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Review Article

ASTHI DHATU POSHANA: AN AYURVEDIC PERSPECTIVE ON BONE NUTRITION AND METABOLISM

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ABSTRACT

Asthi Dhatu is the fifth among the seven *Dhatus* described in Ayurveda and plays an important role in providing support, stability and protection to the body. *Asthi Dhatu* is particularly interesting because of its relationship with *Meda Dhatu, Asthivaha Srotas, Majja Dhatu* and *Vata Dosha*. **Aim:** The present article aims to explore the Ayurvedic concept of *Asthi Dhatu Poshana* and discuss its possible relevance to the contemporary understanding of bone nutrition and metabolism. **Materials and Methods:** Classical Ayurvedic texts including Charaka Samhita, Sushruta Samhita and Ashtanga Hridaya were reviewed to understand the concepts of *Asthi Dhatu, Dhatu Poshana, Dhatvagni, Asthivaha Srotas* and the relationship between *Asthi* and *Vata*. Contemporary literature related to bone nutrition, bone remodeling, physical activity and skeletal health was also reviewed to identify areas of conceptual similarity and possible avenues for future research. **Discussion:** Ayurveda considers *Asthi Dhatu* to be the result of a sequential process of tissue nourishment in which properly digested food ultimately contributes to the formation and maintenance of *Asthi*. The role of *Asthidhatvagni* is particularly important in this process. The classical relationship between *Meda* and *Asthi* suggests that tissue metabolism is interconnected rather than isolated. Similarly, the *Ashraya-Ashrayi* relationship between *Asthi* and *Vata* provides an important explanation for the tendency towards skeletal depletion and degenerative changes with advancing age. Modern science also recognizes bone as a metabolically active tissue influenced by nutrition, endocrine factors, mechanical loading, ageing and systemic metabolism. **Conclusion:** *Asthi Dhatu Poshana* presents a holistic Ayurvedic understanding of skeletal nourishment. It brings together digestion, metabolism, tissue transformation, transport and lifestyle factors in the maintenance of bone health. Although Ayurvedic concepts should not be directly equated with modern anatomical or biochemical entities, they provide several interesting areas for interdisciplinary research into nutrition, bone metabolism and age-related skeletal disorders.

INTRODUCTION

The skeletal system is often thought of simply as the framework that supports the body. In reality, bone is a living and continuously changing tissue. It provides mechanical support and protection to vital organs, helps in movement and also acts as an important reservoir for minerals. Bone undergoes continuous remodelling throughout life, with old or damaged bone being removed and new bone being formed. This process is influenced by nutrition, hormones, physical activity, age and several metabolic factors[1,2].

Ayurveda approaches the same subject from a different physiological perspective through the concept of *Asthi Dhatu. Asthi* is the fifth among the seven *Dhatus- Rasa, Rakta, Mamsa, Meda, Asthi, Majja* and *Shukra*. It is primarily associated with the structural stability and support of the body. The classical texts do not describe the nourishment of *Asthi* as a simple process in which food directly reaches the bones. Instead, nourishment occurs through a gradual process of digestion, transformation and utilisation of nutrients by the different *Dhatus*[3,4].

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This concept is described under *Dhatu Poshana*. Food is first subjected to *Jatharagni*, after which the resulting nutritive material undergoes further transformation and is utilised by the tissues. Each *Dhatu* is considered to possess its own metabolic activity, described as *Dhatvagni*. Thus, *Asthidhatvagni* is considered to have an important role in the formation and maintenance of *Asthi Dhatu*[3,5].

Another interesting feature of *Asthi* physiology is its close relationship with *Vata Dosha*. Ayurveda describes *Asthi* as an important site of *Vata*, and the *Ashraya-Ashrayi* relationship between them is considered to be reciprocal. This relationship becomes particularly relevant in old age, when *Vata* naturally becomes predominant and depletion of *Asthi* may occur[6].

The purpose of this article is therefore to examine *Asthi Dhatu Poshana* as a comprehensive concept of skeletal nutrition and metabolism and to discuss its possible relevance in the light of contemporary knowledge of bone physiology.

