



A Conceptual And Clinical Review Of *Asthi Dhātu* And *Asthivaha Srotas* With Reference To Modern Osteology

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ABSTRACT

Asthi Dhatu is one of the fundamental structural components of the human body described in Ayurveda and holds a pivotal role in maintaining bodily integrity and function. Among the seven *Dhatus Rasa, Rakta, Mamsa, Meda, Asthi, Majja*, and *Shukra*. *Asthi Dhatu* is the fifth and is primarily responsible for *dharana*, or providing support, stability, and shape to the body. Classical Ayurvedic texts, particularly *Sushruta Samhita*, describe *Asthi* as the hardest and most enduring tissue, persisting even after the decay of other bodily components and serving as the last physical identity of an individual after death. Etymological sources such as *Shabda Kalpadruma* and *Amarakosha* emphasize its hardness and load-bearing nature.

Asthi Dhatu is considered a *Pitruja Bhava*, predominantly composed of *Prithvi Mahabhuta*, and is formed from the essence of *Meda Dhatu* through the action of *Asthi Dhatu Agni*. It provides nourishment to *Majja Dhatu* and serves as the primary site of *Vata Dosha*, with an inverse relationship existing between *Vata* aggravation and bone tissue integrity. The *Asthi vaha Srotas* plays a crucial role in the formation, nourishment, and maintenance of *Asthi*. Teeth (*Danta*) are described as the *Upadhatu* of *Asthi*, while *Kesha*(hair), *Nakha* (nails), and *Loma* (body hair) are considered its *Malas*, reflecting the systemic influence of bone health.

This integrative review explores the classical descriptions of *Asthi Dhatu*, its *Srotas*, and related anatomical concepts such as *Asthi Marma*, alongside modern perspectives on osseous tissue. Clinical aspects including *Asthi Kshaya*, *Asthi Vriddhi*, *Asthi Saushirya*, and *Asthi Pradoshaja Vikara* are analyzed to highlight the relevance of *Asthi Dhatu* in contemporary Ayurvedic practice.

Key words: *Asthi Dhatu, AsthiVaha Srotas, Dhatu Agni, Asthi Pradoshaja Vikara.*

INTRODUCTION

Derivation of *Asthi Dhātu*¹:

The term *Asthi* is derived from two Sanskrit roots, “*As*” and “*Kthin*,” which together convey the sense of firmness or stability. This derivation reflects the inherent nature of *Asthi Dhātu* as the rigid and supportive component of the body. According to *Amarakosha*, *Asthi* is described as “*hada iti bhāṣā*,” indicating that it is a hard structure. *Amarakosha* further enumerates several synonyms for *Asthi*, namely *kekkaṣam*, *kikkaṣam*, *kulyam*, and *medojam*², each emphasizing its hardness, supportive role, and structural importance in the body.

Definition³

Asthi is the fifth *dhātu* of the body, which remains stable for a long duration (*āśyatyā*) and participates in bodily movements (*kṣipatyē*) along with the muscles.

Utpatti⁴

Ācārya Charaka explains that *Asthi dhātu* originates from *Meda dhātu*; the *sāra bhāga* of *Meda*, after proper digestion by *Asthi dhātuvāgni* and due to the dominance of *Ṛthvī* and *Agni mahābhūtas*, attains hardness (*kharatva*) and thus forms *Asthi dhātu*.

According to *Acharya Sushruta*, *asthi* is the fundamental supporting structure of the body, just as trees depend upon their inner core for sustenance and stability (*dhāraṇa*). Similarly, the entire human body is dependent on *asthi* for support and maintenance. To emphasize its importance, *Sushruta* highlights that *asthi* persists even after the degeneration of skin, muscles, and other soft tissues, remaining as the last identifiable structure after death. Furthermore, muscles adhere firmly to bones through *siras* and *snāyus*, thereby maintaining the proper posture, stability, and functional integrity of the human body⁵.

Asthi is considered the essence of the body (*deha-sāra*), as it remains even after the degeneration of other body components⁶.

