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Medodhara Kala: Integrating traditional knowledge with contemporary Anatomy

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Abstract

Kala Sharir a significant concept in Ayurvedic medicine, refers to as limiting membrane that lines between the *Dhatu* and *Ashaya*. *Medodhara Kala* is the third *Kala*. Acharya Sushruta states that all animals have *meda* in their abdomen and small bones. The term *Majja* (marrow) pertains to the fatty material found in big bones. Dalhana says that *Medodhara kala* includes *Majja, Vasa* and *Meda*. *Meda* is located in the abdomen and miniature bones; *Majja* is located in the long bones; and *Vasa* is located in the muscular tissues as the unctuous part of the muscle. An essential anatomical component that is crucial to the general health and functionality of bones is the endosteum. While describing the *Kala Sharir* the Acharya Sushruta after defining the *kala*, the characteristics of *kala* also mentioned as they are mostly constitutional or covered by *Snayu-Sutras* (fibrous tissues), *Jarayu-Sutras* (serous tissue), and *Kapha Veshtita* (covered with mucoid tissues). According to contemporary definitions, endosteum is a thin membrane that coats the interior of the compact bone medullary chamber. This membrane is made up of several cell types, such as osteoblasts, osteoclasts, and osteoprogenitor cells, which are crucial for bone remodelling and maintenance. While the structural characteristics of endosteum are also the mucous, fibrous, and serous components. Together, these components preserve the membrane's strength and functionality, assuring that it promotes bone health in an efficient manner.

Key words : *Medodhara kala, Kala Sharir*, Endosteum, Adipose tissue.

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Acharya Sushruta defined Kala as *Dhatwasayantara Maryada*, *i.e.*, it is a Membranous structure that lines between *Dhatus* and their *Ashayas*. *Medodhara Kala* in Rachana Sharir represents as a membranous structure that lines between *Medo Dhatu* and *Asthi Aashaya*. It plays a crucial role in the organization and functionality of adipose tissue within the human body. *Medodhara Kala* is the third of the seven Kalas described by Acharya Sushruta, it's foremost location is in the abdominal region (Udara), small bones (*Anu Asthi*), and long bones *(Maha Asthi)*[11]. *Mamsadhara Kala* arrives after *Maamsadhara Twak*, the seventh layer of *Twak*. Following this, *Raktadhara Kala* (vessels), *Medodhara Kala* (coverings including adipose tissue). If we look closely, we might observe that *Medodhara Kala* is and Meda (fat/adipose tissue) are closely related.[10]

Medodhara Kala serve as a protective covering for adipose tissues, which serve various physiological roles including energy storage, insulation, and cushioning of vital organs[4]. This membranous structure not only supports the anatomical integrity of surrounding tissues but also plays an important role in metabolic processes associated with fat storage and distribution[8]. The integration of ayurvedic concepts with contemporary anatomical knowledge, particularly regarding structures such as the endosteum, which shares functional similarities with *Medodhara Kala*[11]. *Kala* can be recognized as a membrane in current times. Under the *Mamsadhara Kala, Medodhara Kala* is found almost everywhere on the body, even in a few locations like the testicles, eyelids, etc. *Meda* is particularly deposited over the pelvic area, over the blood arteries to shield them from shock, around the eyeballs, and in *Vapavahan* (associated with the belly's omentum).[8] By examining the description of *medodhara kala* in ayurvedic samhitas and in modern terms that can be relates to various modern anatomical components like endosteum, adipose tissue, omentum and peritoneal fat layers, bone marrow etc.[5]

Aim: Study of *Medodhara Kala* with a focus on its anatomical aspects.

Objectives :

To understand the concept of *Medodhara Kala* in Ayurvedic literature. To brief the description about *medodhara kala* in samhitas

To identify its correlation with modern anatomical structures**.**

This study will involve a literature review from Samhita's, websites and published articles.

