Anatomical Study of Asthi vaha srotas & Clinical Study of Asthi Kshaya w.s.r to “Osteoporosis”

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Abstract
Ayurveda is a life science. The researchers of Ayurveda could rule out the presence of srotas spreading throughout the human body. These srotas are governed by vayu which is using all the srotas of the body to carry out all the activity of human body, without which the human society will not exist. Several synonymous words have been described by the Ayurvedacharyas for srotas. The aim of the study was to justify that srotas are nothing but innumerable channels/pathways/cells without which no activities of the human body will develop and to understand the Asthi vaha srotas, Asthi Kshaya and its correlation with osteoporosis. In introductory chapter we have discussed about srotas and provided an insight into the rich Ayurvedic literature comprising the word srotas, the definition and types of srotas, the detailed description of Asthi vaha srotas, the detailed etiological factors, the specific poorvaroapas, the characteristics and clinical features i.e., the roopa, the meticulously described etiopathogenesis i.e., the samprapti and the logical management of disease with special reference to Asthi Kshaya. The modern science provides a systemic description of bone introduction, bone composition and systemic description of osteoporosis starting from different types of definition, the epidemiology of the disease at the global level with special reference to India, the etiological factors, pathogenesis of the disease, classification, clinical features, different laboratory investigation including haematology–radiology–bone mineral density tests etc. The section on drug review begins with the logical reasoning and basis of selection of trial drugs viz., Asthi Srinkhala, Mukta Pisti, Haridra, Amalaki. Further pages in this section are exclusively dedicated to the detailed study of each of the drugs comprising of the following details viz., taxonomical classification, Sanskrit synonyms, Hindi names, English names, habitat, properties, part used, dose, morphology, chemical constituents, general uses etc. The section ends with an attempt to highlight the role of several preventive modalities for preventing the onset of this dreaded disease. The clinical study of this research provides a detailed analysis of the methodology of research in the present clinical trial.

Keywords: Asthi vaha srotas, Asthi Kshaya, osteoporosis

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INTRODUCTION
The word Srotas is derived from “Sru”gatau dhatu, which means movement. Acharya Charaka said that the path which helps for transportation of substances is called SROTAS [1].

Ayurveda is a life science and according to this science the human body is made up of three types of doshas namely, vata, pitta and kapha and they follow srotas to perform their activities. Ayurveda has accepted that the human body is made up of innumerable srotas which are responsible for performing all the activities of the body without these srotas human life will not exist. All the three doshas of the body perform their functional activities with the help of these srotas. For the proper
development of human body, the proper functioning of these srotas are very necessary. Because of these srotas there is development of cells to tissues, tissues to organs and organs to systems. After that a well developed human body is formed.

Ayurveda has given most importance to srotas for every Murtiman bhavas of the body. By saying Murtiman bhavas Ayurveda means that flow of blood neurological activities, activities of organs, systems, nutrition to all the cells of the body are dependent on srotas. Dhatuposhan siddhanta, physiological and functional activities of human body, and formation of diseases are dependent on srotas.

Several synonymous words have been described by Acharya Charaka for srotas such as Sira, Dhamanya, Rasayani, Nadya, Marga and so many [2]. Some are micro and some are macro in structure and they adopt the same colour of the particular dhatu of the body to which it belongs.

Our body consists of several fine and small srotas (circulatory channels) which help in activities of our body. The specific varieties of srotas in the human body are same in number as the structural entities in it. Srotas (circulatory channels) carries the dhatu undergoing transformation to their destination.

As the srotas are numerous but for the study point of view Acharya Charak has described thirteen types of srotas including Asthi vaha srotas. According to Acharya Susurtha there are nine in males and 12 in females in numbers. According to Sarangadhara in males there are 10 in numbers and in females there are 13 in number. The moola (site of origin) of srotas carrying asthi dhatu are Medo and Jaghan (kati region). Bones make the base of locomotor system in our body.

Osteoporosis condition affects both the sexes and all races albeit to different degrees. The lifetime risk for an osteoporotic fracture is 30–40% in women and 13–15% in men. Women are at high risk as compared to men. The risk even increases at menopause, which is a physiological transition period of hormonal imbalance [3]. As Ashtanga samgraha says Shareeram dharayente dhatvaharashcha sarvada means the supporting of the human body is done by dhatu and ahara. Among the saptha dhatus the asthi dhatu is the one which is responsible for the function of shareera dharana. Asthi dhatu is the dhatu which gives a profile to the body and protects the imperative organs [4]. Man without Asthi dhatu would have been a nebulous bolus of soft tissues. Hence Asthi dhatu can precisely be termed as the construction bars, on the systematic framework of which man stands tall and handsome.