Panchamahābhūtika Constituents of *Asthi Dhātu*^{7,8,9}

Classical Text	<i>Panchamahābhūta</i> Involvement	Predominant <i>Mahābhūta</i>
<i>Charaka Saṃhitā</i>	<i>Ṛthvī</i> , <i>Anila (Vāyu)</i> , <i>Teja (Agni)</i>	<i>Ṛthvī</i>
<i>Aṣṭāṅga Saṃgraha</i>	<i>Ṛthvī</i>	<i>Ṛthvī</i>
<i>Aṣṭāṅga Hṛdaya</i>	<i>Ṛthvī</i>	<i>Ṛthvī</i>

According to *Charaka*, *Vāgbhaṭa (Aṣṭāṅga Saṃgraha)*, and *Bhāvamiśra*, the *mūlasthāna* of *Asthivaha Srotas* is described as *Meda* and *Jaghana*, that is, fat tissue and the buttock region. This indicates the close anatomical and functional relationship between *Meda dhātu* and *Asthi dhātu*^{10,11}.

According to *Acharya Sushruta* and *Bhavamishra*, fourteen *Astisanghatas* are described in the human body. Among them, one *Astisanghata* is located each at the *Gulpha* (ankle joint), *Janu* (knee joint), and *Vankshana pradeśa* (inguinal region) in the lower limbs, and similarly corresponding *Astisanghatas* are present in the

upper limbs. In addition, one *Astisanghata* is situated in the *Trika* (sacral region) and one in the *Śira* (head), completing the total number of fourteen *Astisanghatas*^{12,13}.

According to *Vṛddha Vāgbhaṭṭa* in the *Aṣṭāṅga Saṃgraha*, *Astisanghatas* are described at specific anatomical regions, namely one each in *Gulpha* (ankle), *Jānu* (knee), *Vaṅkṣaṇa* (inguinal region), *Maṇibandha* (wrist), *Kūrpara* (elbow), *Kakṣāghāta* and *Kakṣā* (axillary region), *Antarika*, and *Śira* (head)¹⁴.

Acharya Sushruta describes the sequential formation of *dhātus* in terms of *kāla*, stating that *Rasa dhātu* is formed in 3015 *kāla* and subsequently transforms into *Sukra* in males and *Artava* in females within 30 days. He further explains that the complete transformation from *Rasa* to *Śukra dhātu* occurs over a period of 181,090 *kāla*, and within this continuum, the specific time required for the formation of *Asthi dhātu* is 12,060 *kāla*¹⁵.

According to *Ācārya Charaka*, an *Asthisāra puruṣa* is characterized by the predominance of *asthi* in various parts of the body, such as the *pāda-pārṣṇī* (heels), *gulpha* (ankles), *jānu* (knees), *aratnī* (forearms), *jātru* (clavicles), *cibuka* (chin), *śira* (head), *pāśva* (flanks), small joints of the hands and feet, *nakha* (nails), *pāda-nakha* (toenails), and *danta* (teeth). Such individuals are described as consistently enthusiastic, highly active, tolerant to exertion, possessing a strong and firm physique, and endowed with longevity¹⁶. Similarly, *Ācārya Suśruta* states that *Asthisāra* individuals show predominance of *śira* (head) and *skandha* (shoulders), along with firm *danta* (teeth), *hanu* (mandible), *asthi* (bones), and *nakha* (nails)¹⁷.

Functions of *Asthi Dhātu* According to Classical Texts

*Suśruta Saṃhitā*¹⁸: *Dharana*

Deha-dhāraṇa

Majjā-puṣṭi

*Aṣṭāṅga Hṛdaya*¹⁹: *Dharana*

*Asthi Guna*²⁰:

Asthi Dhatu is predominantly formed from *Prithvi Mahabhuta*; therefore, the *gunas* of *Prithvi* are chiefly incorporated in *Asthi Dhatu*. Owing to this predominance, *Asthi* exhibits characteristics such as *Guru* (heavy), *Khara* (rough), *Kathina* (hard), *Sthula* (gross), *Sthira* (stable), and *Mūrtimanta* (having a definite form), which collectively contribute to its structural strength and supportive function in the body.

Upadhatu of Asthi Dhatu²¹:

According to *Acharya Sharangadhara*, *Danta* (teeth) are described as the *Upadhatu* of *Asthi Dhatu*, numbering thirty-two (*dvi-trimshat*) in total.

