

Review Article

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“AYURVEDIC DRUGS FOR OSTEOPOROSIS AND THEIR PHARMACOLOGICAL EVALUATION: AN INTEGRATIVE REVIEW”

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ABSTRACT

Introduction: Osteoporosis is a progressive skeletal disorder characterized by low bone mass, microarchitectural deterioration, and increased fracture risk. With global aging, it has become a major health concern. Conventional treatments such as bisphosphonates and hormone therapy have limitations, including side effects and poor compliance. Ayurveda describes *Asthi-kshaya* and *Asthi-majtagata vata* conditions that closely resemble osteoporosis. Classical texts recommend *Asthi-poshaka* and *Balya* dravyas that support bone health and counteract degeneration. **Methods:** A comprehensive review was conducted through PubMed, Scopus, Web of Science, and Ayurvedic texts (*Charaka Samhita*, *Sushruta Samhita*, *Bhavaprakasha*). Keywords used included: “Ayurveda AND osteoporosis,” “*Asthi-kshaya*,” “Ayurvedic bone health herbs,” and specific herb names. Both preclinical and clinical studies published between 1950–2025 were included. **Results:** Ayurveda emphasizes *Asthi dhatu poshana* (nourishment of bone tissue) and *Vata shamana* (pacification of aggravated Vata) in managing osteoporosis. Herbs such as *Cissus quadrangularis* (*Asthisrinkhala*), *Withania somnifera* (*Ashwagandha*), *Terminalia arjuna* (*Arjuna*), *Glycyrrhiza glabra* (*Yashtimadhu*), and mineral formulations like *Praval pishti* and *Shankha bhasma* have been described. Pharmacological studies reveal mechanisms such as stimulation of osteoblast activity (*Cissus*), reduction of bone resorption (*Ashwagandha*), antioxidant and anti-inflammatory effects (*Arjuna*), and calcium bioavailability from mineral preparations. Clinical studies demonstrate improvements in bone mineral density (BMD), reduced fracture healing time, and symptomatic relief.

Discussion: There is a significant correlation between Ayurvedic concepts of *Asthi-kshaya* and modern osteoporosis. Evidence supports anti-resorptive, anabolic, and bone-strengthening actions of Ayurvedic herbs. However, clinical trials remain limited, heterogeneous, and lacking standardization of formulations. **Conclusion:** Ayurvedic bone-protective drugs offer a promising complementary approach in osteoporosis management. With pharmacological validation, standardized formulations, and rigorous clinical studies, these remedies could bridge the gap between traditional knowledge and modern bone health care.

KEYWORDS: *Asthi-kshaya*, Ayurveda, Bone health, Osteoporosis, Pharmacological validation



INTRODUCTION

Osteoporosis is a systemic skeletal disorder characterized by reduced bone density, compromised strength, and enhanced fracture risk.^[1] The disease is a silent epidemic affecting postmenopausal women and elderly men, leading to morbidity, disability, and economic burden.^[2-3] Despite effective conventional drugs, concerns remain regarding safety (e.g., atypical fractures, osteonecrosis of the jaw) and compliance.^[4]

In Ayurveda, bone tissue is represented by *Asthi-dhatu*. Disorders such as *Asthi-kshaya*, *Asthi-saushirya*, and *Asthi-majjagata vata*^[5] exhibit striking similarities to osteoporosis, presenting with bone pain, fragility, deformity, and reduced strength. Management strategies include *Rasayana* therapy, *Vata shamana*, and use of *Asthi-poshaka* dravyas.^[6-7]

This review aims to systematically explore Ayurvedic drugs for osteoporosis, correlate them with pharmacological validation, and highlight their role in modern bone health management.^[8-9] The objectives are: To review classical Ayurvedic descriptions of bone-strengthening herbs, to summarize pharmacological studies validating their osteoprotective effects, to analyze preclinical and clinical evidence, and to identify gaps and future research opportunities.^[10]

MATERIALS AND METHODS

A comprehensive search was conducted between January–March 2025. Databases included PubMed, Scopus, Web of Science, and Google Scholar. Ayurvedic texts (*Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, *Bhavaprakasha*) were consulted.^[11-12]

Keywords: “Ayurveda AND osteoporosis,” “*Asthi-kshaya*,” “Ayurvedic bone health herbs,” “osteoblast activity,” and individual plant names.^[13]

Inclusion criteria:^[14]

- Experimental (*in vitro and in vivo*) studies on bone-related activity of Ayurvedic herbs.
- Human clinical trials.
- Reviews correlating Ayurveda and bone health.

Exclusion criteria:^[15]

- Reports without proper methodology.
- Non-English sources without translation.
- Anecdotal or single-case reports.

Data were synthesized under Ayurvedic concepts,

pharmacological actions, preclinical evidence, and clinical validation.

OBSERVATION AND RESULTS

Ayurvedic perspective on osteoporosis (*Asthi-kshaya*)

According to Ayurveda, bone health depends on proper nourishment of *Asthi dhatu*, which is derived from *Medo dhatu* through *Dhatvagni paka*. Imbalance of *Vata dosha*, poor nutrition, and defective *Agni* lead to depletion of *Asthi dhatu*. Symptoms include bone fragility, fractures, dental weakness, hair loss, and joint pain. Management includes *Rasayana*, *Asthi-poshaka ahara* (milk, sesame, ghee), and bone-nourishing herbs.