Understanding *Asthi Dhatu*

The word *Asthi* is derived from the root as, which conveys the idea of stability or existence. In Ayurvedic physiology, *Asthi* is regarded as the tissue that provides firmness and support to the body. Charaka and Sushruta describe *Asthi* among the seven fundamental *Dhatus* and attribute important structural functions to it[3,7].

The skeletal framework is essential for maintaining the shape and stability of the body. The long bones support movement, while the bones of the skull and thorax protect vital organs. Although these functions resemble the modern understanding of bone, *Asthi Dhatu* should not be considered an exact anatomical equivalent of modern bone. The Ayurvedic concept of *Dhatu* is broader and includes functional as well as structural aspects.

Ayurvedic descriptions also include structures such as teeth and other hard tissues while discussing *Asthi*. This suggests that the assessment of *Asthi Dhatu* is not restricted to bone density or skeletal structure alone. Clinical features such as the condition of teeth, nails, hair, bone strength and the presence of pain or weakness may also provide clues regarding the state of *Asthi*[3,7].

Concept of *Dhatu Poshana*

The concept of *Dhatu Poshana* is central to understanding how *Asthi* receives nourishment. Ayurveda considers food to be the primary source from which all *Dhatus* are ultimately formed. However, food cannot be considered to nourish every tissue directly. It first has to undergo digestion and transformation.

Jatharagni plays the initial and most important role in the digestion of food. The nutritive portion produced after digestion is then made available for further transformation. *Bhutagni* and *Dhatvagni* are described as contributing to the subsequent stages of this process[3,5].

In simple terms, the Ayurvedic concept can be understood as:

Ahara → Jatharagni → Ahara Rasa → sequential Dhatu Poshana → Asthi Dhatu

This sequence should not be interpreted as a literal anatomical pathway. It is a physiological explanation of how nutrients are progressively transformed and utilised by the body.

The concept becomes particularly interesting when *Asthi* is considered in relation to *Meda*. According to the classical description of sequential tissue formation, *Asthi* is produced following the transformation of *Meda* through the action of *Asthidhatvagni*[3,5]. This makes *Asthi Poshana* part of a larger metabolic process rather than an isolated event.

Role of *Asthidhatvagni*

The concept of *Dhatvagni* is one of the distinctive features of Ayurvedic physiology. Each Dhatu is considered to possess a specific metabolic activity that enables it to utilize the nutrients reaching it and maintain its own structure and function.

Asthidhatvagni is therefore understood as the metabolic principle responsible for the transformation and utilisation of the nourishing material associated with *Asthi Dhatu*[5].

When the process of digestion and tissue metabolism is appropriate, proper nourishment of the *Dhatu* is expected. On the other hand, impairment of *Agni* may interfere with the appropriate transformation and utilisation of nutrients. This provides an Ayurvedic explanation for why simply consuming a nutrient does not necessarily guarantee adequate tissue nourishment.

A similar idea can be appreciated in modern physiology. Bone health depends not only on dietary intake but also on digestion, intestinal absorption, endocrine regulation, cellular activity and the ability of bone cells to utilise available nutrients. Calcium, phosphorus, vitamin D, protein and several micronutrients participate in maintaining skeletal integrity[1,8].

However, *Asthidhatvagni* should not be equated with a particular enzyme or biochemical pathway. It is better understood as a broader Ayurvedic concept of tissue-specific metabolism.

Meda Dhatu and *Asthi Dhatu*

The relationship between *Meda* and *Asthi* is particularly noteworthy in the classical description of *Dhatu* formation. *Asthi* is considered to arise after the transformation of *Meda* through *Asthidhatvagni*[3,5].

At first glance, this relationship may appear different from modern physiology. However, contemporary research has demonstrated that adipose tissue and bone are metabolically interconnected. Both tissues share developmental and endocrine pathways, and adipose-derived factors can influence bone formation and resorption[9].

This does not mean that *Meda Dhatu* can simply be labelled as modern adipose tissue. The two concepts belong to different systems of physiological thought. Nevertheless, the classical *Meda-Asthi* relationship raises an interesting question about the connection between energy metabolism and skeletal health.

