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OSTEOPOROSIS IN MENOPAUSE WOMEN: A REVIEW

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ABSTRACT

Osteoporosis is a multi factorial skeletal disorder which leads to low bone mineral density and is the major cause of fracture incidences, disabilities, reduced mobility and poor quality of life. Lack of menstruation or Menopause causes *Strotorodh* and impairs *Anulomgati* of *Vaatdosha*, leading to its *Prakop* i.e. High bone turnover osteoporosis. There is micro architectural degeneration of bone tissue leading to increased bone fragility. Increased bone fragility leads to increase in fracture risk

Key-words: Osteoporosis, menopause, bone fragility, fracture

INTRODUCTION

Osteoporosis is a worldwide major disease with high prevalence in western areas and in Asia as well.[1] Osteoporosis literally means "porous bone" which can be defined as an impairment in bone strength due to an abnormal quantity and or quality of bone. WHO defines osteoporosis on the basis of bone density. Low bone mass is an important feature. Generalised and localised as well as mineral and osteoid bone mass are reduced. There is micro architectural degeneration of bone tissue leading to increased bone fragility. Fragility means compromised bone strength which reflects integration of two main features, bone density and bone quality. Increased bone fragility leads to increase in fracture risk. *Kshaya* means loss, decline, decay, diminution or waning. Dalhan has aptly defined *kshaya* as '*Swapramanhaani*' (S. Su. 15/24) whereas *Chakrapanidatta* describes it as *hrasa. (literally means loss)* or *nyuntvam* (Ch. Su. 17/4).

These three Sanskrit words together are more than sufficient to explain the present concept of *asthikshaya*. Various terms such as *asthisaushirya, asthidaurbalya, asthishieeran, ashitlaghav, asthishunyata, riktata* and *asthimardav* appear in Ayurveda texts to describe *asthkshaya*[2].WHO defines low bone mass on the basis of T score i.e. standard deviation (SD)of bone mineral density (BMD) with reference to mean of young adult population.

T Score:	
0.00 to –1.00	Normal
-1.00 to -2.5	Osteopenia
< -2.5	Osteoporosis

WHO defines low bone mass on the basis of T score i.e. standard deviation (SD) T score of less than -2.5 SD and evidence of one or more fragility fractures means established osteoporosis.[3] A fragility fracture is one which occurs due to fall from no greater than standing height of an individual or with normal use.[3] The present

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epidemiological data on osteoporosis is based on these definitions. Osteoporosis is of 3types.

Type1 is post menopausal and can occur from 2-3 years before to 15-20 years after cessation of menses. Lack of estrogens is primary factor leading to uninhibited osteoclastic activity. Type2 is senile osteoporosis occurring in men and women with equal frequency. This osteoporosis is caused by inability of kidney to produce active vitamin D as well as by decrease in osteoblastic activity. Both these types are classified as idiopathic, with no identifiable cause. They are also classified as high turnover (increased bone resorption by osteoclasts) and low turnover (decreased osteoblastic activity) osteoporosis respectively. Type3 osteoporosis is secondary to other causes such as hyperthyroidism, hyperparathyroidism, inflammatory bowel disease, malabsorption syndromes, chronic renal failure, drugs, etc. *Asthi-asaar* is an important feature of senility. This is also called as *apratyagradhatutva (jirna)* by Sushruta requiring more time for fracture healing in elderly individuals (A. S. Sha.8/24).

Menopause, too, is considered to be a feature of senility by Ayurveda (S. Sha. 3/11)14. Menstruation is also proposed to be *strotahshodhan* by some of the commentators. Lack of menstruation causes *strotorodh* (S. Chi. 13/33)15 and impairs *anulomgati* of *Vaatdosha*, leading to its *prakop* i.e. high bone turnover osteoporosis.

Menopause is the permanent end of a woman's menstrual periods.[4] Menopause occurs naturally, or it can be caused by surgery, chemotherapy, or radiation. Natural products or mind and body practices are sometimes used in an effort to relieve menopausal symptoms such as hot flashes and night sweats. Perimenopause is this period of transition from normal cycles and levels of sex hormones to menopause.[5]

Menopause is when it has been a year since our last period, and it is driven and accompanied by more dramatic changes with our sex hormones.[6] Perimenopause is considered to last anywhere from a couple years to twelve or more before menopause and although this is not implicitly stated, the term tends to be applied more to women who are experiencing discomfort with the transition.[7] Progesterone starts dropping at age 35, we could argue that most women enter perimenopause as that time and that it progresses as our sex hormones diminish. The more imbalanced our hormones, the more likely it is that perimenopause will be difficult. If our hormones are balanced, it is possible to go from age 35 to 55without any discomfort.[8]

Bone:

Bone is a live tissue. It has blood vessels and nerves. Skeleton is highly vascular; it receives 10% of cardiac output. Bone grows, heals when fractured and remodels if fracture is misaligned[1]. Unnecessary bones get reabsorbed.

