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Review Article

DETAIL STUDY OF *SANDHI SHARIR* WITH SPECIAL REFERENCE TO *JAANU SANDHI*

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ABSTRACT

According to modern text joint is a place where two or more bones are articulates with each other. *Aacharya Sushruta* has quoted that although there are numerous *Sandhi* in our body which cannot be counted so only *Asthi Sandhi* should be considered while enumerating *Sandhi.* Total two hundred and ten *Sandhi* are present in human body. Every bone is unite by joints and covered by muscles and gets blood supply by different *Sira* and *Dhamani*. These bones unite to form *Asthi Sandhi*. In Ayurveda the main *Sthana* of *Kapha Dosha* is all joints in human body. *Janu Sandhi* (knee) is the largest and most complex synovial joint of the body and is of great importance because it plays great role in movements like walking and stability, including maintenance of the erect posture and the transmission of the body weight. *Sandhi* can be taken as union of two or more bone in *Ayurvedic Samhitas* the description of anatomy of *Sandhi* in detail is not found. It is observed that the incidence of joints disorders is increasing day by day. It is burning problem for families and society. A thorough knowledge of the structures and functions of the joint is required to diagnose and treat the disease of joints.

INTRODUCTION

Ayurveda is the most ancient science of medicine in the world. It is considered as the intimate part of *Athraveda.* In ancient text of Ayurveda like *Sushruta Samhita*, *Charaka Samhita* and *Ashtang Sangraha* the knowledge of *Sharir Sthan* is important for the treatment of human being. The detail study of human body (*Sharir)* is described in *Sushruta Samhita*. *Sandhi* means- union. *Sandhi* is the junction of bones and is seat of *Shelshak kapha* which help to keep the body parts together. It also known as *Sayoga*. Inside the bones the mesenchyma is present and it takes part in formation of structure and shape. In our Ayurvedic classics different *Acharyas* have mentioned different numbers of *Sandhi*. *Acharya Sushruta* has classified *Sandhi* on the basis of function (movements) into *Cheshtavanta* and *Sthira sandhi*. *Jaanu Sandhi* is the type of *Cheshtavant Sandhi.*

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Two or more *Asthi* are not enough to form a *Sandhi*. Other structures are required to connect the *Asthi* to one another and help to maintain, stabilize, bear weight and facilitate the *Gati* in them. The knowledge of *Sandhi Sharir* is very essential to understand their structure as well as function. The *Sandhi* is taking active role in locomotion as well as function of the body such as flexion extension and adduction.

Sandhiyo Ki Vividhata (Types of *Sandhi*)

Combination of one type of things is called *Sandhi* inside the body. Example-combination of *Asthi-Asthisandhi*, combination of *Sira-Sirasandhi*, combination of *Peshi-Peshisandhi* in Ayurveda only *Asthi Sandhi* is described in details.

Number of *Sandhi*

According to *Sadaanga*.

- Four limbs- 17x4=68 (Below mentioned are the 17 joints in each limb)
- Middle of body =59
- *Shira* and *Griva* =83

Total-210

1. **Joints of Limbs**
- *Anguli* (in finger and toes) 3x4=12
- *Angushta* (thumb, big toe) -02
- *Janu sandhi* (knee joint)-01
- *Gulpha* (ankle joint)-01
- *Vankshana* (hip joint)-01

Total-17x4=68

2. ***Koshtanga sandhi* (joints of trunk)**
- *Katikapala / shroni* (hip, pelvis)-03
- *Prushtavansha* (spine)-24
- *Parshaw* (side of trunk)-24
- *Uras* (chest)-08

Total - 59

3. ***Urdhwa jatru sandhi* (joints located in the head and neck)**
- *Greeva* (Neck)-08
- *Kantha* (Throat)-03
- *Hridya/Kloma nadi* (Heart/Trachea)-18
- *Dantamula* (Roots of teeth)-32
- *Kakalaka*-01
- *Nasa* (Nose)-01
- *Vartma mandal* (orbit, eye brow)-02
- *Ganda* (Maxillae)-02
- *Karna* (ear) *Shankha* (temples)-04
- *Hnu sandhi* (Mandibular joint), *Bhru* (eye brow) *Shanka upari* (above temples)-06
- *Shiraha kapala* (cranial sutures)-05
- *Murdha* (Head)-01

Total-83

Charaka has mentioned 200 *Sandhi* whereas *Vagbhata* has mentioned 200 *Sandhi.* According to *Sushrut* no. of *Sandhi* 210.