For this reason, the Ayurvedic description may be useful as a conceptual starting point for interdisciplinary research rather than as a direct biomedical equivalence.

Asthivaha Srotas and Tissue Nourishment

Ayurveda describes specific channels or pathways called *Srotas* through which substances are transported and tissues are nourished. *Asthivaha Srotas* is associated with the maintenance and nourishment of *Asthi Dhatu*[7,10].

Classical descriptions mention *Meda* and *Jaghana* as important sites related to *Asthivaha Srotas.* Disorders affecting these pathways are described as capable of disturbing normal *Asthi* physiology[10].

The modern skeletal system also depends upon an extensive vascular supply. Blood vessels deliver oxygen, nutrients, hormones and other signalling molecules to bone tissue. Bone cells are therefore dependent upon continuous communication with the systemic circulation.

It would be inappropriate to state that *Asthivaha Srotas* are identical to blood vessels. Nevertheless, both concepts acknowledge that a tissue cannot remain healthy without appropriate transport and communication. This provides another area where Ayurvedic physiology can be explored through modern research without forcing the two systems into an artificial one-to-one correspondence.

Asthi and *Majja*: An Important Relationship

The relationship between *Asthi* and *Majja* is another distinctive feature of Ayurvedic tissue physiology. *Majja* is the *Dhatu* that follows *Asthi* in the classical sequence. Ayurveda describes *Majja* as occupying the cavities of bones and contributing to nourishment and strength[3,7].

Modern anatomy also recognizes bone marrow within the medullary cavities of bones. Bone marrow has important roles in blood-cell formation, immune regulation and communication with the skeletal microenvironment.

Although *Majja Dhatu* and modern bone marrow are not necessarily identical concepts, the close relationship described in Ayurveda is striking from a structural and functional point of view. Recent literature has explored this relationship and has suggested that it deserves further investigation rather than being dismissed as a simple anatomical analogy[11].

The *Asthi-Majja* relationship also reminds us that Ayurveda views tissues as interconnected. The health of one *Dhatu* is not completely independent of the tissues that precede and follow it.

Asthi and *Vata*: The *Ashraya-Ashrayi* Relationship

Perhaps the most characteristic feature of *Asthi* physiology in Ayurveda is its relationship with *Vata Dosha*. *Asthi* is described as an important *Ashraya*, or site, of *Vata*. The classical principle of *Ashraya-Ashrayi Bhava* suggests that the *Dosha* and the tissue in which it resides influence each other[6].

When *Asthi* becomes depleted, Vata is considered to become aggravated. Conversely, aggravated *Vata* can contribute to *Asthi Kshaya*. This reciprocal relationship becomes particularly important during ageing, when *Vata* naturally becomes more prominent.

The clinical manifestations associated with *Asthi Kshaya* may include bone pain, weakness, fragility and changes involving hard tissues[6,12]. Ayurveda therefore approaches skeletal degeneration not merely as a local structural problem but as part of a wider process involving Dosha, Dhatu and ageing.

Modern medicine also recognizes ageing as an important risk factor for loss of bone mass and increased skeletal fragility. Changes in bone remodelling, hormonal status, physical activity, muscle mass and nutritional status all contribute to age-related skeletal deterioration[1,2].

The similarities are interesting, but *Vata Vriddhi* should not be considered synonymous with any single modern physiological mechanism. The Ayurvedic explanation represents a broader functional model.

Asthi Dhatu and Nutrition

Adequate nutrition is essential for maintaining healthy bone. Modern research has established the importance of calcium, vitamin D, protein, phosphorus and several other micronutrients in skeletal development and maintenance[8,13].

Ayurveda, however, approaches nutrition at a broader level. The quality of digestion and metabolism is considered just as important as the food consumed. A person may consume nutritionally rich food, but if digestion and tissue metabolism are impaired, proper nourishment may not occur according to the Ayurvedic model.

This perspective is particularly relevant when considering the modern problem of malabsorption. Gastrointestinal disorders, inadequate vitamin D status and impaired nutrient absorption can contribute to reduced skeletal health. The modern understanding of the gut-bone axis has further demonstrated that intestinal microorganisms, immune pathways and nutrient metabolism may influence bone homeostasis[14].

