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EXPLORING THE GUT–BONE RELATIONSHIP THROUGH THE CONCEPT OF 'PURISHDHARA KALA VIS-À-VIS ASTHIDHARA KALA': A CASE–CONTROL STUDY

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ABSTRACT

Background: Ayurveda identifies *Purishdhara Kala* as one of the seven membranous layers that separates digested nutrients from waste within the intestine. Acharya Dalhana's interpretation equates *Purishdhara Kala* with *Asthidhara Kala*, suggesting a close link between intestinal and bone health. Osteoporosis, a systemic skeletal condition marked by decreased bone density and structural deterioration, is commonly associated with chronic gastrointestinal (GI) issues. This study explored the relationship between osteoporosis and GI symptoms with reference to the Ayurvedic concept that *Purishdhara Kala* and *Asthidhara Kala* are functionally connected.

Methods: A case-control, observational study was conducted on 196 participants—98 osteoporotic patients and 98 healthy controls. Osteoporosis was diagnosed based on bone mineral density (BMD) (T-score < -2.5). Data collection included BMD tests, serum calcium levels, and symptom-based assessments of *Asthivaha Srotas* and *Annavaha–Purishavaha Srotas Dushti Lakshana*. Statistical analysis using Chi-square and Mann–Whitney tests (GraphPad InStat 3.6) considered $p < 0.05$ as significant.

Results: Results revealed highly significant differences between cases and controls in *Asthivaha Srotas Dushti* ($p < 0.0001$), *Annavaha–Purishavaha Srotas Dushti* ($p < 0.0001$), BMD ($p < 0.0001$), and serum calcium ($p < 0.0001$). A strong positive correlation was noted between *Asthivaha* and *Annavaha–Purishavaha Srotas Dushti* in osteoporotic subjects ($r = 0.5263$, $p < 0.0001$).

Conclusion: These findings validate the Ayurvedic concept that intestinal disturbances (*Purishdhara Kala*) can influence bone health (*Asthidhara Kala*), establishing a physiological link between GI function and bone metabolism. Therapeutic approaches targeting *Purishdhara Kala*, such as *Basti Chikitsa*, may thus offer integrative management for osteoporosis.

Keywords: Osteoporosis, Gastrointestinal Tract, *Purishdhara Kala, Asthidhara Kala, Asthivaha Srotas, Annavaha Srotas*

1. INTRODUCTION:

For any physician, a deep understanding of the human body (*Sharira Dnyana*) is vital for both *Swastha Rakshana* (preserving health) and *Atura Vikara Prashamana* (treating disease). Classical texts of Ayurveda place great emphasis on *Sharira Dnyana*, particularly in the *Sharira Sthana* sections, which form the foundation for preventive and curative medical practices **[1]**. The study of *Sharira Sthana* is crucial for comprehending the human body from conception through all stages of life.

Among the classical Ayurveda treatises, *Sushruta Samhita* is regarded as a cornerstone of anatomical science. It provides detailed accounts of both gross and microscopic body structures. Acharya Sushruta systematically described the human body's structural hierarchy, beginning with the *Twak* (skin), followed by the *Kala* (membranes), and then deeper tissues. One of his remarkable contributions is the concept of *Kala Sharira*—the study of membranous layers that separate, support, and protect bodily tissues. Although *Kala* may seem minimal in structure, it plays a vital physiological and clinical role. Modern histology later recognized *Kala* as analogous to epithelial or membranous tissue, reflecting the profound accuracy of Sushruta's *Gyana Chakshu* (intellectual vision) and use of *Upamana Pramana* (analogy-based reasoning) **[2]**.

In the *Garbhavyakarana Sharira Adhyaya* (fourth chapter of *Sharira Sthana*), Sushruta described seven *Kala*—membranes located between *Dhatus* (tissues) and *Ashayas* (organ cavities) **[3]**. These serve as structural and functional boundaries, maintaining the integrity of organs and systems. The seven *Kala* are *Mamsadhara*, *Raktadhara*, *Medodhara*, *Shleshmadhara*, *Purishadhara*, *Pittadhara*, and *Shukradhara Kala* **[4]**.

