Ayurveda medicinal plants for Asthikshaya (Osteoporosis): A review

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ABSTRACT

Ayurveda is an ancient science of life deals with the preventive as well as curative aspect. It explains human body as a ‘congenial homeostasis’ of dosha, dhatu and mala. The function of dhatu is dharaṇa (maintain the structure) of the sharira (body). Among the dhatu, asthidhatu is responsible for maintenance of structural frame work of the body. It gives shape to the body and protects the vital organs. Concept of osteoporosis has explained under 18 types of kshaya by Acharya Carakain sutra sthan kiyaỹantahshirasiya adhyaya. Asthikshaya pathogenesis can be explained in many ways in Ayurveda. According to the principles of ashrayaashrayibhava, asthidhatu is the seat of vata dosa and inversely related to each other. Increase of vata is the main factor responsible for asthikshaya. Acharya Caraka has opined increase of vata may follow two patterns; one is from margavara and another is from dhatukshaya which can further lead to asthikshaya. Osteoporosis or porous bone is a global problem characterized by low bone mass and structural deterioration of bone tissue, leading to bone fragility and an increased risk of fractures of the hip, spine and wrist. Men as well as women are affected by osteoporosis but females are at higher risk. This risk even increases at the time of menopause, which is the period of hormonal imbalance. Treatment available in modern science is mainly symptomatic and not devoid of adverse effects. Ayurveda treatment visualizes the human body as a single unit and this approach has opened many innovative approaches for treatment. On this background present study was taken to analyze the fundamental concept of asthikshaya and to find out single herbs beneficial for it. Drugs from classical texts along with commonly used in practice have been analyzed in context of asthikshaya. Study reveals that drugs like guduci, ashwagandha, prishnaparni, samanga, vacha etc. possess kaphavatashamak properties which helps in breaking the pathogenesis by clearing and nourishing the srotas (channels). Drugs like madhuyasti, priyang, vidarikanda, shatavari etc. have vatapittashamak, balya (tonic), brimhan (nourishing) properties works directly on dhatukshaya.

Keywords: Doṣa, Dhātu, Māla, Asthi kṣaya, Mārgāvaraṇa, Tarpak.

INTRODUCTION

Ayurveda is a “Divine science” due to its origin as well as its incredible strength[1]. It has two aims; one deal with the preventive way that is to safeguard the health of the healthy individual and another is the curative way that is to treat the disease[2]. The three pillars of life are mana (mind), atma (soul) and sārreṣa (body) and their perfect balance considered as complete health in Ayurveda[3]. Ayurveda explains this human body as a homeostasis of dosha, dhatu and mala[4]. The function of dhatu is dhārana (maintain the structure) of the sarīra (body). Among the dhātu, asthidhātu is responsible for maintenance of structural frame work of the body. It gives shape to the body and protects the vital organs. Asthi dhātu is the seat of vāta dosa[5]. Asthi and vāta are reciprocally each other. Asthi kṣaya is explained in 18 types of kshaya by acharya charak[6]. It can be compared to osteoporosis in contemporary era. Osteoporosis is a systemic skeletal disease characterized by the low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture[7]. It is a growing public health problem worldwide. Worldwide osteoporosis causes more than 8.9 million fractures annually[8]. It affects both genders; however is more prevalent in women, particularly after the menopause[9]. Osteoporosis affects 200 million women worldwide. Worldwide, 1 in 3 women and 1 in 5 men over age 50 will experience osteoporotic fracture. It is projected that more than about 50% of all the osteoporotic hip fractures will occur in Asia by the year 2050[8]. Osteoporosis is the second most common metabolic bone disease in India[10]. Bone loss is only partly reversible and treatment available in the contemporary science is mainly symptomatic and later surgical interventions were done but these all are not devoid of adverse effects. Prevention and early intervention can prevent osteoporosis in majority. On this background present study was taken to analyze the fundamental concept of asthikshaya (osteoporosis) and to find out single herbs which are safe, cost effective from Ayurveda classics for the
betterment of life. Drugs from classical texts along with commonly used in practice have been analyzed in context of asthikshaya with special reference to margavarana and dhatukshaya.

