

## Physiological Implication of *Shleshmdhara Kala* w.s.r. to Synovial Membrane

Pankaj Kumar Rajvanshi, Nitin Pandey<sup>1</sup>, Arvind Kumar

Department of Rachna Sharir, <sup>1</sup>Department of Kaya Chikitsa, Himalayiya Ayurvedic (P.G.) Medical College, Dehradun, India

### ABSTRACT

'Kala' is a unique concept explained by in *Sushrut Samhita* in *Garbha vyakaran Sharir (Sharirsthana)* and *Sarpadashtra vishvignyana (Kalpasthana)*. References about *Kala* are also found in *Ashtanga samgraha*, *Ashtanga hrudaya*, *Sharangdhar samhita*, *Bhav parkash*. Most of them have explained seven *Kalas* is similar to *Sushrut samhita*, but in *Sharangdhar samhita* fourth *Kala* is *Yakrit Pleeha* (liver, spleen). There is no reference about *Kala* in *Charak samhita*. *Acharya sushrut* defined *Kala* as "Dhatwaashyantaryaryaada *Kala*" i.e., it is membrane between *dhatu* and *ashaya*. In modern point of view it is thin membrane which lining the internal cavity of the *ashayas*, organs, blood vessels, fibrous capsule of the joints etc. The specific *Kala* is located at the specific site. Among the *sapta Kala* mentioned by various *acharyas*, *Shleshmadhara Kala* is the fourth and lies in the *sandhis* i.e., joints of body. This study attempts to explain the anatomical and physiological aspects of *Shleshmadhara Kala* in reference to contemporary science.

**Keywords:** *Ashaya*, Hyaluronic acid, *Sapta Kala Dhatu*, *Sleshmak Kapha*

### INTRODUCTION

*Kala sharir* is one of the most important fundamental and unique concept of *Rachana sharir* (Ayurvedic anatomy) explained by *Sushruta* in *Sharir sthana*. Description of *Kala Sharir* found in *Garbha vyakaran sharir* i.e., <sup>[1]</sup> embryology and *Kalpsthana* during *Chikitsa* of *Sarpa Dansha* (snake bite) *Visha Vegantar*, <sup>[2]</sup> hence it is important to understand *Kala Sharir* in anatomical and functional point of view. *Kala* are the layers or membranes present at the junction of the *Dhatu* (tissues) and their *Ashaya* (places). <sup>[3]</sup> In our day to day life, formation and conversion of *Bhava Padartha* is takes place in the *Kala* and this lead to formation of various *Dhatu*. This *Kala* is minute and invisible in nature.

*Kalas* are total seven in numbers and are situated at the extreme borders of *Dhatu* and *Ashaya*. As duramen or core of a piece of wood or stem becomes exposed to view by cutting into it, so the *Dhatu*s of the body may be seen by removing the successive layers. These *Kalas* are extensively supplied with *Snayus*, bathed in *Jarayu* and encased in *Shleshma*. Thus, the three basic principles in the formation of *Kala* are *Snayu*, *Jarayu* and *Shleshma*. <sup>[4]</sup>

According to *Ashtanga Sangraha* the *Kleda* which lies between the

*Dhatu* and *Ashaya* undergoes *Pachana* (metabolic conversion) due to its own heat and it forms *Kala* which is like *Kashtha Sara*, i.e. core of a piece of wood and it is covered by *Shleshma*, *Snayu* and *Jarayu*. <sup>[5]</sup>

According to the *Teekakar Indu*, *Kala* is the *Kleda* of *Dhatu*sara, which is not in the form of *Purva Dhatu* (preceding tissue) and doesn't get converted into *Uttara Dhatu* (following tissue) but it remains as divider between these two *Dhatu*s. <sup>[6]</sup> "*Dhatukledavishesha*" is named as *Kala*, according to *Gananathsen*. *Kalas* are not arranged in the same order as *Dhatu*s. They don't take part in *Dhatu Poshana* (nutrition), they are meant for *Dharana* (holding) only. *Kalas* are not the formative elements or mechanical support of *Dhatu*s but these are the membranes with special functions.

### Aims and objectives of this study

To study the anatomical and physiological aspects of *Shleshmadhara Kala* with contemporary science.

### MATERIALS AND METHODS

Literary and conceptual study of *Shleshmadhara Kala* has been collected from the *Bruhatrayee laghutrayee* along with their commentaries by different authors. Different references from modern science to correlate with the *Kala Sharir* especially *Shleshmadhara Kala* is collected from various modern medical books, publications and journals etc.