Asthi Mala According to Different Ayurvedic Texts^{22,23}

<i>Acharya / Text</i>	<i>Asthi Mala (Waste Products of Asthi Dhatu)</i>
<i>Charaka Samhita</i>	<i>Kesha</i> (hair of the scalp) and <i>Loma</i> (body hairs)
<i>Sushrta</i>	<i>Nakha</i> (nails) and <i>Roma</i> (body hairs)

Asthivaha Srotas²⁴

Asthivaha Srotas is the channel related to *Asthi Dhatu*, and its *Mūla-sthāna* are *Meda Dhatu* and *Janghā*.

Asthi Marma²⁵

Asthi Marma are vital points formed predominantly from bone tissue. There are eight *Asthi Marma* in the body. These include *Katikataruna*, located on both sides of the vertebral column above and near the pelvic crest; *Nitamba*, situated above the two pelvic bones at the flank region; *Amsaphalaka*, present on the scapula with one point on each side of the vertebral column in the upper back; and *Shankha*, located on each side of the head between the outer end of the eyebrow and the ear.

Astidhara Kala

In the context of *Vishavega*, *Dalhana* provides an indirect yet significant reference to *Astidhara Kala*. *Acharya Sushruta* opines that during the fifth *Vishavega*, the *visha* reaches the *Asthi Dhatu* and manifests symptoms such as *Pūrvabheda*, *Hikka*, and *Dāha*²⁶. *Dalhana* further clarifies that the manifestation of symptoms in each *Vishavega* depends upon the respective *Āśraya* of the *Saptakalā*, indicating a specific structural and functional involvement of the *Kala* at each stage.

According to the classical enumeration of *Kalā*, *Purīṣadhara Kalā* is described as the fifth *Kalā*, located in the *Pakwāsaya*. Both *Pakwāsaya* and *Asthi Dhatu* are regarded as the principal seats of *Vāta Doṣa*. Moreover, in *Basti Chikitsā*, which is the foremost therapeutic modality for *Vāta Doṣa*, the drug is administered through the *Guda* to act primarily upon the *Pakwāsaya*²⁷.

According to *Āchārya Charaka*, *Asthi* is derived from *Pitruja Bhāva*.²⁸

The enumeration of *Asthi* varies across different *Samhitas*, with each Ayurvedic text describing a different number of bones in the human body.

SN	<i>Samhitas</i>	No of bones
01	<i>Charaka Samhita</i>	360
02	<i>Sushruta Samhita</i>	300
03	<i>Ashtanga Hridaya</i>	348
04	<i>Ashtanga Sangraha</i>	348
05	<i>Bhava Prakasha</i>	360
06	<i>Kashyapa Samhita</i>	360
07	<i>Modern</i>	206

Asthi can be classified based on its shape and anatomical position in the human body²⁹

SN	Type of <i>Asthi</i>	<i>Sushruta Samhita</i>	<i>Ashtanga Sangraha</i>	<i>Ashtanga Hridaya</i>	<i>Bhava Prakasha</i>
01	<i>Kāpala</i> (Flat bones)	+	+	+	+
02	<i>Ructaka</i> (Teat-like bones)	+	+	+	+
03	<i>Taruṇa</i> (Cartilaginous bones)	+	+	+	+
04	<i>Valaya</i> (Curved or ring-like bones)	+	+	+	+
05	<i>Nālaka</i> (Long bones)	+	+	+	+

This classification reflects the methodical approach of Ayurveda in organizing bones according to their structural characteristics and functional roles.

Human body parts hold great significance in Ayurveda, as clearly emphasized by *Acharya Charaka*. *Chakrapani* highlights that quantitative understanding of bodily structures forms the foundation of anatomical knowledge and plays a vital role in clinical practice. The seventh chapter of *Sharira Sthana* stresses the

importance of *Sharira Sankhya* (enumeration of body parts), stating that a physician well-versed in the number and structure of body components does not face diagnostic confusion, unlike one who lacks analytical insight. In modern anatomy, the adult human skeleton consists of 206 bones. In contrast, ancient Indian anatomists enumerated a higher number 360 bones according to the *Atreya (Charaka)* tradition and 300 bones according to the *Sushruta* tradition. This variation arises mainly from differences in classification. Ayurvedic scholars included teeth, nails, cartilage, and even prominent bony features such as processes, tubercles, and projections as independent bones.