Thus, the Ayurvedic emphasis on *Agni* and the modern understanding of digestion, absorption and metabolic regulation offer an interesting area for comparative research.

Role of Physical Activity in *Asthi Poshana*

Bone is not influenced by nutrition alone. Mechanical loading is an important stimulus for bone adaptation. Regular weight-bearing and resistance exercise can help maintain or improve bone mineral density and reduce some of the consequences associated with physical inactivity[15,16].

Ayurveda also recognizes the importance of appropriate physical activity through the concept of *Vyayama*. Exercise performed according to one's capacity is considered beneficial for strength and overall physiological balance.

At the same time, excessive physical exertion is considered capable of disturbing *Vata* and contributing to tissue depletion in susceptible individuals. This provides a balanced perspective: neither complete inactivity nor excessive exertion is ideal.

From a contemporary viewpoint, this can be understood in terms of the dose-dependent effect of physical activity. Appropriate mechanical loading stimulates skeletal adaptation, whereas prolonged inactivity can contribute to bone loss. Excessive training without adequate nutrition and recovery may also have adverse effects on bone health.

***Asthi Dhatu Kshaya* and Osteoporosis: A Cautious Correlation**

Asthi Kshaya is described in Ayurveda as a state of depletion of *Asthi Dhatu*. Features such as bone pain, weakness and increased fragility may be associated with this condition[6,12].

Because osteoporosis is also characterized by compromised bone strength and increased fracture risk, several authors have attempted to correlate *Asthi Kshaya* with osteoporosis[17,18].

However, it is important not to treat the two terms as exact synonyms. Osteoporosis is a modern clinical diagnosis based on established diagnostic criteria, including bone mineral density assessment where appropriate. *Asthi Kshaya* is a broader Ayurvedic pathological concept that is interpreted through the framework of *Dosha, Dhatu* and *Srotas*.

The appropriate approach is therefore to describe osteoporosis as a possible contemporary clinical correlate of certain aspects of *Asthi Kshaya*, rather than claiming that both concepts are identical. Such careful interpretation is important if Ayurvedic research is to remain both faithful to the classical texts and scientifically credible.

Contemporary Perspective on Bone Metabolism

Modern bone biology describes bone as a dynamic tissue that continuously undergoes remodelling. Osteoclasts are primarily responsible for bone resorption, while osteoblasts participate in bone formation. Osteocytes play an important role in sensing mechanical stimuli and coordinating bone responses[2].

This activity is influenced by calcium and phosphate metabolism, vitamin D, parathyroid hormone, sex hormones, mechanical loading and several local signalling pathways [1,2,8]. Nutrition therefore forms only one part of skeletal health. Physical activity, endocrine function, age, body composition and general metabolic health are equally relevant.

Interestingly, contemporary research has also focused on the gut-bone axis. The intestine is increasingly recognised as an active participant in skeletal physiology through nutrient absorption, microbial metabolites and immune-endocrine signalling[14].

From an Ayurvedic viewpoint, this raises an interesting possibility for studying the relationship between *Agni, Ahara Rasa* and *Dhatu Poshana* and modern concepts of digestion, nutrient availability and systemic metabolism. This should be considered a research hypothesis rather than evidence that *Agni* is equivalent to the modern gastrointestinal system.

Integrative Understanding of *Asthi Dhatu Poshana*

The Ayurvedic concept of *Asthi Poshana* can be understood as a series of interconnected processes:

Ahara → Jatharagni → Ahara Rasa → sequential Dhatu Poshana → Meda → Asthidhatvagni → Asthi Dhatu → Majja

At the same time, the maintenance of Asthi is influenced by *Vata, Srotas, Agni, Ahara, Vihara*, age and the overall condition of the individual.

