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## Morphological Consideration of Osseous Tissue in Ayurveda` with its Applied Aspect

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### ABSTRACT

The concept of tissue is highlighted under different entity like *dhatu*, *kala*, *upadhatu* etc. Osseous tissue or bone is the major structural and supportive connective tissue of the body. The matrix of bone contains abundant of collagen fibres and these impart strength, some flex and resistance to twisting or torsional forces. Bones consist of living cells embedded in a mineralised matrix. It has both organic and inorganic components. Its organic components include the cells (osteogenic cells, osteoblasts, osteocytes and osteoclasts) and osteoid, the organic part of the matrix. The balance of bone tissues consist of inorganic hydroxyapatites, or mineral salts, largely calcium phosphates present in the form of tiny tightly packed crystals in and around the collagen fibres in the extracellular matrix. In relation to osseous tissue, *asthi dhatu*, *asthi-dhara kala* will come under consideration and relating to applied aspect, its *upadhatu* and *mala* i.e *kesha* and *loma* are also emphasised. In the context of formation of *asthi dhatu-vayu*, *teja*, *prithvi* is considered. Here *Vayu* has played the role of creation of pores in the form of Intermedullary canal, Haversian system, Volkmann's canal and Nutrient foramen. Observing the applied aspect the morbidities are found in context of *asthi kshaya*, *asthi vridhhi*, *asthi vaha srota dushti*. The disorders in osseous tissue like Marfan syndrome, Achondroplasia exhibit genetic influences. These characteristics can be understood with *adhyasthi* or *adhidanta* in classics where increased osseous tissue is noticed. The *kesha prapatan* and *loma prapatan* are meant for involvement of *mala* of *asthi dhatu*. The basic function *dharana* can be understood along with the action of bone where it acts as framework of human body after forming skeleton and cartilages. The present work wants to make an interpretation of all these elements.

### KEYWORDS

*Asthi dhatu*, *Osseous tissue*, *Asthi vridhhi-kshaya*, *Osteogenic cells*, *Applied aspect*



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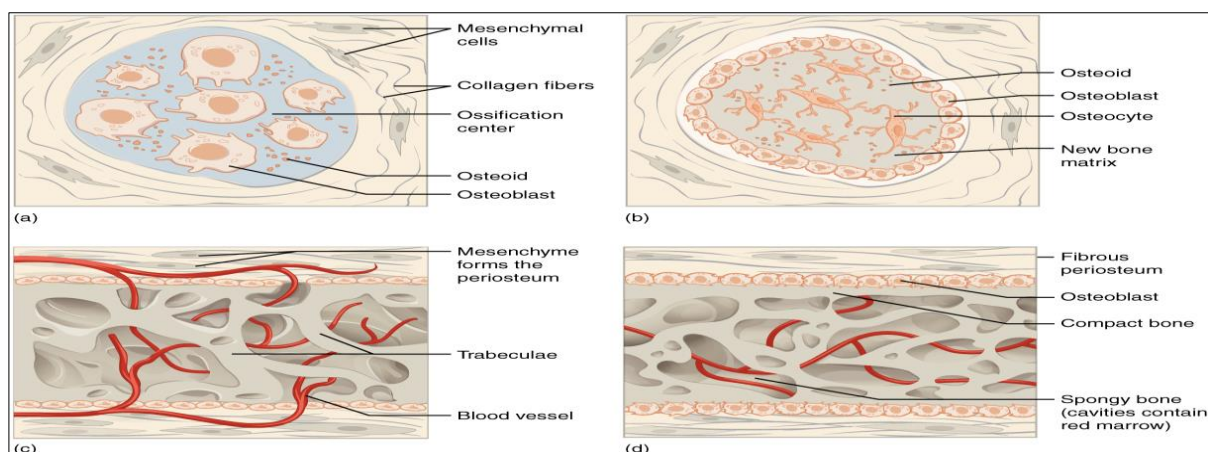


## INTRODUCTION

The concept of tissue is highlighted under different entity like *dhatu*, *kala*, *upadhatu*, etc. Osseous tissue or bone is the major structural and supportive connective tissue of the body. The matrix of bone contains abundant of collagen fibers and these impart strength, some flex and resistance to twisting and torsional forces. In Ayurveda in relation to osseous tissue, *asthi dhatu* will come under consideration and relating to applied aspect its *upadhatu* and *mala* i.e. *kesha* and *loma* are also emphasised.