Ayurveda concept of ‘asthi-ksahya’

Interpretation of word ‘Asthikshaya’

The word Asthikshaya is composed of two words Asthi and Kshaya. The word Asthi is derived from the root ‘As’ + ‘kthin’ meaning “To Stay” or in the sense of “Stability”[11]. The definitions of asthi are ‘asyate kshiyayatev’, ‘asyate iti asthi’; ‘mamsabhantarasthah-sharirastha sapta dhatvantaragata duhushishah’[12]. That which is present in its own state fora long time is called asthi. Sushruta mentions that twacha,mamsa etc. tissues gets destroyed soon (after death), but asthi persists in its own state for a long time. Hence, it is called as the sara of the Sharira[13]. Similarly the definitions of Kshaya are ‘Kshiyate anena iti Kshaya’; ‘Kriya kshayakararatw tu Kshaya ityucyatebudhahi’; ‘Kshaya vyadhi vishesha’[14]. That which decreases is called as Kshaya or the kriya which causeth the decrease either qualitatively or quantitatively is known as Kshaya and it is vyadhi vishesha. So, the combined meaning of asthi kshaya is decrease in bone tissue.

Asthikshaya guna and Karma

Asthi is guru (heavy), khara (rough)[15], kathina (hard), shthula (bulkiness), sthira (stable) and murtimad. Its function is deha dharana (provides structural framework to the body), Majja pushi (nutrition to the bone marrow) and is the seat of vata[16]. The etiological factors for asthi kshaya are not mentioned separately in the texts. However, Charaka has explained the samanya nidana (general etiological factors) which lead to the kshayah of 18 types[17] which includes mostly the vataprakopak nidan like excessive exercise and intake of dry vegetables, irregular dietary habits which includes excessive fasting, dieting and limited foods, excess of food also, excess of worry, grief, fear, hunger, waking at nights, letting out excess of blood, dosha, dhatumalaand time factor (adana kala and vridhavastha). Majja dhatu which is present inside the asthi dhatu provides nutrition to asthi. The factors responsible for the vitiation of asthivaha and majjavaha srotas are also responsible for asthi kshaya. The dietary factor such as intake of abhishayandi and incompetent foods of majjavaha srotadush[18] provokes vata due to obstruction leads to vitiation of vata. Viteration ofasthivaha srotas directly leads to aggravation of vata, resulting in asthi kshaya.

Symptoms: Asthikshaya symptoms described in different samhita are asthibheda, asthishula, keshalomanakhasmashrudanta vikara and paata (disorders of hair, nails, teeth), sandhi shaiithila, rukshta (dryness)[19,20].

Samprapti: Similarly, samprapti of asthikshaya has not been explained directly in Ayurvedic classics, keeping in mind all the etiological factors explained under vatavyadih, asthikshaya pathogenesis can be explained in several ways. According to the principles of ashrayashriyabhavaasthidhatu is the seat of vataadosha, while majjavhatu which is present inside the asthi provides nutrition to asthi. Provocation of vata is the main factor responsible for asthi kṣaya. It may follow two patterns one is from margavarana and another is from dhaatuksaya[21]. Hence the causes of vitiation of vata may be further classified into sakshadhatu and margavarana karanakidanidana.

Chakrapani has explained dhatu kṣaya as sarakshaya and margavarana as vega pratibandha leading tovata prakopa[22]. By the over indulgence in these nidan, the srotas become rikta (devoid of unctionusness) because of decrease of body tissues and obstruction in the channels. This leads to provocation of vata and this vitiated vata fills in the channels which are devoid of unctionusness and vitiate them further leading to the stronger provocation of its own. Beside this, proper nourishment of dhatu is very much essential in maintaining the qualitative and quantitative normalcy of the dhatu. Proper functioning of jatharagni, bhutagni and dhatwagni is essential in performing this important function. Due to the improper functioning of jatharagni, it can lead to formation of aam (indigestion) which can further cause stratorodh (obstruction in channels) leads to improper nourishment of asthi resulting in asthikshaya. As asthi is composed of parthiv, tejas and vayu mahabhuta[23]; any functional deformity in any of these bhutagni leads to improper conversion of parthiv, tejas and vayavaya ansh which can further lead to nutritional deficit resulting in asthikshaya. Dhatwagni leads to the deformity in the transformation of poshayadhatu (Dhatu specific nutrients) into poshya/sthohi dhatu, resulting in dhatu vikriti. Mental factors and kala (age factor) also play a vital role in the pathogenesis of asthikshaya. Thus, there is no single pathogenetic mechanism leading to asthikshaya. Samprapti of asthikshaya is therefore a complex mechanism.

