



A CONCEPTUAL STUDY ON THE ETIOPATHOGENESIS OF ASTHIKSHAYA W.S.R TO SENILE OSTEOPOROSIS

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ABSTRACT

Ayurveda emphasizes that harmony between *Dosha*, *Dhatu*, and *Mala* contributes to good health while their vitiation causes illness. There are four main causes for their vitiation, i.e., *Sharirika* (physical), *Manasika* (mental), *Agantuja* (accidental), and *Swabhawaja* (natural). Natural causes are those that automatically give rise to certain conditions like old age and, eventually death. According to Ayurveda, there is a predominance of *Vata Dosha* in old age, which causes degeneration of body tissues. Senile osteoporosis represents a condition of bone loss that results from aging. With a rise in older population due to increased life expectancy, osteoporosis has become a serious problem among elders because its prevalence increases with age. Considering the causes of *Vata* vitiation and *Asthikshaya* as same and *Vata* dominance in old age, the etiopathogenesis of *Asthikshaya* can be understood in relation with senile osteoporosis. In this study, effort has been made to understand the etiopathogenesis of bone loss in elderly.

Keywords: *Asthikshaya*, Senile osteoporosis, *Vata Dosha*, *Dhatu Kshaya*.

INTRODUCTION

According to WHO, Osteoporosis is a progressive systemic skeletal disease characterized by low bone mass, structural deterioration of bone with increased risk of bone fragility and susceptibility to fractures.¹ Due to increase in safety and advancement of health services, the average life expectancy of people has increased in last century. It caused a significant expansion of the elderly population². According to the WHO, it is estimated that the elderly population will reach 12 billion by 2025³. Aging is associated with chronic diseases, disabilities and cognitive decline⁴. The risk of Hypertension, sleep disorders, malnutrition, obesity, and osteoporosis increase with advancing age⁵. With a global prevalence of 21.7% and highest prevalence reported in Asia i.e. 24.3%⁶, senile osteoporosis has become a growing health problem worldwide. Osteoporosis mostly occurs in elderly women after menopause and in elderly men⁷. Bone loss can also take place in young adults due to any underlying pathology, but it is a natural phenomenon in old age. According to Ayurveda, *Dhatu*s are the body tissues which hold the body and nourishes as well. There are seven *Dhatu*s in the body, accounting for various specific functions. *Asthi Dhatu* is the fifth one, responsible for the specific function of *Dharana* (hold up). It provides strength to bear weight and framework to the body along with contributing to the formation and nourishment of *Majja Dhatu*. *Asthikshaya* can be related with loss of bone mass due to which bones become porous and increasing the chances of fragile fractures in later stages. This condition is known as osteoporosis which can develop at any age but is found in elderly with a greater incidence. The causative factors for *Asthikshaya* are not directly mentioned in classical texts but can be understood with the help of *Ashraya- Ashrayi Bhava*.

Old age is the condition characterized by gradual decline in *Dhatu*s, sensory-motor functions, reduced strength, energy manliness, retention, memorizing and analysing the fact. With predominance of *Vata Dosh*a, diminution of body tissues occurs in old age.⁸ Though the description of *Asthi Dhatu* along with its structure, functions and abnormalities related to it are

explained by all the classical texts but the pathogenesis of *Asthikshaya* is not explained in any of the classical texts. Considering the above factors in present study, an effort is made to understand the etiopathogenesis of *Asthikshaya* with special reference to senile Osteoporosis.

Aim and Objectives-

- 1) To explore various aspects of aging mentioned in Ayurveda literature along with its effect on body tissues.
- 2) To understand the effect of aging on *Asthi Dhatu* in particular and its correlation with modern biological understanding.

Material and methods-

Causative factors and pathogenesis of *Asthikshaya* along with senile osteoporosis were studied and critically analysed from various classical texts and scholarly articles, internet sources respectively. Databases like PubMed, Scopus were searched using keywords like *Jara*, Aging, *Asthi Kshaya*, osteoporosis, senile osteoporosis.