Thus a state of symmetry of dhatus is health and the commotion of the same is termed as disease. Here in the present study Asthi Kshaya was taken for the study in relation to osteoporosis—a metabolic disorder of the bone. In the contemporary science, Osteoporosis is defined as “a progressive systemic skeletal disease characterized by low bone mass and micro architectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture”.

The adult skeleton undergoes a continuous process of remodeling where in bone resorption is coupled with bone formation. When bone resorption exceeds formation, then osteoporosis occurs [5].

AIMS AND OBJECTIVE
The aim of the study was to justify that srotas are nothing but innumerable channels/pathways/cells without which no activities of the human body will develop and to understand the Asthi vaha srotas, Asthi Kshaya and its correlation with osteoporosis and to assess the safety and efficacy of kalpita yoga (Mukta shukti, Amlaki, Haridra & Asthi shrinkhala) in the management of Asthi Kshaya (osteoporosis).

MATERIALS AND METHODS
A total of 40 uncomplicated patients of Asthi Kshaya (osteoporosis) patients with clinical feature of Asthidhatu Kshaya and osteoporosis were selected from OPD & IPD of Major SD Singh PG Ayurvedic Medical College & Hospital, Fatehgarh-Farrukhabad, Uttar Pradesh, India irrespective of sex, caste and race.
Inclusion Criteria
1. Patients presenting with the classical features of Asthi Kshaya (osteoporosis) were taken for the study.
2. Postmenopausal women and osteoporotic men were taken for the study.
3. Patients were selected between the age group of 40–60 years.
4. Patients of osteoporosis diagnosed by BMD test.

Exclusion Criteria
The following patients were excluded from the study:
1. Patients below the age of 40 years and above the age of 60 years were excluded.
2. B.M.D.T. above 1 and less than 3.5.
3. Congenital disorders (Dysostogenesis and Marfan’s syndrome).
4. Patients diagnosed with endocrine disorders (hyperthyroidism, hyperparathyroidism, untreated Cushing’s syndrome).
5. Patients with evidence of malignancy.
7. Rheumatoid arthritis, epilepsy.
8. Patients suffering from cardiac dysfunction, chronic hepatic/renal failure, osteomalacia, malabsorption syndrome, renal stones.
11. Long bone fracture in last six months.
12. Patient not ready to give an informed consent. All patients who are consuming any drug which is known to affect bone metabolism in doses for e.g. SERMs, bisphosphonates, calcitonin, Vitamin D, corticosteroids, methotrexate, anticonvulsants and diuretics.

Withdrawal Criteria
The patients were withdrawn from the trial when they developed any serious adverse or if there was noncompliance of treatment before three months.

Ayurvedic Drug
Muktaṣhutiṭipīṣṭhi: 250 mg
Amalaki churna: 1.5 g
Asthi srunkhala kalka: 1 g

Haridra churna: 500 mg
Route of Administration: Oral
Dosage: 3.25 g twice daily
Anupaha: Lukewarm milk/water
Time of Administration: After breakfast and dinner
Treatment Period: 6 months

Modern Drug as Standard Treatment
Tab Calcimax
Route of Administration: Oral
Dosage: 500 mg BD
Treatment Period: 6 months

Recruitment
Confirmatory period: 1 week
Treatment period: 6 months
Follow-up period: 3 months

Methods of Assessment
a) General information including previous treatment for osteoporosis.
b) Presenting symptoms as per modern medicine and Ayurvedic symptomatology.
c) Physical examination.
d) Radiography (X-ray) Dorsal and Lumbar spine—Lateral view.
e) Bone Mineral Density (B.M.D.) T-Score, assessed at wrist using the Sunlight Omnisense 7000 S, Quantitative Ultra Sonography machine. Omnisense has the best precision level in the QUS market, between 0.4–0.81%, depending on skeletal site. The high sensitivity of Omnisense enable it to detect the smaller changes that take place at the radius, a skeletal site that includes mostly the cortical bones.
f) Laboratory investigations.
Serum Calcium assessed by using the OCPC method.
Marker of bone formation (assessed in the serum).

Adverse Events: Any major or minor adverse events, during treatment period or during follow-up visits were clearly pointed out and its appropriate and timely management was done.

OBSERVATION AND RESULTS
In the present clinical study, 40 uncomplicated patients of Asthi Kshaya (osteoporosis) were randomly divided into two groups viz., Group-1 (n=20) and Group-2 (n=20) (Table 1).
Group-1 patients were administered with Kalpita yoga containing Muktashuktipishti-250 mg, Amalaki churna-1.5 g, Ashtisrunkhala kalka-1.0 g, Haridra churna-500 mg with lukewarm water twice daily for 24 weeks (Table 2).