Asthikshaya in contemporary era

In present era, on the basis of above mentioned etiological factors, symptoms and pathogenesis, asthikshaya can be correlated to osteoporosis. The word “Osteoporosis” was coined by Pommer in 1885 which means “porous bones”. The word osteoporosis is composed of two words i.e. ‘Osteo’ and ‘Porosis’. ‘Osteo’ is derived from the Greek word ‘Osteon’ means the ‘bone tissue’ and ‘Porosis’ is derived from the Latin word ‘Porosus’ which means ‘full of pores’[24]. It may be localized to a certain bone or region, as in disuse osteoporosis of a limb, or may involve the entire skeleton, as a manifestation of a metabolic bone disease. Generalized osteoporosis may be primary or secondary[25]. It may be seen as a consequence from the involutional losses associated with aging and also from the additional losses related to natural menopause in women. This condition is called as the ‘ Primary Osteoporosis’. Osteoporosis caused or worsened by other disorders or medication exposures is referred as ‘Secondary Osteoporosis’[5].

In 1994 World Health Organization (WHO) defined osteoporosis operationally to be femoral neck bone mineral density (BMD) value 2.5 standard deviations or more below the mean for normal young white women, or t-score of -2.5[26].

There are many risk factors related to lifestyle for developing bone loss and osteoporosis such as a diet having low calcium, magnesium and vitamin-D; smoking or tobacco in any form, lack of exercise (sedentary life style), alcoholism, advanced age, history of fracture as an adult, female gender, caucasian race (White origin), menopause, surgical menopause (radical hysterectomy or oophorectomy in early age)[27,28,29]. Additionally, genetics is a factor. Women after 35 years with a family history of osteoporosis have almost twice the risk of developing the disease, compared to women without a family history[30].

Bone metabolism occurs throughout life. It involves repetitive turnover cycles for formation of bone osteoclasts and osteoblast. Osteoclast, breaking down the bone structure, referred as bone resorption and bone osteoblast building up the bone structure, known as bone remodeling[31]. In both sexes, peak bonemass is reached within three years after linear growth stops[32]. In women estrogen is needed to keep a healthy balance between bone resorption and bone remodeling[31]. Perimenopausal women are mainly susceptible to bone loss due to the fluctuating and declining estrogen levels. During the perimenopausal transition, serum estradiol levels can fall from 10% to 20%, and the level of serum estrone which is a four fold weaker than estrogen falls to about 25% to 35% of the premenopausal level. During this time, bone resorption can increase by 90%, whereas bone formation increases by only 45%. This imbalance in bone resorption and remodeling leads to accelerated bone loss[31]. In the first five to seven years after menopause, a woman can lose up to 20% of herbone mass, and this loss can lead to osteoporosis[29]. Most of the patients are asymptomatic until they develop a complicating fracture (most common in hip, humerus, ribs and wrist) which often occurs with minimal trauma.

The most frequent symptoms are pain in the back, tenderness, general debility, muscular weakness, abdominal distension, insomnia, loss of appetite, osteo-arthritis, constipation and ileus and deformity of spine (kyphosis and scoliosis) and loss of height[5,33]. Prevention and treatment is possible if it is diagnosed early and accurately. But, it often remains undiagnosed until a fracture occurs. So, screening of people must be increased for this disease. Bone mineral density (BMD) is the most important criteria for the diagnosis of osteoporosis. The gold standard for measuring BMD is the dual-energy X-ray absorptiometry (DEXA) densitometer, a specialized X-ray device that precisely quantifies BMD at the spine, femur, and other skeletal sites[34].

Management

Modern treatment is mainly intended at preventing further bone loss and fractures. It maintains the bone mass through calcium and vitamin D supplementation, hormone replacement therapy (HRT), and use of certain drugs like bisphosphonates, selective estrogen receptor modulators (SERMs), anabolic steroids but usually produce long term side/adverse effects[35].

Ayurveda treatment visualizes the human body as a single unit and this holistic approach has opened many newer methods for treatment. The treatment of asthikshaya includes nidana parivarjana (Avoidance of etiological factors), shodhana (Biopurification), shamana (Palliative treatment), rasayana (Rejuvenation), pathyapathya (Proper diet).

Nidana parivarjana: Avoid the excessive indulgence in etiological factors responsible for provocation of vata, vitiation of asthi, majjavahasrotas and also the psychic factors.

Shodhana: It is indicated in bahudoshavastha. Vaghbhatta had mentioned the asthikshayachikitsa[36] as:

**Acharya charak has given the similar line of treatment for asthi pradoshaja vikara which includes panchakarma, especially basti which contains kshira, ghrita and tikt dravya[37]. Table no. 1 is having drugs which are mostly tikt in rasa.**

**Asthyashrayanam vyadhinam panchakarmani bhesajam |**

**Bastayoha kshira sarpishi tiktakopahitani cha | | (C.Su.28/27) | |**

**Shamana:**

The main aim of Ayurvedic therapy in asthigatvata includes vatashamak (asthi is the seat of vata), tarpak and brihman[38] treatment. Sushrut explained the principle of asthikshaya as Tatra Swayoni Vardhana Dravya Prayogaha Pratikaraha (Su.su.15). Below described herbs in table no. 2 have mainly Vatahar, tarpan, brihman, balya and asthisandhankar property.