A) General causes of *Dhatu Kshaya*-⁹

- -*Ativyayama* (excessive exercise)
- -*Anashana* (fasting)
- -*Ati Chinta* (worry)
- -*Rukshashana* (consumption of dry food)
- -*Alpaashana* (less food intake)
- -*Vataatapa Sevana* (exposure to wind and sunlight)
- -*Bhaya, Shoka* (worry, grief, fear,)
- -*Rukshapana* (intake of dry liquid like *Ruksha Madya*)
- -*Prajagara* (waking at nights)
- -*Ativartana* (excessive loss of *Kapha, Rakta, Shukra, Mala* from the body)
- -*Kala* (time factor (*Adana Kala* and *Vridhavasta*))
- -*Bhutopaghata* (invasion of other infectious agents)

Further it is important that in addition to *Asthivaha Srotasa*, the knowledge of *Medovaha, Majjavaha* and *Purishvaha Srotasa* is also important to understand the pathogenesis of *Asthikshaya* as the vitiating factors vitiating for these Channels, also affect the *Asthi Dhatu*.

Asthivaha Srotodushti Nidana¹⁰

- Vyayama (excessive exercise)
- Ati Sankshobha (excessive irritation)
- Asthi Vighattana (repeated trauma)
- Vatala Ahara Sevana (excessive consumption of Vata aggravating food)

Majjavahasrotodushti Nidana¹¹

- Utpeshana (being crushed)
- Ati Abhishyandana (being filled with wet components of Kapha)
- Abhighata (trauma)
- Prapedana (compressed)
- Virudha Ahara Sevana (consumption of incompatible and unwholesome food)

Purishava Srotodushti Nidana¹²

- Sandharana (withholding urge of defecation)
- Ati Ashana (excessive eating)
- Ajeerna (indigestion)
- Adhyashana (repeated eating)
- Durbalagni (weak digestion)
- Krusha (in emaciated persons)

Medovaha Srotodushti Nidana¹³

- Avyayama (lack of exercise)
- Diva Swapna (sleeping during daytime)
- Medhyanam Ati Sevanat (excessive intake of fatty, fried and caloric foods)
- Varuni (an alcoholic product).

B) Specific causes of Asthi Dhatu Kshaya-

1) Sahaja Nidana:

- Beeja, Beejabhaga, Beejabhagavayava¹⁴
- Pitrija Bhava¹⁵
- Kulaja (Caucasians)
- Prakriti (Vata dominant Prakriti)

2) Jataja Nidana¹⁶: Vatakaraka Ahara, Vihara

3) Swabhavaja Nidana^{17,18}: Old age persons and women

Samprapti:

There are two main mechanisms leading to *Asthikshaya*-

- 1) Aggravation of *Vata Dosha*, which due to its catabolic activity, causes decrease in the formation of nutrients required for *Dhatu Poshan*.

- 2) Obstruction of the channels due to which required amount of nutrients cannot reach *Asthivaha Srotasa*, thus causing *Asthi Kshaya*.

The first mechanism is involved in the pathogenesis of *Asthikshaya* taking place during old age.

Owing to the concept of *Ashraya- Ashrayi Bhava*, all the factors responsible for *Vata* aggravation, act as the cause for *Asthi Kshaya* also. Keeping in mind all the causative factors explained under *Vata Vyadhi*, an attempt has been made here to formulate and explain the *Samprapti* of *Asthi Kshaya*.

In order to have a proper interpretation of the pathogenesis of *Asthi Kshaya*, apart from the *Vata* aggravating causes, other associated factors like vitiating factors for *Asthivaha*, *Medovaha*, *Majjavaha*, *Purishavaha Srotasa* should not be neglected.