The major reasons for variation in *Asthi Sankhya* can be summarized as follows:

Further variations are evident in the enumeration of specific bones. Regarding ribs, *Charaka Samhita* describes 24 ribs (*Parshvaka*), 24 sockets (*Thalaka*), and 24 tubercles (*Arbuda*), which when analyzed through the *Sushruta* method leads to an expanded count. Similarly, differences are observed in cervical vertebrae enumeration. *Charaka Samhita* mentions 15 neck bones, *Sushruta Samhita* counts 9, and *Vagbhata* records 13, whereas modern anatomy recognizes only 7 cervical vertebrae. *Sushruta*'s method involved counting the first six cervical vertebrae separately, while dividing the seventh into three components body, spine, and transverse processes thus resulting in nine cervical bones.

These variations in *Asthi Sankhya* reflect fundamental methodological differences between Ayurvedic and modern anatomical sciences. Ayurveda adopts a holistic, functional, and clinical perspective, whereas modern anatomy is based on structural, embryological, and osteological principles.

Classification of *Asthi* as per *Suśruta Samhitā*

SN	Type of <i>Asthi</i> (<i>Prakāra</i>):	Total Number	Examples
01	<i>Taruṇāsthi</i> (soft bones)	14	<i>Grāṇa</i> (nasal bones) -3 <i>Karna</i> (ear bones) -2 <i>Grīvā</i> (neck bones) -9 <i>Akṣikoṣa</i> (eye socket bones)
02	<i>Valayāsthi</i> (ring-shaped bones)	110	<i>Parshva</i> : (ribs) – 72 <i>Prishtha</i> : (backbones) – 30 <i>Uras</i> : (chest bones) – 8
03	<i>Nalakāsthi</i> (long tubular bones)	125	<i>Pādāṅguli</i> : toes – $3 \times 5 = 15$; both feet = 30 <i>Pādātala</i> : (sole bones) <i>Pādakūrcha</i> : (foot arches) – 20 <i>Gulpha</i> : (ankle bones) <i>Pārshṇi</i> : (heel bones) -2

			<i>Jāṅgā</i> :(shin bones) -4 <i>Uru</i> : (thigh bones) -2 <i>Hastāṅguli</i> : (fingers) – 3 × 5 = 15; both hands = 30 <i>Hastatala</i> : (palm bones) <i>Hastakūrcha</i> : (wrist bones) -20 <i>Māṅikya</i> : (metacarpal bones) <i>Karpūrasthi</i> : (carpal bones) -2 <i>Prakōṣṭhāsthi</i> : (forearm bones) -4 <i>Bahu / Bahuṅalaka</i> : (upper arm bones) -2 <i>Drikāsṛta</i> : (sacral bones) -1 <i>Aṁśaphalaka</i> : (shoulder bones) -2 <i>Kanṭhanādi</i> : (throat-related bones) -4 <i>Hanuvāsti</i> : (jaw bones) -2
04	<i>Kapalāsthi</i> (flat bones)	19	<i>Janu</i> : (knee) – 2 <i>Nitamba</i> : (hip) – 4 <i>Amsa</i> : (shoulder) – 2 <i>Ganda</i> : (cheek) – 2 <i>Talu</i> : (palate) – 1 <i>Shankha</i> : (temple) – 2 <i>Sira/Shira</i> : (head region) – 6
05	<i>Rucakāsthi</i> (teeth-like bones)	32	<i>Danta</i> : (teeth) – 32
	Total	300	

Bones³⁰

Bones are hard structures that provide a rigid framework to the body. They are composed of highly vascular, mineralized connective tissue containing bone cells and a dense extracellular organic matrix impregnated with inorganic salts. The organic matrix is mainly made of collagen fibers, which give bones flexibility and resilience, while inorganic components such as calcium phosphate provide hardness and rigidity, making bones radio-opaque on X-ray examination. Bones are not inert structures; they are living tissues supplied with blood vessels, lymphatics, and nerves. They possess a remarkable capacity for growth, regeneration, and repair, exceeded only by blood tissue. Bones may be affected by various diseases and can undergo structural changes such as atrophy, in which they become thin and weak, or hypertrophy, in which they become thick and strong. Regular physical activity plays a vital role in maintaining healthy bones.