Research studies have also showed that drug like guduchi, samanga, ashwagandha, vacha, dadima have antiosteoporotic and phytooestrogenic properties which strengthen the bone. Similarly drugs in table no. 2 were mostly rich in calcium[42,43] as proven by their nutritional values. According to modern science there is calcium deficiency in asthikshaya (osteoporosis). So, it can be used in osteoporosis. Few recent experimental studies for supporting the study were given below:

**Guduchi[44]**

Study was carried out on ethanolic stem extract of Tinospora cordifolia (TC) (10, 50, 100mg/kg b.wt.) subcutaneously for 4 weeks on ovariectomized rats. Study reveals that ovariectomized rats treated with TC (10 mg/kg b.wt.) showed estrone like effects in bone as the bone loss in tibia was slower than ovariectomized control and thus has the potential for being used as antiosteoporotic agent.

**Samanga[45]** –In vitro study was done on four medicinal plants for evaluation of antiresorative activity in the treatment of bone loss disease. All the four drug decoction inhibited osteoclastogenesis similarly to standard alendronate at the highest doses, but Hemidesmus indicus was found effective at lower concentrations also.

**Shatavari[46,47]**- Study was carried out on aqueous and methanolic extracts of Asparagus racemosus root in ovariectomized rats to evaluate the antiosteoporotic activity. Study showed significant effect on mineralization, ossification and osteoclastic activity suppression in histopathological examination. It showed significant results in biochemical parameters, also reduced serum alkaline phosphatase activity, serum calcium significantly and also inhibited the ovariectomized induced excessive loss of calcium in urine. 

**Studies of ashwagandha[48], vacha[49], dadima[50], madhuyashti[51,52], vidarikanda[53], parushak[54], padmabeeja[55]** also shows anti-osteoporotic properties.

**DISCUSSION**

Sampraptivighatana (breaking of pathogenesis) is the prime line for the treatment of any disease in ayurveda. So, treatment of asthikshaya should be done considering both the facts for vata prakopa that is margavaran and dhatu kshaya.
In margavan, strastoshodhak treatment should be given which clears the channels and nourishes the next dhatu. Drugs or medicinal plants given in table no.1 are mostly having katu, tikta rasa, snigdha guna. tikta rasa is having strastoshodhak property which acts on margavan. But tikta rasa is vata propaka. So, it shouldnot be used in asthikshaya as vataprapaka increase the asthikshaya. It can be explained like this; asvaghbhat has mentioned that asthikshaya treatment with tiktaksheer sadhita basti. Arundatta commenting on it explains dravya which havesnigdha, shoshana and khara property are used in asthikshaya. khara is the main property of asthi. Dravya which have both snigdha and shoshan properties are not available that’s why this principle was explained. Use of ksheera (snigdha), ghirita with tikta rasa (shoshan) produces khara properties which helps in asthivridhi. In the same way, drugs given in table no. 1 can be given single or in combination with other drugs (table no. 2) In dhatu kshaya (asthikshaya) includes vatashamak (asthi is the seat of vata), tarpak and brihan treatment. Vata is having properties laghu, ruksha, sheeta, khara, sukshma, chala, vishada, medicinal plants described in table no. 2 are mostly vatashamak due to predominance of guru, snigdha guna, madhura vipaka and ushna virya. Hence, it can be used directly in dhatukshaya condition.