Group-2 patients were administered with Elemental Calcium-500 mg (in the form of Calcium Carbonate) + Vitamin D3-250 IU for 24 weeks. Several observations regarding the subjective parameters and the objective parameters were recorded at each visit at an interval of four weeks and analysed under the following two heads viz (Table 3): 1. Demographic profile; 2. Clinical profile

**Table 1: Age group & Sex Cross-Tabulation.**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age group (in years)</th>
<th>Group A</th>
<th>Group B</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>41–45</td>
<td>2</td>
<td>0</td>
<td>02</td>
<td>05.00%</td>
</tr>
<tr>
<td>Male</td>
<td>46–50</td>
<td>1</td>
<td>2</td>
<td>03</td>
<td>07.50%</td>
</tr>
<tr>
<td>Male</td>
<td>51–55</td>
<td>2</td>
<td>3</td>
<td>05</td>
<td>12.50%</td>
</tr>
<tr>
<td>Male</td>
<td>56–60</td>
<td>2</td>
<td>1</td>
<td>03</td>
<td>07.50%</td>
</tr>
<tr>
<td>Female</td>
<td>41–45</td>
<td>1</td>
<td>0</td>
<td>01</td>
<td>02.50%</td>
</tr>
<tr>
<td>Female</td>
<td>46–50</td>
<td>4</td>
<td>2</td>
<td>06</td>
<td>15.00%</td>
</tr>
<tr>
<td>Female</td>
<td>51–55</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>25.00%</td>
</tr>
<tr>
<td>Female</td>
<td>56–60</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>25.00%</td>
</tr>
</tbody>
</table>

**Table 2: Distribution of Patients of Osteoporosis (Asthi Kshaya) According to B.M.I.**

<table>
<thead>
<tr>
<th>B.M.I.</th>
<th>Group A</th>
<th>Group B</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td>2</td>
<td>00</td>
<td>02</td>
<td>05.00%</td>
</tr>
<tr>
<td>20–25</td>
<td>7</td>
<td>05</td>
<td>12</td>
<td>30.00%</td>
</tr>
<tr>
<td>25–30</td>
<td>3</td>
<td>11</td>
<td>14</td>
<td>35.00%</td>
</tr>
<tr>
<td>&gt;30</td>
<td>8</td>
<td>04</td>
<td>12</td>
<td>30.00%</td>
</tr>
</tbody>
</table>

**Note:** Among 40 patients, 35% of patients were having B.M.I. in range 20–25, 30% of patients were having B.M.I. in range 25–30 &>30 and 5% of patients were having B.M.I. in range less than 20.

**Table 3: Radiological Assessment-Wise Distribution of the Patients of Asthi Kshaya (Osteoporosis) Before Treatment.**

<table>
<thead>
<tr>
<th>Radiological assessment X-Ray L/S</th>
<th>Group A</th>
<th>Group B</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbosacral spondylosis</td>
<td>01</td>
<td>00</td>
<td>01</td>
<td>02.50%</td>
</tr>
<tr>
<td>NAD</td>
<td>08</td>
<td>13</td>
<td>21</td>
<td>52.50%</td>
</tr>
<tr>
<td>Osteophytes</td>
<td>01</td>
<td>00</td>
<td>01</td>
<td>02.50%</td>
</tr>
<tr>
<td>Osteophytes Osteoporosis</td>
<td>08</td>
<td>06</td>
<td>14</td>
<td>35.00%</td>
</tr>
</tbody>
</table>

Although, significant improvement was seen in the Bone Mineral Density (BMD) T-Score across all the two groups viz., the BMD T-Score improved from -2.07 to -1.56 in Group A and from -1.89 to -1.625 in Group B. Also there was corresponding change in p-value across the two groups, yet most significant effect was observed among the patients of Group A (Table 4 and Table 5).

**DISCUSSION**
Asthi is the fifth among metamorphic chain of dhatus. From general properties of Asthi dhatu, its location, relation with other body tissues and its functions, sthayiasthi dhatu can be considered as bones.

From the ahararasa asthiposhakansa goes to the sthayi asthi dhatu by Vyana vayu through the Asthi vaha srotas. The poshakansha are permeated inside the asthi cells either by syandana (oozing) between the liquid or are transported in by the action of vyana vayu. These asthi cells can be correlated with Asthi vaha srotas and these are none other than osteocytes.

The importance of medodhatwagni, vitamin D, which is derived from sterols, is essential for absorption of calcium in the body. Hence the moola of Asthi vaha srotas is rightly considered as meda. Imbalance of asthidhatwagni leads to improper formation of sthayi asthi dhatu from poshakaasthi dhatu.

Asthikshaya is a condition explained in almost all the samhitagranthas of Ayurveda. It is explained along with the kshaya of all the doshas, dhatus and malas i.e., asthadasha (18 types) kshaya. In osteoporosis also there will be decrease in the bone tissue leading to increased susceptibility to fractures.