They indirectly affect the *Asthi Dhatu* because of the following reasons-

- 1) *Medo Dhatu* is prior to *Asthi* and *Majja* is the next one and following the theories of *Dhatu Poshana*, *Medo Dhatu Kshaya* will cause *Kshaya* of *Asthi* also.
- 2) *Asthi Saushirya* is mentioned as a symptom of *Majja Kshaya* in classics, which is indicative of porosity of bones.
- 3) *Purishadhara* and *Asthidhara Kala* are considered the same, so the morbidities related to *Purishavaha Srotasa* will affect *Asthi Dhatu* also. Moreover, the proper functioning of *Jataragni*, *Bhutagni*, *Dhatwagni* is essential for the formation and proper nutrition of the body tissues.¹⁹ In this regard, theory of “transformation and Nourishment of body tissues” is important to explain the pathogenesis of *Dhatu Kshaya*. Key points for the understanding of this process are-

- 1) Abnormal functioning of *Jatharagni* hampers the formation of prime most *Rasa Dhatu*, which further affects the subsequent *Dhatu*s.
- 2) Disturbed *Dhatwagni* interfere with the transformation of *Poshaka Dhatu* (mobile portion of *Dhatu* specific nutrients required for the formation and nourishment of next *Dhatu*) into *Poshya Dhatu* (Stable portion of nutrients providing strength and nutrition to concerned *Dhatu*).

This imbalance ultimately results in deformities related to that particular *Dhatu*.

- 3) If *Bhutagni* is not functioning properly, the assimilation of the particles of element specific to the configuration of particular *Dhatu*, get interrupted and further impede with the development of that *Dhatu*.

Considering the above-mentioned factors, it is clear that the pathogenesis of *Asthikshaya* during old age is not a simple mechanism but a complex of many events taking place simultaneously inside the body, in order to cause degeneration of body tissues.

Purvarupa: There is no description about *Purvarupa* of *Asthikshaya*. As the causative factors for *Vata Vriddhi* and *Asthikshaya* are same, and *Purvarupa* of *Vata Vyadhi* are *Avyakta*. *Acharya Chakrapani* has commented on the word *Avyakt* to clarify that it can be taken as '*Alpa Vyakt*' or '*Asampurnalakshana*' which means, manifestation of mild symptoms. Thus, the symptoms in their mild form i.e. mild pain in *Asthi-Sandhi*, mildness of other symptoms related with *Kesha, Roma, Nakha, Danta*, can be regarded as the *Purvarupa* of *Asthikshaya*.

Rupa: While describing 18 types of *Kshaya*, *Acharya Charaka* has mentioned *Asthikshaya Lakshanas* as falling of hairs of head & whole body, falling of nails, teeth, lethargy, and laxity in joints while those in *Sushrut Samhita* are pain in bones, dryness and brittleness of the teeth and nails. Following the concept of *Ashraya-Ashrayi Bhava*, aggravated *Vata* is mainly responsible for causing *Asthikshaya*. So, there are various types of pain in *Asthi, Sandhi* and *Utsahahani*. Since *Dhatu Poshana* is also interrupted, negative effect on *Upadhatu* and *Mala* can also be seen i.e. dryness and falling of nails, hair, teeth.

Upashaya

-*Ahara- Dravyas* rich in *Madhura, Amla, Lavana Rasa* are favourable in condition of *Asthikshaya*. Use of *Dugdha, Dahi, Ghrita, Mamsa* and *Mansa Rasa* is also beneficial.

-*Vihara- Abhyanga, Swedana* and *Niyamita Vyayama*

-*Achara- Yoga, Achara Rasayan*

-*Aushadhi- Vata Nashaka* and *Vedana Shamaka Aushadhi, Basti Prayoga, Rasayana*

Anupashaya

-*Ahara- Kashaya, Katu, Tikta Rasa Pradhana Dravyas*, specially *Shushka Shaka, Mamsa, Mudga, Masura, Adhaki, Kalaya, Madya*.