Table 1: Drugs which works on margavan

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Sanskrit name</th>
<th>Family</th>
<th>Botanical name</th>
<th>Effect on Dosha &amp; Important Uses</th>
<th>Part used</th>
<th>Reference</th>
</tr>
</thead>
</table>
| 1.      | Guduchi       | Menispermaceae | Tinospora cordifolia Willd. | Tridoshahar & 
important Uses | Stem | Bh.p.3/9[39] |
| 2.      | Prishniparni  | Fabaceae | Uuria picta Desv. | Tridoshahar 
Asthibhagnasandhanker | Root | Ch.su.25/40[40] 
Bh.p.3/35 |
| 3.      | Ambashthahi   | Menispermaceae | Cissampelas pareira Linn. | Vatashlehsmahar | Root | Bh.p.3/192 |
| 5.      | Kataphala     | Myricaceae | Myrica esculenta Buch Ham | Vataphahhar | Stembark | Bh.p.1/181 |
| 6.      | Ashvagandha   | Solanaceae | Withania somnifera linn. | Vataphahhar, 
shothakshapapaha, Balya, Rasayan | Root | Bh.p.3/189,190 |
| 7.      | Shhira (Shalaparni) | Fabaceae | Desmodium gangeticum DC. | Tridoshahar, Shoshahar, brihmano, rasayan | Wholeplant | Bh.p.3/31-33 
Ch.su.25/40 |
| 8.      | Vacha         | Araceae | Acorus calamus Linn. | Vatashlehsmahara | Root | Bh.p.1/103 
Dh. Ni. |
| 9.      | Dadima        | Puniceae | Punica granatum. | Tridoshahar | Fruit | Su.su.46/142 |
| 10.     | Arjuna        | Combretaceae | Terminalia arjuna Roxb. | Kaphapittahara, 
Sandhankara | stembark,H 
heartwood | Bh.p.5/27 |
| 11.     | Asthishrinkhala | Vitaceae | Cissus quadrangularis Linn. | Vataphahhar, 
Stem | Bh.p.3/226 |
| 12.     | Yvami         | Apiaceae | Trachyspermum ammi Sprague 
Linn. | Vataphahhar | Fruit | Bh.p.1/77 |
| 13.     | Guggul        | Burseraceae | Commiphora mukul Engl. | Tridoshahar, 
Asthibhaghnasandhanker, balya, | Gum- resin | Bh.p.2/39-41 |
| 14.     | Shunthi       | Zingiberaceae | Zingiber officinale Roscoe. | Vataphahhar | Stem | Ch.su.27/296 
Bh.p.1/45 |
| 15.     | Methika       | Fabaceae | Trigonella foenum-graecum 
Linn. | Vataphahhar | Seed | Bh.p.1/95. |
| 17.     | Shirsha       | Fabaceae | Albizia lebeck Benth. | Tridoshahar | Heartwood | Bh.p.5/14 |
| 19.     | Tila          | Pedaliaceae | Sesamum indicum Linn. | Tridoshahara | Seed | Bh.p.8/63-65 |

Table 2: Drugs which acts on dhatukshaya

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Sanskrit name</th>
<th>Family</th>
<th>Botanical name</th>
<th>Effect on Dosa &amp; Important Uses</th>
<th>Part used</th>
<th>Reference</th>
</tr>
</thead>
</table>
Kai. ni. |
<p>| 3.      | Priyangu      | Verbenaceae | Callicarpa macrophylla Vahl. | Vapatipittahar | Seed, flower | Bh.p.2/104 |
| 4.      | Vidorikanda   | Fabaceae | Pueraria tuberosa DC. | Vapatipittahar, Brihmana, | Rhizome | Su.su.46/301 |</p>
<table>
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<tr>
<th>Sr. No.</th>
<th>Sanskrit name</th>
<th>Rosa</th>
<th>Guna</th>
<th>Virya</th>
<th>Vipaka</th>
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<tr>
<td>1</td>
<td>Guduchi</td>
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<td>Guru, snigdha</td>
<td>Ushna</td>
<td>Madhura</td>
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<td>2</td>
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<td>Laghu, snigdha</td>
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<td>4</td>
<td>Samanga (manjishtha)</td>
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<td>6</td>
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<td>Sthira (Shalaparni)</td>
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<td>13</td>
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<td>Katu</td>
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</table>

Abbreviation: Bh.P.- Bhava prakash, Ch. Su.- Charak samhita sutra sthan, Su.su.- Sushrut samhita sutra sthan, Dr.vi.- Dravyaguna vigyan, Mp.ni – Madanpala nighantu

Table 3: Raspanchaka[41] of drugs given in table no.1
CONCLUSION

Asthi Kshaya (Osteoporosis) being a multifactorial disorder needs a holistic approach to treat it. Prevention is better than cure. So, early diagnosis, prevention and intervention should be done in order to treat it easily. Ayurveda is a system of medicine which can prevent this by considering all the etiological factors involving in its pathogenesis. Drugs given above can be given either single or in combinations considering all the factors like dosha, dushya, kala, bala, agni etc. of the patients. Use of these drugs according to Ayurveda fundamentals can become a boon for the prevention of this disease. However, most of the drugs are not studied yet; further researches should be carried out in order to confirm these effects.

REFERENCES


Table 4: Rasapanchakaof drugs given in table no. 2

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<tr>
<th>Sr. No.</th>
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<td>Guru, snigdha</td>
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<td>2</td>
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<td>Priyangu</td>
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<td>katu</td>
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