha)**

Sr. No.	Name of bone (Modern Name)	No. of bones
1	Angulyasthi (14 Phalanges & 1 <sup>st</sup> Metacarpals)	15+15=30
2	Talasthi (4 Metacarpal except 1 <sup>st</sup> )	4+4=8
3	Kurchasthi (Trapezium, Trapezoid, Capitate Hamate, Triquetrum)	5+5=10
4	Manika (Scapoid & Lunate)	1+1=2
5	Parshni (Pisiform)	1+1=2
6	Aratni (Radius & ulna)	2+2=4
7	Karpurasthi (Olecranon process)	1+1=2
8	Bahunalak (Humerus)	1+1=2
<b>Total</b>		<b>30+30=60</b>

**Lower extremities (Adho Shakha)**

Sr.No.	Name of bone (Modern Name)	No. Of bones
1	Padanguly Asthi (14 Phalanges & 1 Sesmoid bone)	15+15=30
2	Talasthi (Metatarsals except 1 <sup>st</sup> )	4+4=8
3	Kurchasthi (3 cuneiforms, cuboid, Navicular)	5+5=10
4	Gulf (Talus)	1+1=2
5	Parshni (Calcaneum)	1+1=2
6	Janghasthi (Tibia & Fibula)	2+2=4
7	Janu (Patella)	1+1=2
8	Urunalaka (Femur)	1+1=2
<b>Total</b>		<b>30+30=60</b>

**Mid Region (Madhya Sharir)**

Sr. No.	Name of bone (Modern Name)	No. of bones
1	Nitambasthi (Hip bone except pubic bone)	1+1=2
2	Bhagasthi (os pubic)	1
3	Gudasthi (Coccyx)	1
4	Trikasthi (Sacrum)	1

5	Prasthasthi (1 <sup>st</sup> sacral & all lumber vertebrae with their Transverse processes & 12 Thoracic vertebrae without transverse processes)	30
6	Sthalak (transverse processes of Thoracic vertebra)	24
7	Sthalakarbuda (Vertebral ends of Ribs)	24
8	Parshuka (Ribs)	24
9	Urosthi (6 sternal segments & 2 clavicles)	8
10	Ansfalak (Scapula)	1+1=2
<b>Total</b>		<b>117</b>

**Head, Neck, Face (Shiro - Greeva)**

Sr.No.	Name of bone (Modern Name)	No.of bones
1	Greevasthi (7 cervicle vertebrae & 2 transverse processes of 7 <sup>th</sup> vertebrae)	9
2	Kanthnadi (Hyoid, Thyriod, cricoid & cartilages of skeleton of Trachea)	4
3	Hanwasthi (Mandible & maxilla)	2
4	Nasasthi (2 Nasal bone and 1 Nasal septum)	3
5	Gandasthi (Zygomatic bones)	1+1=2
6	Talwasthi (Palatine process of maxilla & palatine bones) Hard plate	1
7	Shankasthi (Squamous Temporale)	1+1=2
8	Karnasthi (Petromastoid)	1+1=2
9	Shirosthi (1 frontal, 2 parietals, 1 occipital, 1 sphenoid & 1 Ethmoid bones)	6
<b>Total</b>		<b>63</b>

**60 + 60 + 117 + 63 = 300**

**Modern science**

Modern science has stated the total number of bones in human body are 206. There is also slight difference about number of bones is 206 or 208. Many modern peoples are considering coccyx as single bone but some of them believe that it is a fusion of three bones hence the number differs to 208 but here we will consider the number 206 which is stated by most of the modern science texts and accepted universally.

**Upper extremities (Urdhwa Shakha)**

Sr. No.	Name of bone	No. of bones
1	Humerus	1+1=2
2	Radius	1+1=2
3	Ulna	1+1=2
4	Carpals (Scaphoid, Lunate, Triquetrum, Pisiform, Trapezium, Trapezoid, Capitate, Hamate)	8+8=16
5	Metacarpals	5+5=10
6	Phalanges	14+14=28
<b>Total</b>		<b>60</b>

**Lower extremities (Adho Shakha)**

Sr.No.	Name of bone	No. of bones
1	Femur	1+1=2
2	Tibia	1+1=2
3	Fibula	1+1=2
4	Patella	1+2=2
5	Tarsals (Calcaneum, Talus, 1)	7+7=14
6	Metatarsals	5+5=10
7	Phalanges	14+14=28
<b>Total</b>		<b>60</b>

**Mid region (Madhya Sharir)**

Sr. No.	Name of bone	No. of bones
1	Scapula	1+1=2
2	Clavicle	1+1=2
3	Sternum	=1
4	Ribs	12+12=24
5	Vertebrae (12 Thoracic, 5 Lumber 1 Sacrum, 1 Coccyx)	12+5+1=19
6	Hip Bone	1+1=2
<b>Total</b>		<b>50</b>

**Head, Neck, Face (Shiro Greeva)**

Sr. No.	Name of bone	No. of bones
1	Cranial bones (1 Frontal, 1 Occipital, 2 Parietal, 2 Temporal, 1 Ethmoid, 1 Sphenoid)	=8
2	Facial bones (1 Mandible, 2 Maxilla, 2 Palatine bones, 2 Zygomatic, 2 Nasal, 1 Lacrimal, 2 Inferior nasal conchae, 1 Vomer)	=14
3	Middle Ear (2 Malleus, 2 Incus, 2)	=6