Function of the bones

Bones perform multiple vital functions in the human body. They form a rigid framework that provides shape, support, and stability, while also offering surfaces for the attachment of muscles, tendons, and ligaments. Acting as levers, bones enable muscular action and facilitate movement. They protect essential viscera such as the brain, spinal cord, heart, lungs, liver, and urinary bladder. Bones also contain bone marrow, which serves as the site of hematopoiesis, producing red blood cells, white blood cells, and platelets. In addition, bones function as a major reservoir for minerals, particularly calcium and phosphorus, with about 95% of the body's phosphorus stored in bones and teeth. Certain bones surrounding the nasal cavity contain air-filled spaces known as paranasal sinuses, which contribute to the resonance and timbre of the voice.

Microscopic structure of bones

Bone is a specialized connective tissue composed of three principal components: cells, ground substance, and fibers. The ground substance and fibers together constitute the extracellular matrix, which subsequently undergoes mineralization. Bone cells are of three types: osteoblasts, osteocytes, and osteoclasts. Osteoblasts arise from pluripotent osteoprogenitor cells present in the mesenchyme, periosteum, and endosteum. They synthesize osteoid, an unmineralized matrix rich in proteoglycans, glycoproteins, and type I collagen fibers. For mineralization, osteoblasts secrete osteocalcin and alkaline phosphatase, facilitating the release of calcium and phosphate ions, and also produce matrix vesicles containing these minerals, which are essential for calcification. Osteoblasts are mitotically active and serve as precursor cells for osteocytes. Osteocytes are formed when osteoblasts become embedded within the mineralized matrix. These flattened cells occupy lacunae and extend cytoplasmic processes through canaliculi, allowing intercellular communication via gap junctions and diffusion of nutrients. Although osteocytes do not undergo mitosis, they maintain bone viability and mineral balance by regulating osteogenic and osteoclastic activity and by secreting alkaline phosphatase; death of these cells leads to decalcification of the matrix. Osteoclasts are large, multinucleated cells formed by the fusion of monocyte-derived cells from red bone marrow. They reside in shallow bone depressions known as Howship's lacunae and play a crucial role in bone resorption and remodeling. Osteoclasts do not undergo mitosis.

Classification of Bones

Bones are usually classified in three ways:

- a. According to shape
- b. According to structure (structural classification)
- c. According to development (developmental classification)

A. Classification According to Shape

Based on size, shape, and form, bones are classified into the following types:

- Long bones
- Short bones
- Flat bones
- Irregular bones
- Pneumatic bones
- Sesamoid bones
- Accessory bones

1. Long Bones

Long bones are those in which the length exceeds the breadth and thickness. They are mainly found in the limbs and act as levers for muscular movements. Long bones are of two types:

- a. Typical long bones
- b. Miniature (short) long bones

a. Typical Long Bones

Typical long bones have the following features:

- 1 They consist of three parts: one elongated tubular shaft called the diaphysis and two expanded ends called epiphyses.
- 2 They contain a medullary cavity filled with bone marrow.
- 3 They ossify in cartilage.
- 4 They lie vertically in the body.
- 5 They are weight-bearing bones.
- 6 They are found in the limbs and function as levers for muscles.

b. Miniature (Short) Long Bones

Miniature long bones are much shorter in length compared to typical long bones and have an epiphysis at only one end. Examples include metacarpals, metatarsals, and phalanges.

All metacarpals and metatarsals have epiphyses at their distal end, except the first metacarpal and first metatarsal, which have epiphyses at their proximal end.

2. Short Bones

Short bones are small and usually cuboidal in shape, presenting six surfaces. These bones are found in the wrist (carpal bones) and foot (tarsal bones).

3. Flat Bones

Flat bones are thin, flat, and plate-like bones. They form the boundaries of certain body cavities, such as the cranial cavity and thoracic cavity.

Examples include bones forming the cranial vault—frontal, parietal, occipital bones, and bones forming the thoracic cage, scapula and sternum.

4. Irregular Bones

Irregular bones are highly irregular in shape and do not fit into any other category. Examples include hip bones, vertebrae, and bones forming the base of the skull.

5. Pneumatic Bones

Pneumatic bones are a variety of irregular bones that contain air-filled cavities within them. These bones are mainly located around the nasal cavity and include the maxilla, frontal, sphenoid, and ethmoid bones.