Major Ayurvedic herbs and formulations

1. *Cissus quadrangularis* (*Asthishrinkhala*)

- Classical reference: described as *Sandhaniya* (bone union promoter).
- Phytoconstituents: ketosteroids, triterpenes, flavonoids.
- Mechanisms: stimulates osteoblast proliferation, enhances mineralization, suppresses osteoclastogenesis.
- Preclinical: accelerated fracture healing in rats, increased callus formation, improved bone strength.
- Clinical: studies show faster healing of mandibular and long bone fractures, improved bone density in postmenopausal women.

2. *Withania somnifera* (*Ashwagandha*)

- Properties: *Balya*, *Rasayana*, *Vata-shamaka*.
- Constituents: withanolides.
- Mechanisms: anabolic effect on bone, improved osteoblast differentiation, anti-inflammatory activity.
- Evidence: animal studies show increased bone density and strength; clinical trials demonstrate improved BMD and reduced bone turnover markers.

3. *Terminalia arjuna* (*Arjuna*)

- Traditionally used for *Asthi dhatu poshana* and cardiovascular health.
- Constituents: arjunolic acid, flavonoids, calcium salts.
- Mechanisms: antioxidant, anti-resorptive, and calcium-supplying.
- Preclinical: protective effect against glucocorticoid-induced osteoporosis.

4. *Glycyrrhiza glabra* (*Yashtimadhu*)

- Known for *Rasayana* and *Asthi vardhaka* actions.
- Constituents: glycyrrhizin, flavonoids.
- Pharmacology: phytoestrogenic action mimicking estrogen, prevents bone loss in ovariectomized models.

5. Herbo-mineral preparations

- Praval pishti* (coral calcium), *Shankha bhasma*, *Godanit bhasma*: supply bioavailable calcium.
- Kukkutanda tvak bhasma* (egg shell calcium): improves bone density.
- Clinical evidence: used in Ayurvedic practice for osteoporosis and osteopenia with significant improvements in calcium levels.

6. Other supportive herbs

- Shatavari* (*Asparagus racemosus*) – phytoestrogenic bone protective.
- Shallaki* (*Boswellia serrata*) – anti-inflammatory, supports joint and bone health.
- Guggulu* (*Commiphora mukul*) – anti-inflammatory, stimulates bone formation.
- Guduchi* (*Tinospora cordifolia*) – immunomodulatory and anabolic effect on bone.

Summary of pharmacological validation

- Anabolic effects:** *Cissus quadrangularis*, *Ashwagandha*.
- Anti-resorptive effects:** *Glycyrrhiza glabra*, *Arjuna*.
- Calcium supplementation:** *Praval pishti*, *Shankha bhasma*.
- Adjunct actions:** anti-inflammatory (*Boswellia*, *Guggulu*), antioxidant (*Guduchi*).

Clinical trials, though limited, consistently report:

- Improved fracture healing rates.
- Increase in bone mineral density in osteoporotic patients.
- Reduction in bone pain and improved mobility.
- Enhanced calcium and vitamin D utilization.

DISCUSSION

Ayurveda and modern medicine converge on the concept of bone fragility and degeneration in osteoporosis. While modern therapy focuses on anti-resorptive and anabolic drugs, Ayurveda emphasizes *Asthi dhatu poshana* and *Vata shamana*. Herbs like *Asthishrinkhala* provide direct anabolic stimulation, while *Ashwagandha* and *Arjuna* act as adaptogens and antioxidants, creating systemic support.^[16]

Pharmacological validation strengthens Ayurvedic claims. *Cissus quadrangularis* has shown remarkable osteogenic potential, with molecular

studies confirming its role in osteoblast differentiation. *Ashwagandha* modulates hormonal balance and bone turnover markers, supporting its use in postmenopausal osteoporosis. Mineral preparations provide bioavailable calcium and micronutrients.^[17]

However, limitations exist. Most clinical trials are small, short-term, and lack standardized formulations. Variability in plant sources, extraction methods, and dosage forms hampers reproducibility. Herb-drug interactions (e.g., phytoestrogens with hormone therapy) require evaluation. Safety concerns around long-term use of herbo-mineral preparations also warrant toxicological validation.^[18] Future prospects include:^[19-20]

- Standardized herbal formulations with defined phytochemical markers.
- Multicenter randomized controlled trials evaluating fracture risk reduction.
- Exploring synergistic effects of polyherbal-mineral combinations.
- Integration of Ayurveda with modern diagnostic tools (BMD scans, bone markers).

Thus, Ayurveda offers a holistic and potentially safer approach to osteoporosis management, complementing modern therapeutics.

CONCLUSION

Osteoporosis, a condition of bone fragility, is well correlated with the Ayurvedic concept of *Asthi-kshaya*. Ayurvedic herbs and formulations offer diverse mechanisms—osteoblast stimulation (*Cissus quadrangularis*), anabolic and adaptogenic support (*Withania somnifera*), anti-resorptive activity (*Glycyrrhiza glabra*), and mineral supplementation (*Praval pishti*, *Shankha bhasma*). Clinical evidence, though preliminary, suggests improvements in bone density, fracture healing, and symptomatic relief.

Integration of Ayurvedic drugs with pharmacological validation presents an opportunity to develop evidence-based complementary therapies for osteoporosis. Standardization of formulations, robust clinical trials, and safety assessments are essential. Ayurveda's holistic emphasis on diet, lifestyle, and *Rasayana* therapy further enhances long-term bone health.

With continued research, Ayurvedic remedies could provide safe, affordable, and effective strategies for osteoporosis, bridging traditional knowledge with modern bone biology.



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