The present work observed the ossification and its interpretation of *asthi* formation. The *mahabhutas* which are included in *asthi dhatu* formation are *prithvi*, *agni* and *vayu*. Here *vayu* takes the role in forming nutrient foramen, while *prithvi mahabhuta* acts in the formation of lamellus. Osseous tissue gives stability and shape of an

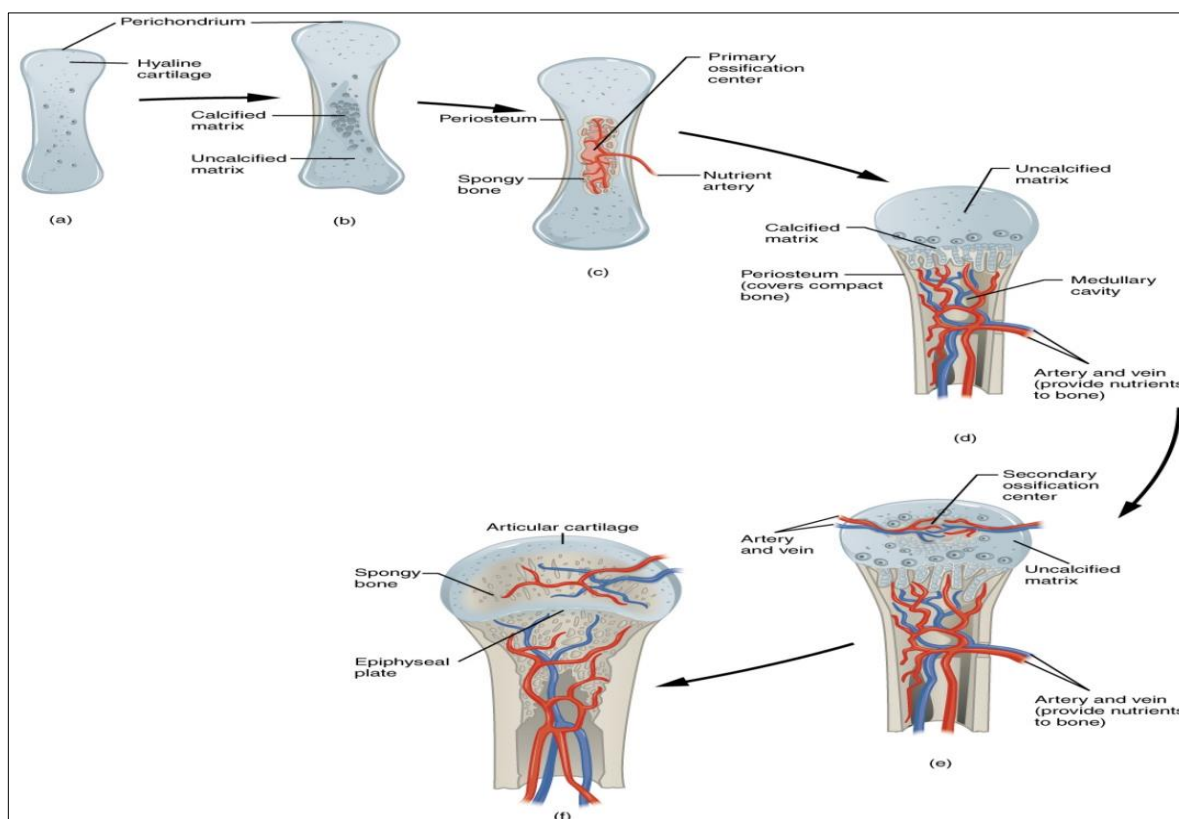
## INTRAMEMBRANOUS OSSIFICATION



**Fig. 1** Intramembranous ossification follows four steps. (a) Mesenchymal cells group into clusters, differentiate into osteoblasts, and ossification centers form. (b) Secreted osteoid traps osteoblasts, which then become osteocytes. (c) Trabecular matrix and periosteum form. (d) Compact bone develops superficial to the trabecular bone, and crowded blood vessels condense into red bone marrow.

individual which is imparted by *prithvi mahabhuta* and its function of *sanghata*, *sthairya* and *gourav*. The enzyme i.e. alkaline phosphatase, which is secreted by the cartilage cells to form empty spaces i.e. primary areolae; can be understood along with the activity of *agni mahabhuta*. Moreover, the basic unit of osseous tissue i.e. osteocytes impart stability, activity of the osteoblast is to form new cells while its increase is restricted through the activity of osteoclast, by which it gives remodelling and shape. This process of metabolism also can be understood with the functions of *agni mahabhuta*. The process of development of bone is ossification which occurs in intra-uterine period and continues in post natal period.