Bone has 2 components:

1) Fibrous tissue which gives resilience and toughness and

2) Mineral which gives hardness and rigidity.[9] Collagen fibres have tensile strength like tendons. Mineral salt have compressional strength. Minerals i.e. calcium, phosphorus, zinc, magnesium, fluoride, etc are in the form of needle shaped crystals of hydroxyapatite and are arranged around collagen fibers. 35% of dry bone is osteoid i.e. organic ground substance (matrix made up of glycoprotein and collagen fibers Type 1).

Bone has following types of cells:

1) Osteoprogenitor cells i.e. stem cells of mesenchymal origin converted to osteoblast when required.

2) Osteoblasts- Bone forming cells which lay down organic matrix and collagen fibers around which crystals are deposited.

3) Osteocytes provide nutrition to bone.

4) Osteoclasts- Large multinucleated bone removing cells derived from monocytes secretes acid and proteolytic enzymes that degrade bone.[10]

Bone is a dynamic structure. The calcium ions are not fixed and are constantly interchanged with calcium in circulation. 18% of total skeletal calcium is replaced each year (just are RBCs are replaced every 120days- *chakravatparivruttihi*).[11] Bone remodelling begins with resorption of bone by osteoclasts forming a "pit" which is subsequently mineralized by osteoblasts. Remodelling removes weak and older bone which is replaced by strong new bone in skeletal areas subjected to mechanical stress.

Some important references in Ayurveda need to be cited here.

1) *Upadhatu* do not has *gati*. *Gati* is an important feature of all *dhatus* including *asthidhatu*1 (Chakrapani C. Chi. 15/15)

2) *Asthi*is accepted in a liquid form (Chakrapani C.Vi.5/8) 2. This liquid *asthi* is present in minute quantities (? ionic free calcium) and hence not quantified as *anjalipraman* of body fluids (C. Sha. 7/15).

3) Sushrut has not described *asthivahartrotas* in *viddhalakshan* as it extends throughout body (Dalhana S. Sha. 9/12)3.

4) The entire body including bones is *chetan* except nails and hair (Chakrapani C. Vi. 5/7)4.

5) *Asthiposhan*is a function of *medodhatu* (S. Su. 15/5)5.

6) *Asthidhatwagni* has peculiar action. The *sanghat*is made *khar* i.e. hard, solid, dense or thick (i.e. mineralization only) by *asthidhatvagni* (C. Chi. 15/31) 6. It is important to note that mineralization cannot occur without osteoid (cells and fibers)

7) The porosity of bone is due to *Vayu* and *Aakash* amongst other factors (C. Chi. 15/33).

FACTORS IN BONE HEALTH

1) Calcium - Adequate dietary calcium (400mg per day) is essential.[12] Increased gastric acidity, high protein diet, lactose in milk favour absorption. Milk is best source of calcium. Shrimp, crab and vegetables like spinach (*palak)*, colacasia *(aalu)*, gingili seeds *(teel)*, agathi *(agasthi)*, drum-stick leaves *(shigrupatra)* and amaranth *(math)* are also good sources. Oxalic acid in vegetables and phytates in cereals inhibit calcium absorption. High salt intake, lack of exercise, smoking, caffeine, alcohol, carbonated beverages and drugs like steroids, thyroxin and anticoagulants have negative impact on calcium balance. Increased gastrointestinal motility as in *grahani*, laxative abuse and steatorrhoea (fatty acid + calcium=soap) impair calcium absorption. Calcium is excreted in urine. Inadequate re-absorption in chronic renal failure increases calcium losses.

2) Exercise - Weight bearing exercise is essential for bone health. Stress and strain makes bones denser. Bedridden people lose up to 5% bone each month.[13]Even rest in pregnancy causes demineralization. Swimmers and astronauts suffer calcium loss. It would be interesting to note that advantages of exercise are similar to a *asthisarata* (C. Su. 7/328, C. Vi. 8/1099).

3) Vitamin D - Vitamin D, considered to be hormone itself, is essential for calcium homeostasis. It facilitates calcium absorption from gut and resorption from renal tubules.[14]This fat soluble vitamin is synthesized under skin by photo biogenesis in presence of ultraviolet rays in sunlight. This vitamin D3 is further transformed in liver and kidneys to dihydroxy D3, the physiologically active hormone form. Adequate sunlight is thus necessary for bone health. Pardah, ghunghat, dark skin are detrimental to bone health. Milk drawn towards evening has special properties (S. Su. 45/60).