**Address for correspondence:** Dr. Pankaj Kumar Rajvanshi, Assistant Professor, PG Department of Rachna Sharir, Himalayiya Ayurvedic (P.G.) Medical College, Dehradun, India.  
Email: rajvanshi.pankaj@gmail.com

### Review of literature of *Shleshmadhara Kala*

It is fourth in order among the seven *Kala* as described by *Acharya Sushruta*. It is present in all the bony joints. It provides lubrication for bony joints and enables to move freely. Functionally it is compared with synovial membrane of inner surface of the joints. [7]

### Physiology of *Shleshmadhara Kala*

As per *Sushruta*, *Shleshmadhara Kala* is said to exist in all the *Sandhis*. We find that the *Shleshmaka* component i.e. mucin is characteristic of the *Shleshmadhara Kala* found in the joints. *Sandhi* is an inclusive term, but the references we find with this term elsewhere are about *Asthi Sandhi* and not *Mrudu Avayava Sandhi*. This is why the *Shleshmadhara Kala* is correlated with synovial membrane only. We could find the substantial explanation of the sutras about the *Shleshmadhara Kala*. *Ashtanga Sangraha* has briefly explained the biomechanics of joints as- “As the well lubricated wheel rotates smoothly around its axis the joints move smoothly because of *Shleshma*.” [8] The superiority of the biological joints over the artificial joint is best proved by the failure of an attempt to construct a joint to fulfil all the biological attributes. The major reason for this superiority lies in the built in lubricating system of the biological joints, i.e., *Shleshmadhara Kala*. By the study of mechanics and experiments, it is proved that *Sandhigata Shleshma* is the principle factor to reduce the coefficient of friction. The integrity of the synovial membrane and synovial fluid play the principle role in the normal work out of joint with the strain with standing properly and ultimately “*Pranbhrutam*”.

Synovial fluid is said to be the dialysate of plasma with the added mucin content. Synovial fluid is originated from plasma and being a dynamic system is absorbed in the plasma. This in and out flow of components depends upon the circulation.

*Kapha* or *Shleshma* is found in the body in different locations with difference in function and composition. In the *Sandhi* (joints), it is of *Shleshmak* type which lubricates *Sandhis* is called *Shleshmaka Kapha*. Being situated at a specialised location and secreted by the specialised tissue, it contains a specified lubricating material the mucin. Mucin is a combination of hyaluronic acid and glycoprotein.

### Physiology of synovial membrane

Synovial membrane is a specialized connective tissue that lines the inner surface of capsules of synovial joints and tendon sheath. [9] It makes direct contact with the synovial fluid lubricant which it is primarily responsible for maintaining. In contact with the synovial fluid at the tissue surface are many rounded macrophage-like synovial cells (Type A) and fibroblast like (Type B) synovial cells. Type A cell maintains the synovial fluid by removing wear and tear debris and type B cell produces hyaluronic among other extracellular components in the synovial fluid.

The synovial membrane secretes synovial fluid which forms a thin film over the surfaces within the articular capsule. This viscous, clear or pale yellow fluid was named for its similarity in appearance and consistency of uncooked egg-white (albumin). Synovial fluid consists of hyaluronic acid, secreted by fibroblast-like cells in the synovial membrane and interstitial fluid filtered from blood plasma.

The principal role of synovial fluid is to reduce friction between the articular cartilages of synovial joints during movement, lubricate the joint and supplying nutrients, and remove metabolic wastes from chondrocytes within articular cartilage. Synovial fluid also contains phagocytic cells that remove microbes and the debris resulting from the normal wear and tear in joint. When a synovial joint is immovable for a time, the fluid is quite viscous, but as the joint movement increases the fluid becomes less viscous.

### DISCUSSION

Synovial membrane can become irritated and thickened (synovitis) in condition such as osteoarthritis, rheumatoid arthritis etc. Inflamed synovial membrane is accompanied by extra macrophage recruitment, fibroblast proliferation and an influx of inflammatory cells including lymphocytes, monocytes and plasma cells. When this happens, the synovial membrane can interfere with the normal functioning of the joint. Excessively thickened synovial membrane, filled with cells and fibrotic collagenous tissue can physically restrict joint movement. Synovial fluid analysis helps to diagnose the cause of joint inflammation.

In *Ayurvedic* treatises, there is no direct mention of *Shleshmadhara Kala* as a *Nidana* (cause) of a disease; but when the anatomical structure of synovial membrane is studied in detail, it reveals the basis for the location of joint disorders. It is found that synovial membrane is a unique epithelium in which the basement membrane is also lacking. [10] So, there is no structural barrier between the capillary endothelium and the synovial fluid. Therefore the circulating pathologic products are readily passed in the synovial cavity causing joint disorders like osteoarthritis, rheumatoid arthritis etc. In *Ayurvedic* classics, *Ama sanchiti* diseases and affection of joints in the *Amajanya Vyadhi* like *Amavata* etc. [11] is substantiated by these anatomical and physiological features. From above literature it seems that although not mentioned in the *Samhitas*, the involvement of synovial membrane in the disease process plays a principle role.