In classics there is no direct mentioning about the asthikshayanidana or factors that cause asthikshaya. But the relationship between Asthi dhatu and vata dosha is beautifully explained through Ashraya ashrayibhava mentioned in our classics; when vata increases, asthikshaya occurs and vice versa.

In order to have a proper interpretation of the samprapti of Asthi Kshaya, apart from the normal vataprakopanidana, the main factors for the materialization of the disease, srotopradushakanidanas of medowaha, asthivaha, majjavaha and purishvahasrotas should not be neglected, as they also play a definite role, either directly or indirectly in the pathogenesis of Asthikshaya.

The proper functioning of Jatharagni, bhutagni, dhatwagni is essential for the “Samayaka dhatu posanaprakriya” in order to maintain the qualitative and quantitative normally of the dhatus while explaining concept of dhatu utpatti.

Charaka says that, even though food is taken in proper quantity and quality and is wholesome, it is not digested properly if a person is afflicted by chinta, bhaya, shoka and krodha etc. Hence these psychological factors have the direct influence on functioning of agnis and also results in vataprakopa leading to Asthi Kshaya.

So to conclude, vataprakopakanidanas along with the srotopradushakanidanas of meda, asthi, majja and purishvahasrotas, agnidusti i.e., jatharagni, parthivagni, tejasagni, vavyagni and asthyagni and manasikanidanas altogether form a complex mechanism of pathogenesis of Asthi Kshaya. When there is hyperfunctioning of any one of these agnis the formation of the dhatus may increase.

Thus it may be concluded that as long as this group of dhatwagni is normal, dhatus are maintained at the normal level and with its hypofunctioning there is kshaya of dhatu and on the contrary when it is in hyperfunctioning state, there is vriddhi of the dhatu, which may be selective or total.

Almost all the samhitagranthas have mentioned about the lakshanas of the disease Asthi Kshaya. Acharya Charaka has mentioned it along with the lakshanas of asthadasha (18 types) kshaya. In Harita Samhita the lakshanas of asthikshaya are described along with the lakshanas of kshaya (Rajayakshma).

Due to the above said reasons lakshanas of asthikshaya are reflected as vikaras and pata of danta, kesha, roma, naksha and smasru. The other lakshanas seen in Asthi Kshaya are either due to the rachnmataka or kriyatmakavikrti of the asthi dhatu and its mala.

The present study has been conducted on 40 uncomplicated patients of Asthi Kshaya (osteoporosis). The subjects were selected from among the patients attending the Ayurvedic OPD of the Major SD Singh PG Ayurvedic Medical College & Hospital, Bewarroad, Fatehgarh, Farrukhabad, Uttar
Pradesh, India. Twenty patients were administered with Kalpita yoga containing Muktashuktipishi-250 mg, Amalakichurna-1.5 g, Asthisrunkhala kalka-1.0 g, Haridra churna-500 mg with lukewarm water twice daily for 24 weeks and twenty patients were treated with Tab Calcimax (as the standard control drug).

Significant improvement was seen in the chief objective parameter i.e., BMD T-Score among both the groups viz., the BMD T-Score improved from -2.07 to -1.56 in Group A and -1.89 to -1.625 in Group B. Also there was corresponding change in p value from 0.589 (BT) to 0.312 (AT).

Thus it may be concluded that the drugs selected in this study have shown a promising potential to benefit the patients of Asthi Kshaya (osteoarthritis).

CONCLUSION

- The maximum number of patients (37.50%) was found to be in the age group of 51–55 years.
- Females in the age group of 46–50 years thereby suggesting more prevalence of the disease among the menopausal age group females. Most of patients were found to be Hindus, literate, married, addicted, with contemporary dietary habit (Viruddhashana).
- The maximum number of patients (35.00%) was found to be of having BMI in the range of 25–30.
- The mean duration of illness was 3.18 years and the maximum duration of illness (8 years) was found to be among the patients of Group A.
- The total number of patients with skeletal pain i.e., 82.50% before treatment decreased to 37.50% after treatment.
- The total number of patients without pain i.e., 17.50% before treatment increased to 65.00% after treatment.
- The mean Serum Calcium improved from 8.900 before treatment to 9.465 after treatment in Group A.
- The BMD T-Score improved from -2.07 to -1.56 in Group A.

Further studies with a longer duration of trial, covering a bigger population and assessing more specialized parameters such as blood and urine markers of bone forming/reabsorption, and DEXA scan is recommended to authenticate the result obtained in the present humble attempt. The drugs selected in this study have shown a promising potential to benefit the osteoporotic population and it is hoped that the present work would prove beneficial to future research scholars who wish to work towards the cause of finding a better remedy for the prevention /treatment of Asthi Kshaya (Osteoporosis).

REFERENCES


Cite this Article