4) Parathyroid hormone - This maintains plasma calcium levels by calcium mobilization from bones.[15] Plasma calcium level is more important as this free ionized calcium is essential for various actions like blood clotting, neuromuscular transmission, muscle contraction and relaxation, etc.

5) Sex hormones - Both androgens and estrogen promote mineral deposition and bone growth by increasing osteoblastic activity.[16] They are responsible for bone maturation and make bone matrix thicker.

6) Peak Bone Mass is achieved at the age of 30 years in males and somewhat earlier in females. Both sexes loose 0.7% to 1% of bone mass for the rest of their life.[17] Age related bone loss is more marked in females. They can lose over 2% of bone mass each year during initial 5-6 postmenopausal years.[18] Growth stops at age of 20 and waning starts at age of 30 (Sha. S. I/6/20)11. It is therefore important to invest in bone health before this age with appropriate diet and exercise. *Rasayanchikitsa*, too, needs to be carried out upto *madhyavay* (S. Chi. 27/3)12- middle age (*youvan* upto 30 years, *madhyavay* upto 60years)

Pathology:

Loss of bone mass is hallmark of osteoporosis. The bony trabeculae are thinner and are more widely separated than usual, resulting in increased susceptibility to fractures. There is no alteration in the ratio of minerals to protein matrix i.e. the

mineral content of remaining bone is normal. *Saushirya* is an action of *vaatdosh* (C. Chi. 15/31)16. *Asthishosh* and fractures are a feature of *asthigatvaat* (S. Ni. 1/28)17. *Medodhatu* provides nutrition to *asthidhatu (asthipushti)* whereas, *asthisoushirya (douvarbalya, laghav)* is a feature of *majjakshaya*. This *snehaparampara* needs to be born in mind during study of *asthikshaya*. Sushrut has described 7 types of *Shoshavyadhi*. *Shosha* by itself is a *vaatprakoplakshan*(V. Su. 12/50). *Kshay*, *Rajyakshama*, etc are the alternative terms for *Shosh*. One of the types, *sthaviryashosh* is due to *asthikshay*. This means that various features of senile degeneration are due to *asthidhatukshaya*. Nutrition of all *dhatu* is dependent upon diet (S. Su. 14/11)18. It seems that even a proper diet is unable to nourish *dhatu* which are aging (S. Su. 14/1919,S. U. 41/4,2720) *Madhavnidan* describes *Rajayakshma*as *anulom*and *pratilom* (M.Ni. 10/2)21.It can be seen that the *samprapti* of *Rajyakshma* encompasses Type1 and Type2 osteoporosis or high turnover and low turnover osteoporosis respectively. It seems that modern medicine is concentrating more on mineral rather than osteoid in diagnosis and treatment of osteoporosis. Ayurveda gives more weightage to osteoid and treats osteoporosis with *snigdha* medications. This appears more appropriate in view of the fact that osteoid is formed first which is then followed by deposition of mineral in relation to fibers.

CLINICAL FEATURES

There are no specific clinical features of osteoporosis except back pain and propensity for fracture after trivial trauma. Wrist and hip fractures cause considerable morbidity. Hip fractures at this age have 15-25% mortality in one year and 70% of survivors have compromised function. Vertebral fractures, though usually painless, cause kyphosis (loss of height-widow's hump), disability, reduced quality of life and reduction in vital capacity of lungs. As there are no specific features of osteoporosis, the subtle features of *Asthikhaya* (C. Su. 17/67, S.Su. 15/9, V. Su.11/19, Bhav Prakash p.323) along with those of *Asthigata Vata* (S. Ni. 1/28) and *Asthiasaratwa* (C. Vi. 8/112) described in Ayurveda need to be carefully looked for. These features are as follows:

- Falling of hair (alopecia)
- Falling of lanugo hair (*Loma*)
- Loss and breaking of nails
- Loss of facial hair
- Loss and breakage of teeth
- Desire of meat containing
- *majja*, *asthi* and *sneha*
- Fractures
- *Laghuta* of heel, ankle, etc
- Fatigue
- Dryness
- Laxity of joints (*shaithilya*)
- Bone pains (*shool*, *toda*)
- Lack of vigor
- Inactivity
- Inability to bear pain/over work
- (*klesh*)
- *Asar sharer*
- *Asthir sharer* (tremulous)

MODERN DIAGNOSTIC METHODS

1) X ray - Conventional radiographs are insensitive and unreliable as features are apparent only after 30-50% of bone loss.

2) DEXA - (Dual Energy X ray Absorptiometry) gives best accuracy and least radiation. The WHO classification of osteoporosis is based on DEXA measurements. Central or axial (spine and hip) DEXA measurements require larger machines but are best predictors of fracture risk. Peripheral DEXA (heel, radius) is more widely available and is least expensive. The T score compares bone mass of patient with that of young (30year) normal subject, whereas Z score is comparison with age matched subject. One SD below mean level implies about 12% loss of BMD and fracture risk doubles with each negative SD.