Modern bone physiology similarly demonstrates that skeletal health results from the interaction of nutrition, absorption, cellular

metabolism, hormones, mechanical loading and systemic factors. The two frameworks should not be forced into direct equivalence. Their terminology, methods and underlying theories are different. However, the comparison demonstrates that Ayurveda views skeletal health as a systemic process rather than simply a consequence of mineral intake. This may be one of the most useful aspects of the concept of Asthi Dhatu Poshana for contemporary Ayurvedic research.

DISCUSSION

The concept of *Asthi Dhatu Poshana* provides a broader understanding of skeletal nutrition than the simple idea that consumption of calcium-rich food leads directly to strong bones. Ayurveda places the entire process within the context of digestion, tissue transformation, metabolic activity and systemic balance.

The role of *Asthidhatvagni* suggests that tissue-specific metabolism is important in determining whether nutrients are appropriately utilised. The relationship between *Meda* and *Asthi* highlights the connection between energy metabolism and skeletal tissue. *Asthivaha Srotas* introduces the importance of transport and tissue communication, while the *Asthi-Majja* relationship illustrates the interdependence of adjacent tissues.

The *Ashraya-Ashrayi* relationship between *Asthi* and *Vata* adds another dimension. It provides an Ayurvedic explanation for the association between tissue depletion and degenerative changes, particularly during ageing. Several of these ideas have interesting parallels in contemporary science. Bone is now recognised as a metabolically active organ that communicates with adipose tissue, muscle, endocrine organs, immune cells and the gastrointestinal system[2,9,14].

Nevertheless, Ayurvedic concepts should not be retrofitted into modern biomedical terminology without adequate evidence. Such an approach may make an article appear scientifically modern but can weaken its academic value. A more useful approach is to preserve the original Ayurvedic meaning and identify areas where modern research can test or explore the underlying concepts. In this regard, *Asthi Dhatu Poshana* may serve as a valuable framework for developing new research questions concerning nutrition, metabolism, ageing and skeletal health.

Future Research Perspectives

The concept of *Asthi Dhatu Poshana* opens several possible avenues for research. Ayurvedic assessment of *Agni, Asthi Sara* and *Asthi Dhatu* status could be studied alongside objective parameters such as bone mineral density and biochemical markers of bone turnover.

The relationship between *Meda Dhatu* and *Asthi Dhatu* could also be investigated in individuals with metabolic disorders, obesity or age-related bone loss. Such studies may help determine whether the classical description of *Meda-Asthi* interrelationship has measurable contemporary correlates.

Another promising area is the relationship between *Agni* and the gut-bone axis. Studies involving nutritional status, intestinal health, microbiota and bone parameters could provide new insights into the Ayurvedic concept of tissue nourishment.

The classical *Asthi-Vata* relationship could also be examined in relation to ageing, bone mineral density, musculoskeletal symptoms and physical function. Importantly, future research should use clearly defined Ayurvedic assessment methods together with validated biomedical outcome measures. This would allow the classical concepts to be evaluated without losing their original context.

Limitations

The present article is a narrative review and conceptual analysis rather than a systematic review or meta-analysis. The comparison between Ayurvedic and modern concepts is interpretative and should not be understood as proof of equivalence. Further clinical, observational and experimental studies are required to establish measurable relationships between Ayurvedic assessments of *Asthi Dhatu* and contemporary markers of skeletal health.

CONCLUSION

Asthi Dhatu Poshana is a comprehensive Ayurvedic concept that describes skeletal nourishment as a dynamic process involving digestion, sequential tissue transformation, *Dhatvagni, Srotas*, lifestyle and *Dosha-Dhatu* interaction. The relationship of *Asthi* with *Meda, Majja* and *Vata* makes the Ayurvedic understanding of skeletal health distinctly holistic.

Contemporary science similarly recognizes bone as a dynamic and metabolically active tissue influenced by nutrition, hormones, mechanical loading, ageing and systemic metabolism. These areas of convergence provide opportunities for interdisciplinary research, although direct equivalence between Ayurvedic concepts and modern anatomical or biochemical entities should be avoided.

The value of *Asthi Dhatu Poshana* for contemporary Ayurveda lies not merely in finding modern names for ancient concepts, but in exploring whether the classical framework can generate meaningful, testable approaches to the prevention and management of skeletal disorders.

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