-*Vihara- Ati Vyayama, Ati Sahasa, Ratri Jagarana*

-*Achara- Chinta, Bhaya, Krodha*

-*Aushadhi- Vata Prakopaka, Atiyoga of Shodhana*

Sadhyasadhya: *Asthi* is *Gambhira Dhatu* (deeply situated), and the disease of *Gambhira Dhatu* are said to be *Yapya* or *Kashta Sadhya*.²⁰ *Asthikshaya* occurs in *Vridhdhastha* and is manifested in last stage of *Kriya Kaala* i.e. *Bhedawastha*. So, it is *Asadhya* if not treated timely and is *Yapya* if treatment is continued.²¹

Upadrava: If the diseases are not diagnosed and treated properly, *Asthi Dhatu* becomes very weak and fails to nourish subsequent *Dhatus*, resulting in *Kshaya* of *Majja Dhatu, Shukra Dhatu* and *Oja*. Due to persistent *Kshaya* of *Asthi Dhatu, Majja Kshaya* occurs, a symptom of which is *Asthi Saushirya* (porous bones) which later leads to *Asthi Bhagna*, most common *Upadrava* of *Asthi Kshaya*.

Senile osteoporosis-

The word Osteoporosis means "bone with pores". It is a condition of progressive bone loss that is painful, disfiguring and debilitating.²² osteoporosis is classified into primary and secondary. In Primary, bone loss occurs due to natural process of aging while the secondary is caused by various clinical factors. Primary or involutional osteoporosis is further classified as Type 1 and Type 2. The type 1 is referred as postmenopausal, occurs exclusively in females and is caused due to estrogen deficiency whereas type 2 is Senile osteoporosis, affects both male and females over the age of 70 years.²³

Etiopathogenesis-

A major factor contributing to the etiology of senile osteoporosis is age-related decrease in bone formation. It represents a condition of significant decline in bone mass due to imbalanced bone remodeling. Bone remodeling, sequence of bone resorption and formation, is a process which continues throughout life. Equal proportion of resorption as well as formation is required in order to strengthen and repair

bones in the body. But with aging, bone resorption surpasses bone formation, resulting in diminished bone mass giving rise to senile osteoporosis.²³

In Particular to senile osteoporosis, aging of cortical and trabecular bones causes loss of bone density in elderly.

Although clear etiological considerations regarding osteoporosis are not confirmed, the risk factors contributing to senile osteoporosis are identified as- gender, age, hormone imbalances, reduced bone quality, and compromised integrity of bone microarchitecture.²³

Some studies suggest that the pathogenesis of bone loss in old age is related to zinc deficiency which further leads to an increase in endogenous heparin.²⁴ It is caused by mast cell degranulation and increased bone resorption reaction of Prostaglandin E2. It discharges calcium from the bones, which restricts the formation of more bone mass and results in fragile bones. These factors enhance the action of parathyroid hormone and add on to the pathogenesis related to senile osteoporosis.²⁴ The low intake of calcium and its reduced absorption capability in elders support the progression of bone loss. Alongside, decreased absorption of vitamin D related with hampered metabolism also promotes to develop senile osteoporosis.²⁴

Risk factors-

A major determinant of bone density is peak bone mass which starts in intrauterine life and completes by the age of 40.²⁵ Though senile osteoporosis is mainly attributed to age, other risk factors affecting the peak bone mass and rapid progression of bone loss which ultimately result in senile osteoporosis includes genetics, environment, nutrition, associated medical conditions and medications.

1) Genetic- Maternal body built along with her lifestyle and status of vitamin D can affect the bone density of offspring. Moreover, some studies indicate that race (eg. Asians), age (older age), Body mass (eg Lower weight) and gender (female) contributes to the risk of developing osteoporosis.²⁵ Although the incidence of osteoporosis and hip fracture vary in different populations, old age is consistently in asso-

ciation with higher incidence of fragility fractures due to osteoporosis.²⁵

2) Social-

Smoking tobacco, excessive Caffeine intake, alcohol consumption are associated with decrease in bone density in the elderly population.²⁵

3) Dietary-

Deficiency of Calcium and vitamin D in diet can increase the risk of osteoporosis in elderly by decreasing bone mass, reduced calcium absorption and increase in bone turnover.