This process of ossification are of two types viz. Intramembranous (fig. 1) and Endochondral ossification (fig. 2).



**Fig. 2** Endochondral Ossification. Endochondral ossification follows five steps. (a) Mesenchymal cells differentiate into chondrocytes. (b) The cartilage model of the future bony skeleton and the perichondrium form. (c) Capillaries penetrate cartilage. Perichondrium transforms into periosteum. Periosteal collar develops. Primary ossification center develops. (d) Cartilage and chondrocytes continue to grow at ends of the bone. (e) Secondary ossification centers develop. (f) Cartilage remains at epiphyseal (growth) plate and at joint surface as articular cartilage

In endochondral ossification, the initiation of formation of spaces such as bony trabeculae is the function of *vayu mahabhuta*. *Ruksha, laghu, khara* are the characteristics of *vayu guna* which may facilitate in the process of ossification. The *prithvi mahabhuta* helps in the formation of lamellus of bone where the osteoid is calcified. The cellular transformation from progenitor cell i.e osteoblast to osteoclast undergo metabolic changes is the function of *Agni mahabhuta*. All these can be understood under the heading of *vayu* and *agni mahabhuta*. Growth and development

are a continuous process persisting from zygote till death. But in certain tissue, the maturation gets stopped in a particular period of life. *Vridhhi* is the concept of Ayurveda, which emphasize from cellular stages upto systemic development.

## AIMS AND OBJECTIVES

1. Consideration of osseous tissue in Ayurveda from morphological point of view
2. Applied aspect of osseous tissue

## MATERIALS AND METHODS

1. Literature searched for formation of *asthi dhatu*



2. Applied aspect of *asthi dhatu* with osseous tissue will be stressed
3. Specific skeletal abnormality relating to morbidity of *asthi Dhatu* is also seen

## RESULTS AND DISCUSSION

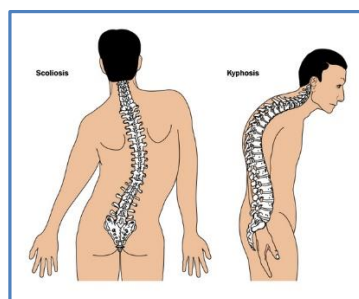
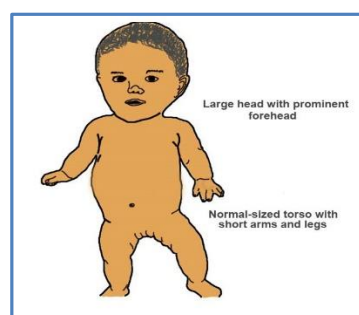
In the applied aspect of osseous tissue, its function and morbidity are stressed in *vrddhi kshaya* and *asthi vaha srota dushti lakshana*. Here some character may be genetic while some develop in later stages of life. Here certain disorder which occurs during the process of ossification can be analysed in this aspect. *Adhyasthi*, mentioned as *asthi vriddhi lakshana*<sup>1,2</sup> can be understood with excess bony formation in different parts of bone. Some symptoms of Achondroplasia (fig.3a,b)<sup>3</sup> like disproportionately large head compared to the body and an abnormally large prominent forehead can be compared to *Adhyasthi*<sup>1,2,4</sup>.



**Fig. 3 (a)** Proliferative Zone – can be understood with *adhyasthi*

In this disease, pain is also the character, found in bony curvature specifically

kyphosis and lordosis can be termed with *asthi-shula*<sup>1,2,4</sup> which is mentioned as a disease of *dushta asthi*. Another symptom of Achondroplasia is a short stature that's significantly below average for age and sex. The patient has short arms and legs especially upper arms and thighs, in comparison to body height and also short fingers in which the ring and middle fingers may also point away from each other. In this case, in relation to *Janmabalapravritta vyadhi*<sup>5</sup>, '*Bamana*' is mentioned by Sushrut which can be correlated along with the Achondroplasia. However genetic abnormality involving dwarfism, where the chromosomal aberration exhibiting autosomal morbidity which is also prominent.