Thus by reviewing the earlier, it is clear that the *Shleshmaka Kapha* and synovial fluid are the same. Diseases affecting the joints inevitably affect the synovial membrane and fluid from a lesser to greater extent, which alter the basic constitution of the fluid. Also, both the terms synovia and *Shleshmak Kapha* indicate towards the same viscous nature of the substance.

The description of the *Shleshmaka Kapha* states that it is *Pichchila*,<sup>[12]</sup> and modern science also clearly states viscous nature. According to *Ayurveda*, the *Kapha* component is responsible for the viscosity and as per the modern studies hyaluronic acid is responsible for the 80 % of its viscosity. Hyaluronic acid content is found to be varied in different diseased conditions. The viscosity test and the mucin clot test are performed in routine synovial fluid analysis. It is found that viscosity is decreased in the inflammatory and septic conditions. *Ayurveda* also states that the heat component (*ushna guna*) of *Pitta* makes the *Kapha* more liquid (*Pichchila guna vridhhi*)<sup>[13]</sup> thereby reducing its viscosity.

## CONCLUSION

*Sleshmadhara Kala* has great physiological and anatomical importance in diagnosis, prognosis and treatment of various inflammatory joint disorders like rheumatoid arthritis, osteoarthritis etc. From the detailed physiological study of *Sleshmadhara Kala* from our ancient *Ayurvedic* literature of *Bruhatrayee* and *Laghutrayee*, it is concluded that among the seven *Kalas*, *Sleshmadhara Kala* is fourth in order. In contemporary science, anatomically and physiologically it can be correlated with the synovial membrane of body joints.

## REFERENCES

1. Kaviraj Ambika Dutt Shastri, Sushruta Samhita edited with Ayurvedatvasandipika purvardha, Chaukhambha Sanskrit Sansthan, Varanasi, Reprint 2010. Su.Sha.4/5. p.38.
2. Ibidem (1), Sushruta Samhita, Kalpasthana, 4/40-41, p.56.
3. Ibidem (1), Sushruta Samhita, Sharirasthana, Su.Sha.4/5-7.p.38.

4. Anantram Sharma, Sushruta Samhita with Hindi commentary "Susrutavimarsini", Vol. II, Published by Chaukhambha Subharti Prakashan, Varanasi, 2010; Su.Sha.4/5-6, p.48.
5. Kaviraj Atridev Gupt, Ashtanga Sangraha hindi commentary, Vol.1, Krishnadas Academy, Varanasi, 2002, A.S.Sha.4/34, p.300.
6. Dr. Shivaprasad Sharma, Ashtanga Sangraha with Sanskrit commentaries, "Shashilekha" by Indu, Published by Chaukhambha Prakashan, Varanasi, 2006; A.Sn.Sha.4/34, p.302.
7. Ibidem (1), Sharirasthana, Su.Sha.4/14, p.40.
8. Ibidem (5), Sharirasthana, A.S.Sha.4/32, p.298.
9. Gerard J.Tartota, Bryan Derrickson, Principles of Anatomy & Physiology, Vol.1, 13<sup>th</sup> edition, 2011, Jhon Wiley & Sons (Asia) pte.ltd, p.294.
10. Ibidem (9), Principles of Anatomy & Physiology, p.142.
11. Vijayarakshitha, Madhava, Madhavanidana with Madhukosha Sanskrit commentary, Vidyotini hindi commentary by Sudarshanshastri, edited by Yadunandanupadhyaya, Chaukhambha Prakashan Varanasi, 2006, ch.25/3-4, p.509.
12. Arunadatta, Sarvangasundara & Hemadri, Ayurveda Rasayana commentary of Astangahradaya, Vagbhatta, Published by Chaukhambha Subharti Prakashana, Varanasi, 2002, A.H.1/11 (Ayurvedrasayan), p.1.
13. Agniveshakrita Charaka Samhita by Vaidya Satya Narayana Shastri, Viyotinitika by Pt. Kashinath Shastri, Dr. Gorakhnath Chaturvedi, Chaukhambha Bharti Academy, Varanasi, 2009, Ch.Su.1/60-61, p.36-37.

**How to cite this article:** Rajvanshi PK, Pandey N, Kumar A. Physiological Implication of *Shleshmadhara Kala* w.s.r. to Synovial Membrane. Int J Ayurveda & Med Sc 2018; 3(3): 24-26.

**Source of Support:** Nil

**Conflict of Interest:** None