The *Purishadhara Kala*, the fifth among them, is situated in the intestinal region and is responsible for separating *Mala* (waste matter) from digested nutrients **[5]**. Extending from the *Yakrit* (liver) through the

intestines, it plays a key role in nutrient absorption and waste elimination. At the level of the *Unduka* (caecum), it demarcates fecal matter from assimilated nutrients, thereby maintaining digestive equilibrium.

Further insights appear in *Kalpasthana* of *Sushruta Samhita*, where Acharya Sushruta explains how *Sarpavisha* (snake venom) passes through the seven *Kala*, producing different effects at each stage. In his commentary, Acharya Dalhana draws an important correlation between *Purishadhara Kala* and *Asthidhara Kala*—the membrane associated with bone tissue. He suggests that dysfunction in *Purishadhara Kala* (intestinal lining) can influence *Asthidhara Kala* (bone membrane), revealing a physiological link between gut and bone health **[6]**.

This interpretation provides a unique Ayurveda perspective on the gut–bone axis, illustrating how intestinal imbalances may contribute to bone diseases like osteoporosis. Osteoporosis, as defined in modern medicine, is a systemic skeletal disorder characterized by reduced bone mass, microarchitectural deterioration, and increased fracture risk. Clinical observations show that individuals with chronic gastrointestinal (GI) disorders often develop osteopenia or osteoporosis, supporting this interrelationship **[7]**.

From a modern biomedical perspective, GI disorders such as malabsorption, celiac disease, inflammatory bowel disease (IBD), and liver dysfunction significantly affect bone metabolism. These conditions impair calcium and vitamin D absorption, cause nutritional deficiencies, and alter bone remodeling processes. Inflammatory mediators in IBD, along with reduced mobility and systemic inflammation, further accelerate bone loss. Liver diseases can disrupt vitamin D metabolism and the production of binding proteins, contributing to skeletal fragility **[8]**.

Additionally, surgical procedures like gastrectomy or small bowel resection, and chronic conditions such as ulcerative colitis or irritable bowel syndrome (IBS), are recognized risk factors for osteoporosis due to reduced nutrient absorption **[9]**. Consequently, modern gastroenterologists frequently encounter patients presenting with both GI complaints and reduced bone density. This overlap aligns with the Ayurvedic view that the *Purishadhara Kala* (intestinal membrane) and *Asthidhara Kala* (bone-supporting membrane) are functionally interlinked.

In Ayurveda therapeutics, this connection is utilized in the management of *Asthivaha Srotas* (bone-related disorders) through

treatments targeting the *Annavaha–Purishavaha Srotas* (digestive channels). *Charaka Samhita* advocates *Panchakarma*, particularly *Basti Chikitsa* (medicated enema therapy), using *Tikta Rasa* (bitter drugs), *Dugdha* (milk), and *Ghrita* (ghee). Administered through the *Pakwashaya*—the seat of *Purishadhara Kala*—this therapy corrects *Asthidhatu* pathology, thereby strengthening the gut–bone connection **[10]**.

Given the rising prevalence of osteoporosis and its frequent coexistence with gastrointestinal dysfunction, this study was designed to scientifically examine the association between these two conditions. Guided by the Ayurveda concept '*Purishdhara Kala Sa Eva Asthidhara Kala'*, it seeks to bridge classical Ayurveda theory with modern biomedical understanding. This integrative approach highlights the physiological continuity between digestive and skeletal health and proposes that maintaining intestinal integrity is fundamental for bone strength. The findings thus offer a scientific basis for holistic management strategies in osteoporosis, combining traditional Ayurveda therapies with contemporary medical insights.

MATERIALS AND METHODS:

All relevant Ayurveda and modern literature, including *Brihattrayee*, *Laghutrayee*, *Nighantus*, and contemporary biomedical texts, along with authentic online resources, were thoroughly reviewed for conceptual understanding of *Kala Sharira*, *Asthi Kshaya* (Osteoporosis), and *Annavaha–Purishavaha Srotas*.