**Fig.3 (b)** Achondroplasia

Osteogenesis Imperfecta (Fig. 4)<sup>6</sup> is a group of disorder which is also known as a brittle



bone disease, is characterised by extremely fragile bones<sup>7</sup> that break or fracture easily (brittle bones). In OI type 1 and 4, the effected individuals may develop brittle, discoloured teeth which can be correlated with *danta bhanga*<sup>1</sup> and *vivarnata* of *danta*<sup>4</sup> respectively.

Cleidocranial Dyostosis (fig. 5)<sup>8</sup> is a rare congenital hereditary disorder, which mostly effects development of bones and teeth .It can be correlated with *adhidanta*<sup>4</sup> and *danta-vaivarnam* which falls under *asthi vridhhi lakshana*.



**Fig. 4** Osteogenesis Imperfecta

The symptom of abnormal teeth can be correlated with *danta bhanga*, which is an *asthi-kshaya lakshana*. This disease is inherited in an autosomal dominant manner. Individuals may have decreased

bone density (osteopenia) and may develop osteoporosis which can be compared to *asthi-kshaya*.

*Adhyasthi* is understood with excess bony tissue formation again found in Marfan's syndrome (fig. 6)<sup>9</sup>, where symptoms such as disproportionately long arms, legs and fingers are found. And the symptoms of crowded teeth can be correlated with *adhidanta*. Further some characteristics of Marfan syndrome can be included in *Atidirgha purusha* specifically in morphological alteration with disproportionate increase of length.

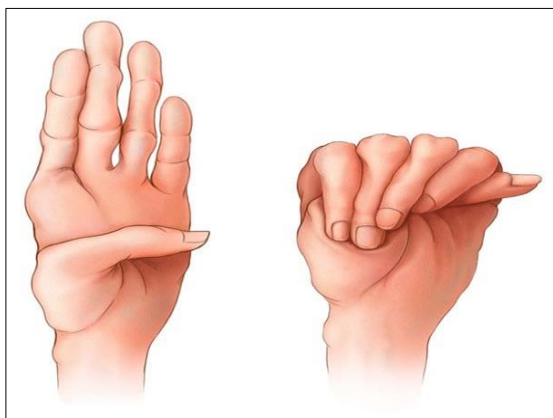
Another disease Osteopetrosis (fig. 7)<sup>10</sup> which is literally defined as Stone bone or marble bone disease ,is the result of a genetic defect that causes the body to add new bone more rapidly than existing bone disintegrates. This also gives the glimpse of *adhyasthi*.



**Fig. 5** Cleidocranial dysostosis



Fibrous dysplasia (fig. 8)<sup>11</sup> is linked to a problem with genes (gene mutation) that control bone producing cells.



**Fig. 6** Marfan syndrome  
Symptoms of Fibrous Dysplasia include bone pain which can be compared with *asthi toda* or *asthi-shula*, placed under *asthi kshaya lakshana*.



**Fig. 7** Osteopetrosis

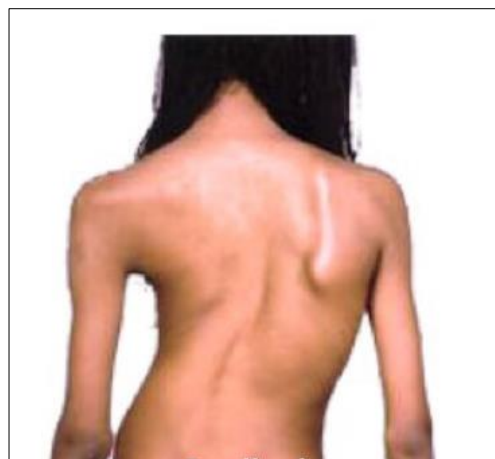


**Fig. 8** Fibrous Dysplasia  
Neurofibromatosis (fig. 9)<sup>12</sup> is another condition where bone deformities, included twisted spine (scoliosis) or (bowed lower

legs)<sup>13</sup> develop as symptoms. This can be compared with *Asthi- toda* again.

In Caffey syndrome (fig. 10)<sup>14</sup> or infantile cortical hyper-ostosis, symptoms such as swellings of periosteum, bone cortex or upper arms, shoulder girdle, lower jaw occur. This show a trait of *Adyasthi* which is an *asthi-dhatu vriddhi lakshana*.