Classification of *Sandhi*

Based on range of movements [1]

1. ***Cheshtavanta* or *Chestha Yukta Sandhi* (joints or diarthroses):** These are the joints which permit free movements. These joints are flexible and able to move in multi directions. They are found in *Shakha* (limbs) *Hanu* (jaw) and *Kati* (pelvis).

   Subtypes of *Cheshtavanta Sandhi:*

   a) *Bahu-cheshtayukta Sandhi*- These joints allow wide range of movements and found in limbs (elbow, knee shoulder joint) and lower jaw (tempo- mandibular joint).

   b) *Alpa cheshtayukta sandhi*- These comes under movable joints too but allows only a small range of movements (in comparison to *Bahu cheshtayukta sandhi*) like *Prasthvansha* (vertebral column).

2. ***Sthira Sandhi* or *Acheshta Sandhi* (Immobile joints):** These joints are stable and do not allow movements. All the other joints apart from those explained in *Cheshtavanta Sandhi* are considered as *Sthira Sandhi.*

Classification of *Sandhi* – According to structure of joints

On the basis of structure and shape of joint, *Sandhi* are of 8 types [2]

1. ***Kora Sandhi* (Hinge joint or gingimus joint):** These posses the shape of hinge and are freely mobile in one direction while partially mobile in the opposite direction. Examples of such *Sandhi* are seen in the joints of *Anguli Sandhi* (joints of the fingers, inter-phalanges joints) *Manibandha Sandhi* (wrist joint) *Gulpha Sandhi* (ankle joint) *Janu Sandhi* (knee joint)and *Kurpura Sandhi* (elbow joint). These *Sandhi* are compared to hinge joint in modern science [3].
2. ***Ulukhala Sandhi* (Ball and socket joints):** These types of *Sandhi* look like stone grinder used in the kitchen in older days that why it is named so. The *Ulukhula* variety of joints is found at *Kaksha, Vankshana* and *Dashana* [4].
3. ***Samudaga Sandhi* (saddle joint):** These joints are of box shaped or plate shaped (bowl). Example of *Samudaga Sandhi* are the joints found in *Amsapeetha* (glenoid cavity of scapula) *Guda* (coccygeal) and *Nitamba* (iliac) regions. These joints can be correlated to cavity *Kantha* joints [5].
4. ***Pratra Sandhi* (Gliding or plain joint):** These are just plain type of joint wherein one surface of bone articulates with the other surface of another bone example of *Pratra Sandhi* can be found in the joints of *Greeva vamsha* (cervical vertebrae) and *Prustha vamsha* (dorsal or thoracic vertebrae) i.e., articulation in 2 vertebrae or inter-vertebral joints. These joints are correlated to plain joints [6].
5. ***Tunna Sevani Sandhi* (sutures):** These joints are in the forms of stitches or sutures between two bones i.e. one feels as if two bones have been stitched with each other. Examples of *Tunna Sewani Sandhi* can be found in the joints of *Shiraha kapala* (sutures of the skull) and *Kati Kapala* (sutures joints of pelvic bones). These joints can be compared to sutural joints [7].
6. ***Vayasa Tunda Sandhi* (Condylar joint):** Shape of these joint resembles with the shape of the beak of a crow example of *Vayasa Tunda Sandhi* is found in the joints of *Hanu Sandhi* (Tempo-mandibular joint). These joints can be correlated to crow beak joints [8].
7. ***Mandal Sandhi* (Annular joints):** These joints are fixed in nature and cartilaginous joints found in some parts of the body. Example of *Mndala sandhi* is found in (throat) *Hrudya* (heart) *Netra* (eye) and *Klomanadi* (trachea) [9].
8. ***Shankhavarta Sandhi:*** These joints are in form and shape of spiral windings of a conch. Example of *Shankavarta Sandhi* can be seen in the joints of *Srota* (ear) and *Sringataka* regions. These joints

can be correlated with the spiral and cartilaginous or membranous and fixed joints. Synchondroses are temporary joints which are only present in children, up until the end of puberty. For example epiphyseal plates present in long bones. Symphesis joints are everlasting cartilaginous joints, for example pubic symphysis [10].

Arthrology

Arthrology is the branch of science which deals with the study of anatomy, function, dysfunction and treatment of joints and articulations. The prefix "arthro-" means joints, which derived from the Greek word arthron. Joints are classified on the basis of anatomical characteristics and their type of movement. The structural classification of joints depends on two criteria:

- Space present between the articulating bones called a synovial cavity.
- The type of connective tissue which binds the bones together structurally.