Study Participants: A total of 196 subjects were included—98 diagnosed cases of osteoporosis and 98 healthy controls—selected based on predefined inclusion and exclusion criteria.

2. Methodology

2.1 Conceptual Study: Classical Ayurvedic texts and modern scientific references related to *Purishadhara Kala* and *Asthidhara Kala* were analyzed to establish conceptual correlations between gastrointestinal health and bone metabolism.

2.2 Clinical Study:

- **Type and Design:** Observational, analytical, case-control study.
- **Setting:** Department of Rachana Sharir and associated hospital, Ayurveda College.
- **Population:** Patients aged 30–50 years diagnosed with osteoporosis (BMD T-score < –2.5) and healthy volunteers of the same age group.
- **Sample Size:** 196 (98 per group), determined using EpiTools epidemiological calculators **[11]**

(Confidence level: 95%, Power: 80%, OR = 4).

- **Sampling Technique:** Simple Random Sampling, ensuring equal selection probability for all eligible participants.
- **Eligibility Criteria**
  - ❖ **Inclusion Criteria (Cases):** Individuals aged 30–50 years with clinical features of *Asthi Kshaya* and BMD T-score < –2.5.
  - ❖ **Inclusion Criteria (Controls):** Healthy individuals aged 30–50 years without osteoporosis.
  - ❖ **Exclusion Criteria (Both Groups):** Age > 50 years, postmenopausal women, pathological or secondary osteoporosis, endocrine disorders, diabetes, neoplasms, or systemic diseases; non-cooperative patients.
- **Plan of Action:** After obtaining written informed consent, participants underwent physical examination, BMD, and serum calcium estimation. GI and *Asthivaha Srotas*-related symptoms were recorded using a validated questionnaire. Data were entered in MS Excel 2017 for analysis.
- **Measurement Tools:** Case record form, BMD and Serum Calcium tests, Validated GI and bone symptom questionnaire and PSS-10 stress scale.
- **Data Analysis:** Statistical analysis was performed using GraphPad InStat 3.6. Continuous variables were expressed as Mean ± SD; categorical data as n (%). Tests applied included:
  - ❖ **Chi-Square Test** for association between categorical variables.
  - ❖ **Spearman's Rank Correlation** for non-parametric correlations between GI and bone parameters.
  - ❖ **Mann-Whitney U Test** for comparison between case and control groups.
  - ❖ A p-value < 0.05 was considered statistically significant.

3. RESULTS:

The present observational case-control study was conducted to analyze and compare the clinical and biochemical parameters of individuals with *Asthi Kshaya* (Osteoporosis) and healthy controls. A total of 196 participants were enrolled — 98 in the Case Group (Osteoporosis) and 98 in the Control Group (Healthy individuals). The analysis was done under two major headings: (1) Demographic details and (2) Clinical assessment of study participants.

3.1 Demographic Details:

The age-wise distribution revealed that the maximum number of participants in both groups were between 46–50 years (41.84% in

Case Group and 36.73% in Control Group), indicating that Osteoporosis is more prevalent in the later decades of life. Regarding gender distribution, females constituted the majority in both groups (74.49%), reflecting the known higher susceptibility of women to Osteoporosis due to hormonal factors **[12]**.

In terms of religion, most participants were Hindus (86.73%), followed by Muslims (13.27%). The educational status showed that the majority of participants were educated up to HSC (34.69%) and graduates (32.65%), with only a small proportion being uneducated (1.53%). Occupationally, workers formed the largest category (41.33%), followed by housewives (29.59%) and individuals with sedentary or sitting jobs (29.08%). A greater proportion of housewives was found in the Case Group (38.78%), which may reflect lifestyle-related vulnerability.