4) Medical conditions-

Though senile osteoporosis has a specific pathogenesis, some other ailments act as secondary to fasten the pathogenesis. These includes endocrine disorders (e.g. hyperthyroidism and diabetes mellitus), gastrointestinal, hepatic and nutritional disorders (e.g. celiac disease and inflammatory bowel disease), hematological disorders (e.g. systemic mastocytosis), renal disorders (e.g. chronic kidney disease), and autoimmune disorders (e.g. rheumatoid arthritis and systemic lupus erythematosus).²⁶

5) Medications-

Various medications can interfere with the absorption of calcium, such as anticonvulsants, diuretics, corticosteroids, immunosuppressive medications, some antibiotics, and NSAIDS.²⁵

Symptoms and complications-

Osteoporosis is also termed as a silent disease as it only came to know after the occurrence of fracture. Senile osteoporosis is caused due to continuous and gradual loss of bone mass throughout the process of aging so, the bones are more fragile and thus more prone to fractures. The associated consequences of fragile fractures may be doubled risk of getting fractured in future, poor quality of life because of disability and chronic pain, increased relative mortality risk. Senile osteoporosis is characterized by fractures of the proximal femur, the proximal humerus, the proximal tibia, the pubic rami, and sacral alae in women and men over the age of 75.

Clinical Findings

1) Discomfort on sitting and standing due to acute thoracic compression fracture.

- 2) Normal but slow gait
- 3) Thoracic kyphosis due to anterior compression fractures
- 4) Loss of lumbar lordosis
- 5) Decreased axial height.
- 6) Reduced spinal movements, with more restricted flexion than extension.
- 7) Tenderness of Spine and paravertebral muscles on palpation and percussion over the level of fracture.
- 8) Secondary to severe lumbar vertebral collapse, the most common manifestation is distention and protrusion of abdomen.
- 9) With progression of disease, development of Circumferential pachydermal skin folds at the rib and pelvic margins

Diagnosis-

As osteoporosis can only be diagnosed only after onset of a pathological fracture .So, time to time BMD (bone mineral density) measurements should be done for high-risk individuals (elderly)²⁷.

WHO has established a criterion to diagnose osteoporosis using T-scores of BMD (Bone mineral density). T- score ranging from 0 to -1 SD denotes normal bone health, from -1SD to <2.5 SD is suggestive of osteopenia while the range >-2.5 SD indicates osteoporosis. DEXA (dual-energy X-ray absorptiometry) scan of the hip and/or spine is considered as a gold standard to diagnose osteoporosis.²⁵

Prevention-

Falls contribute most significantly to the incidence of osteoporotic fractures in old age so precautions should be taken to minimise the risk of falling. Regular weight bearing and muscle strengthening exercises are beneficial as they reduce the risk of falls and fractures by improving strength, posture, and balance.²⁸ Healthy diet rich in Calcium and Vitamin D is essential for healthy bones. Discontinuance of Smoking, excess caffeine intake and alcohol consumption are also helpful to prevent bone loss.

DISCUSSION

The concept of *Asthikshaya* can be explained through the principle of *Ashraya- Ashrayi Bhava*. According