Literature review :

In the fourth chapter of *"Sharir Sthana,"* Acharya Sushruta described *Kala Sharir* in *Garbhavyakarana Sharir.*

कलाः खल्वपि सप्त भवन्ति धात्वाशयान्तरमर्यादाः ॥
स्नायुभिश्च प्रतिच्छन्नान् सन्ततांश्च जरायुणा |
श्लेष्मणा वेष्टितांश्चापि कलाभागांस्तु तान् विदुः ॥
(Su.Sha.4/5,7)

The thin membrane layer known as *Kala* divides the underlying *Dhatu* from its *Aashaya*. Similar to how cutting wood tranversely reveals *Sarabhaga*, cutting

Dhatus like *Mamsa* reveals *Kala*, which differentiates itself as *Snayu Praticchanna, Jarayu Santata*, and *Sleshmaveshtita*.[14]

According to *Ashtanga Samgraha*, the moisture that remains inside the spaces in the *Dhatus* gets cooked (processed) by the heat present in them, forms into structure similar to those found in the wood and become covered with *Snayu*, *Slesma* and *Jarayu*. It is called as *Kala*, because it is formed from very little quantity of *Rasa,* and essence of *Dhatus*.[13]

The other references are in *Ashtang Hridayam*[12]*, Sharirsthan in Angavibhaga Shariram* chapter as well as in *Ashtang Samgrah*a and *Sharangdhar Samhita*. All Acharyas have explained seven *Kala's* which is similar to *Sushrut Samhita*, but in *Sharangadhar Samhita*, location of fourth Kala is stated to be at Yakrut and Pleeha[16].

तृतीया मेदोधरा; मेदो हि सर्वभूतानामुदरस्थमण्वस्थिषु च, महत्सु च मज्जा भवति ||
स्थूलास्थिषु विशेषेण मज्जा त्वभ्यन्तराश्रितः |
अथेतरेषु [१] सर्वेषु सरक्तं मेद उच्यते |
शुद्धमांसस्य यः स्नेहः सा वसा परिकीर्तिता ||
(Su.Sha.4/12-13)

According to Acharya *Sushruta, third Kala* is *Medodhara kala*. *Meda* is present in the abdomen of all Animals and small bones. The fatty substance present in large bones is called *Majja* (marrow). According to Dalhana, *Medodhara kala, Vasa, Majja,* and *meda* all are included under *Medodhara kala. Majja* situated in long bones; *Meda* situated in abdomen and small bones; *Vasa* situated in muscle tissues as unctuous portion of muscle[15].

Author	Description of Medodhara Kala
Maharshi Sushruta	• *Meda* (fat) is present in the abdomen and *Anu Asthis* (small bones). • *Sthula Asthis* (long bones) contain *Majja* (bone marrow). • *Medodhara Kala* also contains *Sarakta Medo* (fat mixed with blood) and *Vasa* (muscle fat), the unctuous portion of *Sudha Mamsa*.[4]
Acharya Vagbhata	The third *Kala* holds fat (adipose tissue), primarily in the abdomen and small bones mixed with blood (appears red). Fat inside the head, covered by skull bones, is known as *Mastiska* and *Mastulunga*, while fat in gross bones is *Majja* (marrow).[3]
Damodar Sharma Gaur	*Medodhara Kala* is the peritoneum containing extraperitoneal fat (omentum), fatty layers of superficial fascia, the lining of medullary canals, marrow spaces of bones, and meninges supporting the brain.[11]
Dr. B.G. Ghanekar	Fat accumulation is significant in *Sthula Sharira,* particularly in the *Sphik* (buttocks), *Sthana* (pectoral region), and *Udara Pradesh* (abdomen). Fat is present in subcutaneous tissue and omentum (peritoneum).[1]
Dr. D.G. Thatte	• Fat is abundant in the abdominal wall and deposited in *Udaravarana Kala* (peritoneum), especially in *Vapavahana* (omentum).

- Medo is differentiated as *Peeta Majja* (yellow marrow) found in large bones and *Rakta Majja* (red marrow) in small bones. *Sarakta Medo* refers to fat mixed with blood.[3]

The structure that limits the *dhatu* and *ashaya* is called *Kala*. *Medodhara Kala* is a membrane structure that typically exists in the abdominal cavity and within bones and acts like a barrier between *Medo Dhatu* (fat tissue) and its *Ashaya* (asthi).

From a modern perspective, the endosteum is a thin membrane that lines on the inner surface of the compact bones' medullary chamber.[17] The endosteum, that includes osteoblasts, osteoclasts, and osteoprogenitor cells, encompasses the trabeculae of the cancellous bones.[6] It is defined via its mucous, fibrous, and serous components which maintain its solidity of structure and functional abilities.[7]

In modern terms the Medodhara Kala can be relates to various modern anatomical components. They are:

1. *Adipose Tissue :* Adipose tissue, which includes medullary fat (found in the bone marrow), visceral fat (found around internal organs), and subcutaneous fat (found beneath the skin), is the key component of *Medodhara Kala*.