Addiction patterns showed that most participants had no addiction (68.88%), while 28.06% reported tobacco use. The Case Group had a slightly higher prevalence of tobacco and alcohol use. Analysis of Vihara (physical activity/lifestyle) revealed that in the Case Group, 43.88% engaged in sitting/standing work and 22.45% had stressful occupations, suggesting that limited physical activity and stress could be contributing factors.

3.2 Clinical Assessments:

Assessment of perceived stress (PSS) showed no statistically significant difference between the two groups ($p = 0.1438$), indicating that stress levels were comparable. However, *Sharira Prakriti* analysis revealed that *Vata-Pitta* type predominated in both groups, particularly in the Case Group (66.33%), aligning with the Ayurveda understanding that *Vata Dosha* aggravation leads to degenerative changes like *Asthi Kshaya*.

Agni assessment showed *Vishamagni* as the most common type (62.12%), followed by Mandagni (30.81%), in both groups. This may indicate irregular digestion and metabolism as potential contributory factors. Regarding *Koshtha*, *Krura Koshtha* (hard bowel) was predominant in both groups, especially in the Control Group (54.08%).

3. Srotas Dushti and Biochemical Correlations

A highly significant difference was observed in *Asthivaha Srotas Dushti Lakshana* scores between the Case and Control Groups ($p < 0.0001$). Similarly, *Annavaha–Purishavaha Srotas Dushti Lakshana* scores were also significantly higher in the Case Group ($p < 0.0001$), reflecting greater impairment of

metabolic and nutritional pathways among osteoporotic individuals.

Biochemical parameters demonstrated clear distinctions. The mean Bone Mineral Density (BMD) was significantly lower in the Case Group (-1.63 ± 0.37) compared to the Control Group (-0.01 ± 0.63), confirming osteoporotic changes ($p < 0.0001$). Serum calcium levels were also significantly reduced in the Case Group (8.51 ± 1.49) compared to controls (9.10 ± 0.37), indicating compromised calcium metabolism ($p < 0.0001$).

Correlation analyses revealed a strong positive and statistically significant correlation between *Asthivaha Sroto-Dushti* and *Annavaha–Purishavaha Sroto-Dushti* scores in the Case Group ($r = 0.5263$, $p < 0.0001$), suggesting that disturbances in the digestive and excretory systems are closely associated with structural bone deterioration. However, in the Control Group, the correlation was negative and not significant ($p = 0.7379$). Correlations between Annavaha–Purishavaha Srotas Dushti and BMD, as well as between Annavaha–Purishavaha Srotas Dushti and serum calcium levels, were positive but not statistically significant in both groups, indicating a trend but not a strong association.

4. Sex-Wise Analysis: Within the Case Group, sex-wise comparisons of Asthivaha and Purishavaha Srotas Dushti scores revealed no significant differences ($p = 0.2238$ and $p = 0.7138$ respectively). However, in the Control Group, significant differences were observed between males and females in both Asthivaha ($p = 0.0411$) and Purishavaha ($p = 0.0092$) assessments, implying gender-based physiological variations even among healthy individuals.

Overall, the study findings demonstrate that individuals with Asthi Kshaya exhibit significantly higher *Srotas Dushti* scores, lower BMD, and reduced serum calcium levels compared to healthy controls. These outcomes affirm a strong link between *Asthivaha Srotas Dushti* and metabolic disturbances in *Annavaha–Purishavaha Srotas*, supporting the Ayurveda concept that improper digestion and metabolism contribute to *Asthi Dhatu Kshaya* (bone depletion).

The observations underline the integrative correlation between Ayurveda and modern parameters, emphasizing that preventive and corrective measures aimed at improving digestive fire (Agni) and maintaining balanced *Vata Dosha* may play a crucial role in managing and preventing Osteoporosis.