to this, there is a mutual interdependency between *Dosha*, *Dhatu* and *Mala*. The group of *Dosha*, *Dhatu* and *Mala* possessing similar properties are directly related with each other but the inter-relation of *Asthi Dhatu* and *Vata Dosha* is exception. *Asthi* and *Vata* are inversely related and with the increase in *Vata Dosha* there is decrease in *Asthi Dhatu*. It is stated in many classical texts that *Vata dosha* become predominant with the advancement of age, justifying *Asthikshaya* in old age.^{29,30} *Vridhawahastha* (old age) is the phase of life starting after 60 or 70 years, at which the body tissues, sense organs, strength etc. begin to decay.³¹ *Vardhakya* (aging) or *Jara* is defined as the state of growing old by the act of ongoing wear and tear. According to Ayurveda, *Jara* (aging) is a *Swabhavika Vyadhi* (natural phenomenon) just like hunger, thirst and sleep. Almost all the classical texts explain that assimilation of nutrients into *Dhatu*s is slowed down due to aging and results in decline in their quality and quantity.³² *Acharya Charaka* and *Sushruta* has mentioned the effect of aging on *Dhatu*s as "*Hiyamana*" or *Ksheeyamana* which means there is decrease in the quality and quantity of the *Dhatu*s.³³

Kshaya can occur either due to *Dhatu Kshaya* or due to *Margavarana*. Direct role of *Vata Dosha*, improper digestion, vitiation of corresponding *Srotasa* results in *Dhatukshaya*. While explaining *Margavarana*, *Acharya Charaka* explained that if the pathway of *Vata* is obstructed, it (*Vyan Vayu*) loses its normal movement and gets aggravated at that site, further absorbing *Rasadi Dhatu*s. Due to this, the functions of *Vyan Vayu* i.e. *Ahara Rasa Viksepa* (*Rasa Samvahana*), *Dhatu Vyuhana* and *Agni Samirana* are affected. As a result of this, the *Ahara Rasa* containing the nutrients required for *Dhatu Poshana*, will not be able to reach and nourish the *Sthayi Dhatu*s. *Dhatu Vyuhana* is permeability of the *Posaka Ansha* inside the *Sthayi Dhatu*s. If this process is altered, *Dhatu Poshana* will not be possible and the functions of the *Dhatwagnis* will also be affected. It signifies the importance of *Medodhatwagni* in the formation and nourishment of *Asthi Dhatu*. It is supported by the fact that Vitamin D (which is derived from ster-

ols) is essential for absorption of calcium in the body. Therefore, *Meda* is rightly considered as the *Moola* of *Asthivaha Srotas*. Imbalance of *Asthi Dhatvagni* leads to improper formation of *Sthayi Asthi Dhatu* from *Poshaka Asthi Dhatu*. Hormones responsible for bone metabolism (Parathyroid, calcitonin, estrogen etc.), can be regarded as different types of *Agni* acting in the course of *Asthi Dhatu Utpatti* and *Poshana*. So, to sum up briefly, it can be stated that *Asthikshaya* is caused due to aggravated *Vata*, which is common during old age. This vitiated *Vata* occupies the vacuum in *Asthivaha Srotasa* and causes *Asthi Kshaya*.

CONCLUSION

Asthikshaya is a disabling disease which renders elders a bedridden life. The prevalence of senile osteoporosis is more in people aged above 70 years. *Asthikshaya* is *Swabhavabala Pravritta Vyadhi* because *Vaya (Vriddhavastha)* plays major role along with *Vata* as *Pradhana Dosha* and *Asthi* as *Pradhana Dhatu*. Classical texts explain that *Vata* aggravating factors plays a significant role in manifestation of *Asthikshaya*. The symptoms of *Asthikshaya* mentioned in texts hold similarity with that of senile osteoporosis in modern science which include pain in the back, deformity of spine, risk of developing fractures. Moreover, old age is considered as a state of natural decline in body tissues. Senile osteoporosis must therefore be viewed as the consequence of a specific long-term imbalance of bone remodeling, which leads to net bone loss because formation of new bone by osteoblasts for several reasons does not match the extent of bone resorbed by osteoclast activity. Similarly, Ayurveda explains that aging is a natural phenomenon and as a person grows old, predominance of *Vata Dosha* occurs. The main cause for *Asthi Dhatu Kshaya* in old age was natural decay of body tissues. This process is associated with the effect of predominant *Vata Dosha* which causes decrease in metabolic activities of body and decline in quality of body tissues.

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