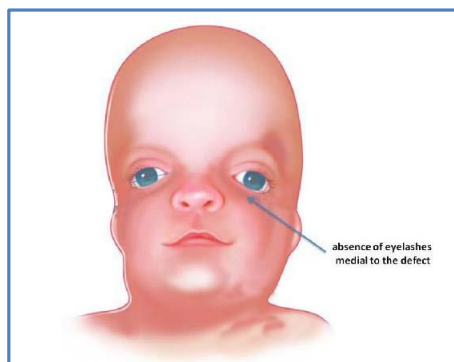
In Mandibulofacial dyostosis (fig. 11)<sup>15</sup> which is a rare genetic disorder, some symptom like scanty eyelashes along the lower eyelid, can be compared with *kesa-satana* which is a characteristic of *asthi-kshaya lakshana*.



**Fig. 9** Neurofibromatosis



**Fig. 10** Caffey Syndrome



**Fig. 11** Mandibulofacial dysostosis

*Asthi dhatu* imparts function In correlance with modern anatomy, skeletal element specifically osseous tissue and cartilaginous tissue can be mentioned. *Dharana*, the basic function of *asthi dhatu* is characteristic of osseous tissue which forms the skeleton and also forms the framework of the body. In relation with its formation i.e. Ossification or osteogenesis in bone remodelling, is the process of laying down new bone material by cells called osteoblasts. It is synonymous with bone tissue formation. Mesenchymal cells have the ability to form many different kinds of cell that is converted into various tissue. It gives rise to chondroblasts which form the cartilage and osteoblasts which form the bone. The unit of bone structure is called a lamellus. Bone acquires thickness by stacking of lamellae over one another. Between adjoining lamellae there are spaces called lacunae. These spaces are occupied by cells of bone called osteocytes. Three main types of cells present in bone

are osteocytes, osteoblasts, osteoclasts. Ossification takes place by two osteogenic pathways i.e Intramembranous ossification and Endochondral ossification. In the context of formation of *asthi dhatu*<sup>16</sup> – *prithvi, agni, vayu* is considered. Here *vayu* has played the role of creation of pores in the form of Intermedullary canal, Haversian system, Volkmann's canal and Nutrient foramen. Observing the applied aspect the morbidities are found in context of *asthi kshaya, asthi vridhhi, asthi vaha srota dushti*.

## CONCLUSION

The present work assess *asthi-dhatu, asthi-dhara kala* and *asthi vaha srota* with osseous tissue, periosteum, lacunae and cannular part or hollow part of bone respectively. The functions of *mahabhuta* is understood with the process of ossification where *prithvi* gives compactness and stability, *agni* emphasize for enzyme and hormones needed for the purpose of ossification, *vayu* creates the porosity necessary for nutrition. In the applied part 9 genetic disorders viz. Achondroplasia, Osteogenesis Imperfecta, Cleidocranial Dyostosis, Marfan's syndrome, Osteopetrosis, Fibrous dysplasia, Neurofibromatosis, Caffey syndrome and Mandibulofacial dyostosis have been taken





for evaluation of features of *Asthi vriddhi-kshaya*. Mostly *adhyasthi* or excess bony tissue formation irrespective of nature and location are observed. *Asthi shula* or pain, also found in all these 9 different disorders. Thus the work put a glimpse of understanding the process of ossification as well as its morbidity in terms of abnormality mentioned in Ayurveda.

**Table 1** Features of Asthi Vriddhi-Kshaya and Asthi-Vaha Srota Dushti, relating to Nine Congenital Morbidity

Symptoms in Ayurveda		Disease
<i>Adhyasthi</i>	Excess or increase of bony mass	Achondroplasia
		Marfan's syndrome
		Osteopetrosis
		Caffey Syndrome
<i>Asthi-shula</i>	Pain or tenderness in bone	Achondroplasia
		Marfan's syndrome
		Osteopetrosis
		Fibrous Dysplasia
<i>Danta bhanga</i>	Cracking of teeth	Osteogenesis Imperfecta
<i>Vivarnata of danta</i>	Discolouration of teeth	Cleidocranial dyostosis
<i>Adhidanta</i>	Excess teeth	Cleidocranial dyostosis
		Marfan's syndrome
<i>Atidirgha</i>	Increase in length of bones	Marfan's syndrome
<i>Asthi toda</i>	Pain in bone	Neurofibromatosis
<i>Kesa-satana</i>	Falling of hair	Mandibulofacial Dyostosis

## CONCLUSION

The present work assess *asthi-dhatu*, *asthi-dhara kala* and *asthi vaha srota* with osseous tissue, periosteum, lacunae and cannular part or hollow part of bone

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