4. DISCUSSION:

Science is a product of gradual evolution rather than sudden invention, and Ayurveda is no exception. The principles of Ayurveda, though ancient, continue to hold relevance due to their scientific foundation. In classical research methodology, *Upanaya* (discussion) precedes *Nigamana* (conclusion), serving as a reflective step that re-examines data and observations before establishing truth. The discussion thus represents a systematic evaluation of results, examining their merits and demerits to derive rational conclusions. This chapter presents a comprehensive discussion of the study titled *"A Case-Control Study to Assess the Association between Osteoporosis and Gastrointestinal Tract Symptoms with Special Reference to the Concept 'Purishdhara Kala Sa Eva Asthidhara Kala'."*

The present study enrolled 196 participants, equally divided into Case (osteoporotic) and Control groups. The majority were in the 46–50-year age group, reflecting the age-related decline in bone mass post-menopause. Women predominated (74.49%), which corresponds with known hormonal influences—especially estrogen deficiency—on bone metabolism.

Most participants belonged to Hindu community, likely due to the study's regional demographic. Educational and occupational patterns indicated that both sedentary and laborious workers were at risk, suggesting that excessive physical strain as well as inactivity may contribute to *Asthi Kshaya*. Addictive habits like tobacco use were slightly higher among osteoporotic individuals, consistent with evidence linking smoking to reduced bone density.

A significant number of osteoporotic participants exhibited *Vata-Pitta Prakriti*, *Vishamagni*, and *Krura Koshtha*, indicating Vata dominance in body constitution and metabolism. Ayurveda identifies *Vata Dosha* as the main factor for *Asthi Dhatu Kshaya*; thus, these findings validate the classical principle of *Ashraya-Ashrayi Bhava*—the interdependence between *Vata* and *Asthi Dhatu* **[13]**.

The study demonstrated significant differences in *Asthivaha Srotas Dushti* and *Annavaha–Purishavaha Srotas Dushti* between the two groups ($p < 0.0001$). Cases exhibited lower Bone Mineral Density (BMD) and reduced serum calcium, affirming impaired bone metabolism. A statistically significant positive correlation was found between *Asthivaha* and *Annavaha–Purishavaha Srotas Dushti* scores ($r = 0.5263$), emphasizing that disturbances in gastrointestinal function are linked with bone degeneration.

These findings substantiate the Ayurveda assertion that *Purishdhara Kala* (intestinal membrane) and *Asthidhara Kala* (bone membrane) are functionally interconnected. Chronic gastrointestinal dysfunction may therefore lead to *Asthidhatu Kshaya*, manifesting as osteoporosis.

Discussion on Relation between Purishdhara Kala and Asthidhara Kala: Acharya Sushruta describes seven *Kala*, each associated with specific *Dhatu*. *Purishdhara Kala*, the fifth, corresponds with *Asthidhara Kala*, the supporting layer of bone. The large intestine (*Pakwashaya*), being the seat of *Vata Dosha*, shares a functional relationship with *Asthidhatu*, which is also *Vata Sthana*. This interdependence explains why intestinal disturbances often manifest as bone disorders.

The study's findings, supported by textual evidence, reaffirm that maintaining *Purishdhara Kala* health is crucial for sustaining bone strength. Ayurveda therapies like *Basti Chikitsa*, administered via the rectal route, act directly on *Purishdhara Kala*, thereby influencing *Asthidhara Kala*. Classical formulations such as *Tikta Ksheera Basti*—combining *Tikta* (bitter) drugs with milk—are known to nourish *Asthi Dhatu* and restore bone integrity.

Thus, both literary evidence and empirical data validate the Ayurveda principle *"Purishdhara Kala Sa Eva Asthidhara Kala."* Disturbance in intestinal functions affects bone metabolism, and therapeutic interventions targeting the gut—especially through *Basti Chikitsa*—can play a pivotal role in the management and prevention of osteoporosis.

5. CONCLUSION:

It can be concluded that there is a relationship between *Purishadhara Kala* and *Asthidhara Kala.* The objective evaluation of relationship between *Purishadhara Kala* and *Asthidhara Kala*, would be instrumental in deciding the conventional and new treatment approaches for diseases of *Asthidhara Kala* or *Asthivaha Srotas*.

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