The air-filled cavities are called paranasal air sinuses. These sinuses make the skull lighter, add resonance to the voice, and act as air-conditioning chambers for inspired air.

6. Sesamoid Bones

The term sesamoid is derived from the word sesame, meaning seed. Sesamoid bones are small, seed-like nodules that develop in certain muscles and tendons, especially where tendons rub against convex bony surfaces during joint movement.

The rubbing surface of sesamoid bones is covered with articular cartilage.

Sesamoid bones are commonly found in the knee, feet, and hands. They help reduce friction, protect tendons from stress, and change the direction of muscle pull.

They are classified into two types:

- True sesamoid bones, which develop independently in tendons
- Accessory sesamoid bones, which are considered anatomical variants

Sesamoid bones act as pulleys during muscle contraction by redirecting muscle pull and minimizing friction, thereby preventing attrition. Their characteristics include development within tendons, absence of periosteum, and presence of multiple ossification centers.

Accessory bones

Accessory bones are additional bones that are not usually present in the human body. When present, they are generally harmless but may sometimes be mistaken by clinicians for fractures on radiological examination. These bones commonly arise due to the appearance of extra ossification centers, especially within skull sutures, forming sutural or Wormian bones, or due to non-fusion of an epiphysis. Typical examples include os trigonum, formed by failure of fusion of the posterior tubercle of the talus; os vesalianum, resulting from non-fusion of the styloid process of the fifth metatarsal; patella cubiti; and occasionally, non-fusion of the olecranon process of the ulna with the shaft.

B. According to structure (structural classification)

Structurally, bones are classified into compact and cancellous types based on their architecture as seen on gross and microscopic examination. Compact bone is dense and ivory-like, composed of concentric lamellae arranged into Haversian systems. In contrast, cancellous or spongy bone consists of a network of interconnecting bony trabeculae enclosing spaces filled with red bone marrow. These trabeculae lack Haversian systems and derive nutrition from surrounding tissues; their arrangement follows the lines of maximal stress in accordance with Wolff's law.

C. According to development (developmental classification)

Developmentally, bones are classified into membranous bones formed by intramembranous ossification, cartilaginous bones formed by endochondral ossification, and membranocartilaginous bones that develop through a combination of both processes.

Clinical Conditions Related to *Asthi* (Bone)

1. *Marma* (*Asthi Marma Injury*)³¹

Injury to *Asthi Marma* causes discharge of thin fluid mixed with bone marrow along with intermittent or severe pain, as described in *Ashtanga Hridaya* under *Trimarma Viddha Lakshana*.

2. *Vranavastu*³²

Asthi is one of the eight *Vranavastu* described by *Sushruta*; *Dalhana* explains it as identifiable either by visible scar (*Vranachinna*) or by the site of injury (*Adhithana*).

3. *Vranasthana*³³

According to *Charaka*, *Asthi* is included among the eight *Vranasthana*, indicating bone as an important structural site for wound manifestation and pathology.

4. *Asthigranthi*³⁴

Injury or morbidity of bone leads to irregular, hard swelling termed *Asthigranthi*, mentioned by *Vagbhata* and also classified by *Sharangadhara* among the eight types of *Granthi*.

5. *Asthi-gata Salya and Asthi Vidradhi*³⁵

Retained foreign body or suppuration in bone produces severe pain, swelling, burning sensation, discharge, and features of *Vidradhi*, which is *Tridoshaja* and considered *Asadhya* (incurable) by *Sushruta*.

6. *Majja-Asthi-gata Dushta Vata*³⁶

Vitiated Vata in bone and marrow causes deep-seated bone pain, joint pain, muscle wasting, loss of strength, insomnia, pricking pain, and relief on hot application and compression, as described by *Charaka* and *Vagbhata*.

7. *Fakkaroga*³⁷

As described by *Kashyapa*, *Fakkaroga* is a pediatric condition where *Asthi* and *Majja* involvement leads to delayed standing and walking even after one year of age.