3) Other methods-like quantitative computed tomography (QCT) and quantitative ultrasound (QUS) can also be used but have limitations. Bone biopsy is used for research purposes only.

4) Bone markers are biochemical markers of bone turnover. They provide assessment of global disease activity throughout skeleton. Two types of markers are used)[19,20,21]

a) Formation markers (osteoblastic activity). Alkaline phosphatase

· Osteocalcin (GLA protein)
· Procollagen-1-N-peptide (P1NP)

b) Resorption markers (osteoclastic activity).

· Acid phosphatase
· C-telopeptide
· Urinary-N-telopeptide

Management in Ayurveda

1) HRT (Harmone replacement therapy)
   a meta-analysis data has proven that Hormone Replacement Therapy (HRT) drastically reduces the risk of vertebral and non-vertebral fractures; these results have also been confirmed from the Women's Health Initiative (WHI) (Richard Keen, 2007). Still, after having so many advantages of the therapy researchers have come up with major health issues caused by this therapy are breast cancer, myocardial infarction, stroke and venous thromboembolic events. That's why it is not commonly used (Richard Keen, 2007)
2) Calcium and Vitamin D
   It is recommended that every woman above 30 should take Calcium and vitamin D supplements and fortified foods. Along with it, timely vitamin D injections should also be taken. In addition, screening should be done after menopause to prevent from consequences
3) Biphosphonates (alendronate sodium) Bisphosphonates are advised as a first line therapy for postmenopausal osteoporosis. These are the binders of phosphates and calcium, which helps in active bone remodeling. Intravenous Ibandronate is licensed for the treatment of post-menopausal osteoporosis, given as 3 mg every 3 months (Richard Keen, 2007). SERM (Selective Estrogen receptor Modulators): Selective Estrogen Receptor Modulators (SERMs) are also used and they produce the same effect like estrogen in the bones. These medications provide protection against bone loss.
4) Teriparatide: is a recombinant form of parathyroid hormone consisting of the first (N-terminus) 34 amino acids, which is the bioactive portion of the hormone. It is an effective anabolic (i.e., bone growing) agent [1] used in the treatment of some forms of osteoporosis.[2] It is also occasionally used off-label to speed fracture healing. Teriparatide is identical to a portion of human parathyroid hormone (PTH) and intermittent use activates osteoblasts more than osteoclasts, which leads to an overall increase in bone.[24,25]
5) Life style moderation
   Regular exercise is a key element in preventing osteoporosis. Both cardiovascular (such as walking, biking, or running) and strength training exercises (such as lifting weights or yoga) are ideal ways to strengthen and condition bones. Alcohol consumption and smoking if any should be avoided
6) Yoga: Yoga is good for range of motion, strength, coordination and reduced anxiety, all of which contribute to the ability to stay upright and not fall.
7) *Panchakarma*
8) Herbal and herbo-mineral preparations.

Recommendation:

- Firstly, at government level, we suggest to make policies to reduce the cause's and decrease the incidence to reduce the prevalence.
- Self-help groups and osteoporosis awareness programs in affiliation with other organizations should be planned for women to create awareness and encourage people for taking steps for prevention and treatment before reaching severe conditions.
- Every woman should take Calcium and vitamin D supplements and fortified foods. Along with it, timely vitamin D injections should also be taken. In addition, regular screening should be done to prevent from consequences.
- According to El-Mekawyl (2012) brisk walking daily for 30 minutes and weight bearing exercises on a treadmill are helpful in prevention and treatment at community level, providing fitness centre facilities and allocating specific hours for women and encourage them to participate.
- In collaboration with NGO's and different institutions we can organize an event on World Osteoporosis day, i.e. 20th October every year

in order to create awareness about prevention, diagnosis, treatment and ways for secondary fracture prevention.

- Development of inexpensive BMD tools and evaluation of biochemical indicators for assessing fracture risk and checking response to therapies (Keen, 2007).
- Identify diagnostic thresholds at various anatomic sites to compare the severity of osteoporosis.

CONCLUSION

Osteoporosis is one of the major concerns globally. Indians have poor bone health, and osteoporosis is common in India. Peak bone mass achieved during puberty is a strong predictor of development of osteoporosis in later years. High prevalence of vitamin D deficiency in India is a major contributor to low bone mass. Its prevalence is higher in menopausal women than any other subgroup. The chief causes are the lower levels of FSH and estrogen, which lead to increased osteoclastic and decreased osteoblastic activities. Along with it other factors like genetic, physical, nutritional, medical and lifestyle make a person more vulnerable. The management includes diet, exercise and medications. The recommendations and work on research needs able to come up with better outcomes in the future.

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