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Vitamin D Deficiency and Its Association with Asthikshaya: Current Insights and Future Directions

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Abstract:
Asthikshaya not indicate that any bone disappears from the body, but the bone is losing its strength. In *Ayurvedic* classical texts the causative factors as well as the symptoms and treatment all has been mentioned. *Asthikshaya* is very much like the Osteoporosis which also indicates the loss of bones mass. Osteoporosis was once thought to be an unavoidable part of aging for which there was no treatment; but, in more recent times, it has come to be recognized as a condition that it may be managed and prevented. Selecting a treatment plan based on the latest research on the etiology of the numerous types of osteoporosis and the diagnostic spectrum associated with them is quite important. Therapeutic medications can be useful in slowing down excessive bone turnover to a physiological level when osteoporosis is impending or manifest during periods of fast bone loss, typically at the start of postmenopausal but also in older individuals. To lessen or even eliminate the chance of developing new fractures, the optimal treatment for established osteoporosis should promote bone growth, enhance bone mass, and address architectural abnormalities. Increasing cortical bone mass and stimulating periosteal bone growth are especially helpful in cases of increasing brittleness. Since vitamin D is essential for the body's metabolism of calcium as well as phosphate, it plays a major role in the pathophysiology of osteoporosis. The potential for drug-assisted osteoporosis treatment lies in several avenues. These include refining current approaches through novel applications, introducing interval therapies, altering daily dosages, and achieving synergistic benefits through appropriate drug combinations. Thus, starting the therapy with vitamin D supplements will accelerate the process of building bone mass and decrease the rate at which bone is reabsorbed.

Keywords: Asthikshaya, Osteoporosis, Vitamin-D deficiency, Ayurveda

Introduction:

The term *Asthikshaya*(1) is made of *Asthi* (bone) and *Kshaya* (loss) which indicates the loss of bone, but this loss of bone is not the quantitative loss but the qualitative loss of the bone. *Astanga Hridayam*, *Astanga Sangrah*, *Sushruta Samhita*, as well as *Charaka Samhita* (compendiums) are examples of classical Ayurvedic texts. *Acharya* (Scholar) has mentioned the signs and symptoms of the *Asthikshaya*. The symptoms of *Asthikshsya* mentioned by different *Acharya* in their texts are mostly common and

broadly include premature falling of the scalp as well as body hairs, teeth, nails, fatigue, dryness over skin and pain in the bones and laxity in the joints(2).

S.N.	Author	Symptoms of Asthikshaya(3)	Symptoms of osteoporosis	Symptoms of Vitamin D deficiency(4)
1.	*Charaka*	Premature falling of scalp hairs, body hairs, nails, beard hairs, tiredness (exertion without work), laxity in the joints.	Pain in the back, reduction in strength of bone leading to pathological fracture, fracture in radius distal end, and hip, vertebral bodies with trivial trauma.	weakness, twitching muscles, weariness, arthralgia, and myalgia. Osteoporosis can result from a vitamin D deficiency and fragility fractures.
2.	*Sushruta*(5)	Pain in the bones, falling of teeth, and nails, and dryness in the body.		
3.	*Astanga Sangrah*	Premature falling of hairs, nails body hairs, dryness, hardness looseness in the joint pain in bones and desire to have non-veg food (especially meat with bones)		
4.	*Astanga Hridaya*	*Asthitoda* (pain in bones), premature falling of teeth, hairs, nails and pain in the joints and bones.		

Table no 1 Classical reference of the symptoms of Asthikshaya, osteoporosis and Vitamin D deficiency

The causes(6) of the *Asthikshaya* are not mentioned separately in compendiums but *Acharya Charaka* while deliberating causes of *Dhatu Kshaya* enumerated excessive exercise, fasting, mental stress, excessive intake of dry food (*Ruksha ahaar)*, excessive exposure to air and sunlight, emotional disturbances like fear or depression, awake late night, excessive loss of mucous, blood, semen or/and faeces and the ageing, are common factors for the *Dhatu Kshaya* in any person. All these factors may not be directly associated with the *Asthikshaya*, but as per *Ayurvedic* principle all *dhatu* are interdependent so if one *Dhatu* underwent *Kshaya* it will lead to the *kshaya* of the others too(7)

Low bone mass and microarchitecture-related bone tissue degeneration that can result in fractures are the hallmarks of osteoporosis ((8)). Osteoporosis is a "silent disease" because it doesn't show any signs. The World Health Organization ranks cardiovascular disease as the top worldwide health concern, ahead of osteoporosis. Low bone density predisposes to osteoporotic fractures, much like asymptomatic disorders like hypertension and dyslipidemia predispose to stroke and myocardial infarction, respectively(8). Histologically it is characterized by a decrease in several size of the trabeculae with normal width of osteoid seams(9).