Subcutaneous Fat : This kind of fat gives the body insulation and protection while also acting as a store of energy. Similar to this, *Medodhara Kala* serves as a shield for underlying structures.

Visceral Fat : Excessive levels of this fat are associated with a number of metabolic diseases. The regulation of fat distribution and storage by *Medodhara Kala* is essential for keeping metabolic health.[11]

Medullary Fat : The principle that *Medodhara Kala* helps in energy storage and utilization inside the skeletal system is supported by the presence of fat in bone marrow.[9]

2. *Omentum and Peritoneal Fat Layers :* The omentum contributes to fat storage, immunological response, and the protective coating of the abdominal organs. *Medodhara Kala* can be correlated with the omentum because of its protective functions and involvement in adipose tissue dynamics.[4] Peritoneal fat layers act as a cushion for the organs in the abdomen, much like *Medodhara Kala* does to provide protection for the tissues underneath from injury.

3. *Bone marrow :* It consists of two types: yellow marrow (primarily adipose tissue) and red marrow (involved in hematopoiesis).

Yellow Bone Marrow : This type is similar to *Medodhara Kala* in that it stores fat and is rich in adipocytes.It also acts as an energy reserve.[4]

Red bone marrow : It contains some adipocytes but is mostly in charge of producing blood cells. The connection between bone marrow and *Medodhara Kala* highlights their mutual function in regulating metabolism and storing fat.

4. *Superficial Fascia and Meninges :* Adipose tissue is present beneath the

connective tissue layer known as superficial fascia. *Superficial Fascia:* This layer acts as insulation and support for the skin and underlying tissues. The protective function of *Medodhara Kala* is similar to that of superficial fascia, emphasizing its significance in preserving structural integrity[11]. *Meninges:* Because of their supportive roles, the layers of the protective membranes enclosing the brain and spinal cord can also be compared to *Medodhara Kala.*

5. *Role of Fat tissue in endocrine function and metabolic regulation :* By secreting hormones like leptin, adiponectin, and resistin, adipose tissue contributes actively to endocrine functions than just serving as a passive storage facility.

Metabolic Regulation: These hormones play a role in controlling insulin sensitivity, hunger, and energy balance in general.[9]

Kala's are barrier between *Medo Dhatu* (fat tissue) and its corresponding *Ashaya (Asthi)*. The characteristic features of *Kala* are they are covered as *snayu* (fibrous shealth), similar as *Jarayu* (serous membrane) and they are smeared by *kapha* (mucous membrane). *Medodhara Kala* is a membrane-like structure that is mostly present in the abdominal cavity and inside bones. The endosteum's mucous, fibrous, and serous components are also its structural features. Collectively, these constituents maintain the membrane's strength and performance, guaranteeing that it effectively nurtures bone health.*Medodhara Kala* is present in nearly every part of the body, including the eyelids, testicles, and other places. *Meda* is especially placed in *Vapavahan* (connected to the omentum of the belly), around the eyeballs, over the pelvic region, and over the blood vessels to protect them from shock.

Kala's are located in between *Aashaya* and *Dhatu*. Their bodily structures and functions allow for their recognition. One of the most important components of *Dhatu* is *kalas*. The creation of *Dhatus* is the outcome of *Kalas'* actions or functions. Acharya Sushruta provides a thorough explanation of *Sapta Kalas*, whereas *Medodhara Kalas* comes in third. *Meda* is defined as the adipose tissue or fat found in the abdomen of all animals as well as cartilage (small bone). *Majja* (marrow) is the term for the fatty material found in big bones.Acharya Vagbhata impart the opinion that fat inside the head, which is covered by skull bones, is called *Mastishka* and *Mastulunga*. The abdominal wall has a lot of fat that is deposited in the peritoneum, or *Udaravarana Kala*, particularly in the omentum, or *Vapavahana*. This buildup strengthens the body's structural integrity and has metabolic and defensive purposes.

Medo is distinguished by the presence of *Rakta Majja* (red marrow) in tiny bones and *Peeta Majja* (yellow marrow) in large bones. Fat combined with blood is referred to as *Sarakta Medo*.This distinction highlights the intricate functions that different forms of fat perform in the body, impacting energy metabolism and general well-being. By looking at how *medodhara kala* is described in Ayurvedic samhitas and in contemporary terminology, it can be connected to bone marrow, adipose tissue, endosteum, omentum, and peritoneal fat layers, among other contemporary anatomical elements.

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