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 vriddhi, 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 vriddhi-kshaya, Osteogenic cells, Applied aspect
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 individual which is imparted by prithvi mahabhuta and its function of sanghata, sthairy 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).
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. *Vriddhi* 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\(^1,2\) can be understood with excess bony formation in different parts of bone. Some symptoms of Achondroplasia (fig.3a,b)\(^3\) like disproportionately large head compared to the body and an abnormally large prominent forehead can be compared to *Adhyasthi*\(^1,2,4\).

In this disease, pain is also the character, found in bony curvature specifically kyphosis and lordosis can be termed with *asthi-shula*\(^1,2,4\) 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 *Janmabalaapravritta vyadhi*\(^5\), ‘*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 (a)** Proliferative Zone – can be understood with *adhyasthi*

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**Fig. 3 (b)** Achondroplasia

Osteogenesis Imperfecta (Fig. 4)\(^6\) is a group of disorder which is also known as a brittle
bone disease, is characterised by extremely fragile bones\(^7\) 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\(^1\) and vivarnata of danta\(^4\) respectively.

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

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)\(^9\), 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)\(^10\) 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.
Fibrous dysplasia (fig. 8)\textsuperscript{11} is linked to a problem with genes (gene mutation) that control bone producing cells.\n
**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**

Neurofibromatosis (fig. 9)\textsuperscript{12} is another condition where bone deformities, included twisted spine (scoliosis) or (bowed lower legs)\textsuperscript{13} develop as symptoms. This can be compared with *Asthi-toda* again.

In Caffey syndrome (fig. 10)\textsuperscript{14} 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 vridhā lakshana*.

In Mandibulofacial dyostosis (fig. 11)\textsuperscript{15} 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. 8 Fibrous Dysplasia**

**Fig. 9 Neurofibromatosis**

**Fig. 10 Caffey Syndrome**
**Asthi dhatu** imparts function In correlation 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** – *prithvi, agni, vayu* is considered. Here *vayu* has played the role of creation of pores in the form of Intermedullary canal, Haverson system, Volkmann’s canal and Nutrient foramen. Observing the applied aspect the morbidities are found in context of **asthi kshaya, asthi vriddhi, asthi vaha srotas 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 vridhikshaya. 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 Vridhhi-Kshaya and Asthi-Vaha Srota Dushti, relating to Nine Congenital Morbidity

<table>
<thead>
<tr>
<th>Symptoms in Ayurveda</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhyasthi</td>
<td>Excess or increase of bony mass</td>
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<tr>
<td></td>
<td>Marfan’s syndrome</td>
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<td></td>
<td>Osteopetrosis</td>
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<td></td>
<td>Caffey Syndrome</td>
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<tr>
<td>Asthi-shula</td>
<td>Pain or tenderness in bone</td>
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<td></td>
<td>Marfan’s syndrome</td>
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<td></td>
<td>Osteopetrosis</td>
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<td></td>
<td>Fibrous Dysplasia</td>
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<tr>
<td>Danta bhanga</td>
<td>Cracking of teeth</td>
</tr>
<tr>
<td>Vivarnata of danta</td>
<td>Discolouration of teeth</td>
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<tr>
<td>Adhidanta</td>
<td>Excess teeth</td>
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<tr>
<td></td>
<td>Marfan’s syndrome</td>
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<tr>
<td>Atidirgha</td>
<td>Increase in length of bones</td>
</tr>
<tr>
<td>Asthi toda</td>
<td>Pain in bone</td>
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<tr>
<td>Kesa-satana</td>
<td>Falling of hair</td>
</tr>
</tbody>
</table>

CONCLUSION

The present work assess asthi-dhatu, asthi-dhara kala and asthi vaha srota with osseous tissue, periosteam, 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 vridhhi-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.
REFERENCES
2. Tripathi Ravi Dutt, Astanga Sangrah, Chaukambha Sanskrit Pratisthan, Reprint-2006, Sutra Sthan 19/7, Vol-1, pg-361
3. Medically reviewed by Daniel Murrell, MD on April 21, 2017, written by Rose Kivi
5. Sashtri Ambikadutt, Sushruta Samhita, Chaukambha Sanskrit Sansthan, Varanasi, Reprint-2015, Sutra Sthan 24/6, pg-130
8. Cleidocranial dyostosis-Wikipedia https://en.m.wikipedia.org/wiki:cleido...
9. Marfan Syndrome-Symptoms and causes-Mayo Clinic https://www.mayoclinic.org:syc-20350...
10. Osteopetrosis-Wikipedia https://en.m.wikipedia.org:wiki:osteo...
13. Neurofibromatosis-symptoms and causes-Mayoclinic https://www.mayoclinic.org:syc-20350...
15. Treacher-Collins Syndrome-Mandibulofacial Dyostosis https://www.news-medical.net:...