The actual prevalence of osteoporosis remains unknown because of its asymptomatic nature initially but is presumed that approximately 35% of post-menopausal women are at risk of developing osteoporosis(10). According to one study, one in 5 persons in India had osteoporosis, and one in 2 have osteopenia(11). In osteoporotic bone fractures are seen commonly in the spine, hip and wrist joints. Bone mass is the result of bone developed during growth and at maturity, the reabsorption of bone occurs due to the activity of the osteoclast cells. In normal individuals, the process of creating and reabsorbing bone stays balanced but in osteoporosis, the process of reabsorption exceeds the

formation(12). There are various factors responsible for bone reabsorption. (13) Primary & secondary osteoporosis are of 2 types of osteoporosis(14). Type-I & type-II primary osteoporosis are distinguished further; type-I osteoporosis develops in postmenopausal women, while type-II osteoporosis results from aging.(15). In type-II osteoporosis, vitamin D Plays a crucial role because vitamin D enhances calcium absorption in the gut and prevents mineral loss from the bone thus osteoporosis.

Osteoporosis has been considered an unavoidable condition for a very long time because the major causative factors are ageing and menopause, which are unavoidable, but nowadays various approaches have been developed to slow down the process of bone reabsorption and enhance the bone mass in the early phase of life. Vitamin D plays a key role in that therapy(16).

The body needs vitamin D to properly metabolize calcium and phosphorus. (17). It enhances the absorption from the gut, their mobilization from the bone and reabsorption from the kidney. To maintain a healthy level of vitamin D, there must be more than 30 ng/ml of 25-hydroxy vitamin D in the bloodstream (19). It can cause a number of issues, most notably adult osteoporosis and childhood rickets. Individuals who suffer from a protracted and severe vitamin D deficiency may exhibit signs of secondary hyperparathyroidism, such as weakness, twitching of the muscles, arthralgia, myalgia, and bone pain(18). Osteoporosis can result from a vitamin D deficiency and fragility fractures.

It is the need of the hour that we prepare public plans and future strategies that include the prevention of *Asthikshaya* as well as target the population which is exposed to vitamin D deficiency so osteoporosis in future. In the present study, we are trying to explore the correlation between *Asthikshaya*, osteoporosis and Vitamin D deficiency.

Discussion

A gradual skeletal condition known as osteoporosis is marked by a reduction in bone mass along with an increased chance of fractures.(19). It is characterized by a compromised microarchitecture of the bone as well as decreased BMD (bone mineral density), This results in bone fragility and increases the risk of fracture. Though men may also be impacted, it primarily affects older persons, especially postmenopausal women. The bones become porous, brittle, and more susceptible to breaks, even from minor falls or, in severe cases, from simple actions like coughing or bending over. The development of osteoporosis is influenced by several factors, including age, genetics, hormonal changes, and lifestyle choices(20). One of the critical contributors to bone health is calcium, which is necessary for maintaining bone density. But without enough vitamin D, which is necessary for the intestines to absorb calcium, calcium on its own is insufficient. The metabolism of bones and the preservation of bone health are critically dependent on vitamin D.

Worldwide, vitamin D insufficiency is a prevalent health concern, affecting various age groups, but it is particularly prevalent in older adults. This deficiency can stem from inadequate dietary intake, limited exposure to sunlight (which is required for the body to produce vitamin D), and various illnesses that impact the metabolism of vitamin D.(21). When the body is deficient in vitamin D, calcium absorption decreases, leading to a compensatory increase in parathyroid hormone (PTH) secretion. To sustain appropriate amounts of calcium in the blood, PTH in turn encourages the release of calcium from bones, this may eventually result in bone loss. This process accelerates the onset and progression of osteoporosis, increasing the risk of fractures.

It is commonly known that osteoporosis and vitamin D deficiency are related. An increased risk of osteoporosis has been connected with low vitamin D levels, fractures, according to investigations.(22).

Furthermore, vitamin D supplementation has been proven to reduce the risk of fractures in older adults, particularly when combined with calcium supplementation. Preventing and managing osteoporosis involves a multifaceted approach. Osteoporosis prevention requires a balanced diet that includes enough calcium and vitamin D, & frequent weight-bearing action. Lifestyle changes like cutting back on drinking and smoking are also crucia(23). Drugs to delay bone loss and lower fracture risk may be administered for patients with those with a higher risk of osteoporosis or who have already been diagnosed with the condition.

Conclusion:

One major issue for public health is osteoporosis, particularly in ageing populations, and vitamin D deficiency is a key factor contributing to its progression. Ensuring sufficient vitamin D levels through diet, supplements, and appropriate sun exposure is essential for maintaining healthy bones along with preventing fractures caused by osteoporosis. The main goals of public health initiatives should be to increase adherence to lifelong bone health-promoting behaviours and to the significance of vitamin D. Through the above discussion, it could be concluded that *Asthikshaya* the condition which is mentioned in the *Ayurvedic* classic has a similar presentation to osteoporosis and Vitamin D deficiency because, in most cases of osteoporosis, the Vitamin D plays a key role. It also justifies the reason for the *Dhatukshaya* mentioned in *Charaka Samhita* which includes the sedentary lifestyle, mental stress, and *Rukshaahaar* that are the similar reasons for the vitamin D deficiency and osteoporosis as well.

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