	Stapes)	
4	Cervical Vertebrae	=7
5	Hyoid Bone	=1
<b>Total</b>		<b>36</b>

**60+60+50+36= 206**

**Comparative charts of number of bones.**

Sr. No.	Region wise	Charak	Waghbhat	Sushrut	Modern
1.	Upper extremities (Urdhwa Shakha)	60	70	60	60
2.	Lower extremities (Adho Shakha)	68	70	60	60
3.	Mid region (Madhya Sharir)	141	120	117	50
4.	Head, Neck, face (Shiro Greeva)	91	100	63	36
		<b>360</b>	<b>360</b>	<b>300</b>	<b>206</b>

**Observations**

- **Sushrutacharya mentioned following bones in details having difference with modern science in number as follows :-**
- First Metacarpal with 14 phalanges included in Anguli Asthi so the number becomes 15 each while modern science mentioned them as a separate bones.
- Four Metacarpal except 1<sup>st</sup> included in Talasthi while modern science mentioned under different types.
- Carpal bones number is seven while modern science number is eight they are described under three types i.e. (1) Kurchasthi-5 (Trapezium, Trapezoid, Triquetrum, Capitate, Hamate), (2) Manika-1 (includes Scaphoid and Lunate as a single bone), (3) Parshni Sthaniya-1 (Pisiform).

- Olecranon process of Ulna as a separate bone i.e. Karpurasthi while it is a part of Ulna bone according to modern science.
- Sesmoid bone is included in Anguli Asthi while modern science not included them in total number of bones.
- Metatarsal bones counted four (Except 1<sup>st</sup>) while modern science mentioned and counted as a five in number.
- Seven Tarsal bones mentioned under three different types i.e. Kurchasthi - 5, (2) Gulf - 1, (3) Parshni - 1 same as a modern science number i.e. 7. Pubis i.e. Bhagasthi as a separate bone while modern science mentioned as part of Hip bone.
- Transverse processes of 1<sup>st</sup> Sacral, 5 Lumber vertebrae as a separate bones (6+6=12) i.e. Prasthasthi, Transverse processes of Thoracic vertebrae are also counted as separate bones (12+12=24) i.e. Sthalak while modern science mentioned them as a part of respective vertebrae and not a separate bone.
- Sternum is considered as six bones with two Clavicles and included as eight bones i.e. Urosthi while modern science mentioned sternum as single bone and clavicle as a separate two bones.
- Transverse processes of 7<sup>th</sup> cervicle vertebrae are included as two separate bones with seven cervicle vertebrae in Greevasthi while Transverse processes are part of respective vertebrae according to modern science.
- Thyriod, Cricoid, Cartilages of Trachea are included as separate bones with Hyoid in Kanthnadi Asthi (4) while modern science considered only Hyoid as bone.
- Teeths (Dant-32) are included in number of bones while modern science not included them in total number of bones.

**Result**

Comparative study of number of bones in a human body is done with detail review of literature both Ayurvedic and Modern science with cadaver study (dissection) and comparison is carried out by scientific analysis of observations obtained through different charts prepared by detail review of literature the final result is prepared as follows.

Number of bones in a human body are **300** according to Sushrutacharya is more appropriate and realistic considering all aspects of Ayurvedic and modern science literature reviewed, modern science bone number 206 is finalized through time

to time study with recent modern techniques like Radio imageing, Microscopic study and diffrenciate the materials like Cartilages and Teeths from actual concept of bone and excludes them from total number of bones.

Difference in total number of bones according to Ayurveda especially Shushrutacharya and Modern science is mainly due to different time and theory base they study, recent modern techniques to seprate the materials like Cartilages and Teeths from concept of bone. Changing the Defination and norms of bone material by Microscopic and Radio-Imaging study, further elaboration and research required to overcome the difference with modern science bone number 206 by various methods suggested by Ayurveda and Modern science with scientific approaches and resprctive techniques.

**Conclusion**

Comparative study of Asthi Sankhya was devised by elaborating and interpreting the basic concept of Asthi from various references appearing in Brihat-Trayi and its relevant commentaries.

The comparison was carried out by Scrutnizing various interpretations/meanings of Asthi.

Asthi Sankhya was comparied from both Ayurvedic and Modern literary references.

Ultimately it must be summarized that Asthi Sankhya must be same with slight differences in Ayurveda and modern science and must be studied more elaboratively by various methods suggested by Ayurveda and modern science with scientific approaches and respective techniques.

Scientific analysis of all observations obtained by review of literature Ayurvedic and modern science with dissection of cadaver on comparative basis the final conclusion of this study is as fallows If we add **32 Teeths** in Total number of bones by **modern science (206)** as hard bones it will comes to 238 as hard bones. **Cartilagenous** bones in body are 7 in Nasal, 2 in external ears, 9 in vocal cords, 18 in trachea, 24 costal cartilages of Ribs total number is **62**.

Thus it is concluded that if we add the Teeths (Dant) and cartilageous bones (Tarunasthi) to modern science bone number the total number of bones will be **300 (206+32+62)** and this is the major



difference in number of bones by Sushrutacharya and many Ayurved Acharyas with modern science bone number **206** which excludes the cartilages (Tarunasthi) and Teeths (Dant) form total number of bones.

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