Asthidhatu disorders are clinically manifested as *Asthyāśraya Vyādhis*, primarily due to *kṣaya* (depletion) or *vṛddhi* (excess) of *Asthidhatu*. *Asthiṣaya*³⁸ is characterized by symptoms such as *asthi-sūla* (pain in bones and joints), *sandhi-chaitilya* (joint laxity or subluxation), *nakha-bhaṅga* (brittle nails), *danta-bhaṅga* and *dvija-patana* (weak, loose, or falling teeth), *keśa-loma-śmaśru-patana* (loss of hair over scalp, body, and beard), and *śrama* (easy fatigability). These manifestations reflect degeneration and undernourishment of *Asthidhatu* and its *upadhatu*, especially *danta*.

In contrast, *Asthivṛddhi*³⁹ presents with abnormal or excessive growth of bone tissue, such as *adhyāsthi* (extra or pointed bony growths resembling osteophytes) and *adhi-danta* (supernumerary teeth or hyperdentia). These conditions indicate disturbed bone remodelling processes.

Further, *Asthi-pradoṣaja vikāras*⁴⁰ include *asthi-bheda* and *danta-bheda* (cracks or splitting pain in bones and teeth), *asthi-śūla* and *asthi-toda* (deep-seated and pricking bone pain), *danta-śūla*, *vibhramta* (instability), *keśa-loma-śmaśru-doṣa*, and *kuṇaka*. Predominant *vāta-vṛddhi*, along with increased *rukṣatā* and *śuṣkatā*, plays a key role in the pathogenesis, leading to pain, degeneration, and structural weakness. Commonly affected sites include *kati*, *jānu*, *pṛṣṭha*, *grīvā*, *aṃsa*, and various *asthi-sandhis*.

Thus, the clinical presentation of *Asthidhatu* disorders ranges from degenerative changes and pain to abnormal bone growth, reflecting the fundamental imbalance in *Asthidhatu* metabolism and *vāta doṣa* dominance.

Diseases of Bones⁴¹

1. Osteoporosis

Osteoporosis is characterized by reduced bone mineral density and deterioration of bone microarchitecture, leading to increased fragility and risk of fractures from low-impact trauma.

- Primary osteoporosis occurs with aging and reduced sex hormones.
- Secondary osteoporosis may result from medications such as glucocorticoids, antiepileptics, chemotherapy agents, and proton pump inhibitors.
- Medical conditions like hyperparathyroidism, hyperthyroidism, malabsorption, chronic renal failure, Cushing's syndrome, anorexia, prolonged immobilization, low body weight, excessive exercise, and secondary amenorrhea contribute to bone loss.

2. Rickets and Osteomalacia

These disorders result from defective mineralization of bone due to deficiencies of vitamin D, calcium, or phosphorus.

- Rickets occurs in children before epiphyseal closure, leading to bone weakness, bending of long bones, skeletal deformities, poor growth, dental problems, and increased fracture risk.
- Osteomalacia occurs in adults after growth plate fusion and presents with bone pain, fractures, and deformities.
- Vitamin D or calcium deficiency is the most common cause.

3. Osteomyelitis

Osteomyelitis is an infection of bone and bone marrow caused by bacteria, fungi, or mycobacteria.

- It may be acute or chronic.
- Clinical features include localized bone pain, redness, fever, weakness, and difficulty in walking, especially in children with acute bacterial osteomyelitis.

4. Paget Disease of Bone

Paget disease is a chronic skeletal disorder characterized by abnormal bone remodeling.

- Excessive osteoclastic bone resorption followed by increased osteoblastic activity produces disorganized, weak, and highly vascular bone.
- Commonly affects the axial skeleton, including the spine, pelvis, and skull.

- It is the second most common bone disorder after osteoporosis and presents with diffuse bone pain and increased fracture risk.

5. Congenital and Metabolic Bone Disorders

- Osteogenesis imperfecta results from collagen abnormalities, producing fragile bones with frequent fractures.
- Osteopetrosis is caused by defective osteoclast function, leading to abnormally dense but brittle bones and impaired marrow cavity formation.
- Endocrine disorders such as hyperthyroidism, growth hormone deficiency, hypogonadism, and excessive cortisol production (Cushing's syndrome) adversely affect bone strength.
- Long-term glucocorticoid use causes growth retardation in children and marked thinning of bones in adults.

6. Bone Tumors

Bone tumors are abnormal growths of bone tissue and may be benign or malignant.

- According to the WHO (2020)⁴² classification, bone tumors include cartilaginous, osteogenic, fibrogenic, vascular, osteoclastic, notochordal, other mesenchymal tumors, and hematopoietic neoplasms.
- Primary tumors arise from bone tissue, while secondary tumors result from metastasis, most commonly from prostate, breast, lung, thyroid, and kidney cancers.
- Metastatic bone tumors are far more common than primary bone cancers.

7. Fractures

Fractures occur due to excessive force, repetitive stress, or weakened bone structure.

- Osteoporosis commonly leads to wrist, hip, and vertebral fractures.
- High-energy trauma, malignancy, and metabolic bone diseases such as Paget's disease increase fracture risk.
- Fractures of long bones are common in both traumatic and pathological conditions.

DISCUSSION

Asthidhatu is described in Ayurveda as the fifth *dhatu* of the body, derived from the root word “*As*”, and “*Kthin*” conveying firmness, stability, and support. It remains stable for a long duration and actively participates in bodily movements along with the muscles. Classical texts like *Charaka*, *Ashtanga Sangraha*, and *Ashtanga Hridaya* explain that *Asthidhatu* is predominantly formed from *Prithvi Mahabhuta*, which imparts hardness, heaviness, and structural integrity. This concept closely correlates with the modern understanding of bones as rigid, mineralized connective tissue that provides shape, strength, and support to the body.

The *Panchabhautika* composition of *Asthidhatu* highlights the dominance of *Prithvi Mahabhuta*, while other *Mahabhutas* contribute to its nourishment and functional balance. The *gunas* of *Asthidhatu* such as *guru*, *khara*, *kathina*, *sthira*, and *sthula* explain its solidity and load-bearing capacity. Ayurveda describes *Danta* as the *Upadhatu* of *Asthidhatu*, while *Kesha*, *Loma*, and *Nakha* are considered its *Mala*, reflecting tissue

metabolism. This can be clinically correlated with modern observations where bone disorders are often associated with changes in hair, nails, and teeth, especially in metabolic bone diseases.

Structurally, Ayurvedic texts enumerate *Asthi* based on shape and location, such as *Kapala*, *Valaya*, *Taruna*, *Ruchaka*, and *Nalaka Asthi*, showing a clear anatomical awareness. *Variations* in *Asthi Sankhya* across *Samhitas* reflect differences in classification criteria rather than conceptual disagreement. Similarly, modern anatomy classifies bones based on shape, structure, and development, including long, short, flat, irregular, pneumatic, sesamoid, and accessory bones. Microscopic descriptions of bone cells osteoblasts, osteocytes, and osteoclasts align with Ayurvedic concepts of continuous tissue remodeling and nourishment through *Asthivaha Srotas* and *Asthidhara Kala*.

Clinically, disorders of *Asthidhatu* manifest as *Asthi Kshaya*, *Asthi Vriddhi*, *Asthi Saushirya*, joint laxity, and subluxations. Classical conditions such as *Asthi Vidradhi*, *Asthigata Shalya*, *Asthi Granthi*, *Majja-Asthi Gata Dushta Vata*, and *Fakka Roga* show remarkable similarity to modern conditions like osteomyelitis, bone tumors, congenital disorders, and nutritional deficiencies. Diseases such as osteoporosis, rickets, osteomalacia, Paget's disease, fractures, and metabolic bone disorders can be effectively understood through an integrative lens, where Ayurvedic pathology explains systemic imbalance while modern science explains structural and biochemical changes.

CONCLUSION

Asthidhatu plays a vital role in maintaining the structural integrity, stability, and functional mobility of the human body. Ayurvedic literature provides a comprehensive understanding of *Asthidhatu* in terms of its origin, qualities, functions, classification, and clinical significance, which closely parallels modern anatomical and physiological concepts of bone tissue. The predominance of *Prithvi Mahabhuta* explains the hardness and supportive nature of bones, while the concepts of *Upadhatu*, *Mala*, *Asthimarma*, and *Asthivaha Srotas* broaden the functional and clinical scope of *Asthidhatu*.

An integrative approach combining Ayurvedic and contemporary perspectives enhances the understanding of bone health, disease manifestation, and management. Such a holistic review not only validates classical concepts in the light of modern science but also opens avenues for comprehensive diagnosis and treatment of bone related disorders. Thus, the integrative study of *Asthidhatu* from structural, *srotas*, and clinical perspectives provides a strong foundation for both academic understanding and clinical application.

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