Joints are classified as following types -

a. **Fibrous joint:** There is no synovial cavity and the bones are held together by fibrous connective tissue that is rich in collagen fibres.
b. **Cartilaginous joint:** There is no synovial cavity and the bones are held together by cartilages.
c. **Synovial joints:** The bones forming the joints have a synovial cavity and are united by the dense irregular connective tissue of an articular capsule and often by accessory ligaments.

The functional classification of joints is based on the degree of movements they permit. Functionally joints are classified as:

- **Synarthrosis:** An immovable joint. The plural is synarthroses.
- **Amphiarthrosis:** A slightly movable joint. The plural is amphiarthroses.
- **Diarthrosis:** A freely movable joint. The pleural is Diarthroses. They have different variety of shapes and permit several types of movements.

Characteristic features of Joint varieties are as follows:

1. **Complex joint**

   Complex joint is one in which the cavity is divided completely or incompletely into two parts by an Intraarticular disc of fibro cartilage. In knee joint the menisci divide the joint cavity incompletely.

2. **Synovial joint**

   a) Contiguous bony surfaces are covered with articular cartilage, hyaline in nature and not directly connected with each other. b) Joint presents a joint cavity which is reduced to a potential space in normal healthy condition. c) It is surrounded by an articular capsule which consists of outer fibrous capsule and inner synovial membrane. d) Synovial membrane lines whole of interior of joint except the cartilage covered ends of articulating bones. Thus forms a cavity filled with Synovial fluid which acts as a lubricant and provides nourishment to articular cartilage. e) Movements in this joint are always possible from simple gliding to wide range.

3. **Compound joint -** When in a joint there is more than pair of articular surfaces is termed a compound joint. In knee joint there are articular surfaces of femur, tibia and patella.
4. **Condyloid joint:** In these joints articular surfaces are present on condyles. These joints permit movements mainly in one axis i.e. Transverse axis for flexion & extension but also partly in other axis for rotation and that occurs around a vertical axis.
5. **Saddle joint:** In these joints articular surfaces of the opposing bones are concave-convex reciprocally and the movements permitted are in two axes-flexion, extension, abduction and adduction. Besides these movements there is some additional movement of rotation (conjunct rotation) around a third axis.
6. **Hinge joint:** Movements are like those of a door on a hinge forward and backward movement is permitted but side to side movement or rotation is not possible. Knee joint is a modified hinge joint because typical hinge joint is always uniaxial but the Knee joint permits movements of flexion, extension in addition there is rotational, abduction and adduction movements in semi flexed position.

Janu Sandhi Sharira

Janu means the *Knee*. *Jan* means to be produced (walking, motion). The word *Sandhi* is made up of *Sam upsharg Dha dhatu* and *Ki pratya* which means *Sandhanamiti* that is Holding together, joining, and binding.

Sandhi Lakshana

Sandhis are the point of junction of bones and are *Sthan* of *Kapha*; which help to keep the body parts together.

***Sankhya* (Number)**

Janu Sandhi are 2 in number present in lower extremities [11].

***Prakara* (Type)**

Janu Sandhi is a example of *Kora Sandhi*. *Kora* joints are present in fingers, wrists, ankles, knees and elbows. *Janu Sandhi* is also a type of *Chestavanta Sandhi*. *Chestavanta* or moving joints are present in extremities, jaws and waist region [12].

***Pramana* (Dimension)**

According to *Acharya Charaka* length of *Janu* is 4 *Angula* and its total circumference is 16 *Angulas* [13].

Sandhi Rachana

Two or more *Asthi* are not enough to form a *Sandhi*. It also needs other structures which connect

the *Asthi* to one another, maintain, stabilize, bear weight and facilitate the *Gati* in them. There are fourteen *Sanghata* (assemblage of bones) of these three are situated in ankle, knee and inguinal region in the similar way they are present in the other leg and both arms[14]. Structures that form a *Sandhi* are mentioned below -

- *Asthi*
- *Snayu*
- *Sleshma Dhara Kala*
- *Sleshma*
- *Peshi*
- *Sira*
- *Dhamani*

1) *Asthi*

Asthi is the primary structures of any *Sandhi Asthi* taking part in formation of *Janu Sandhi* are:

1. *Janghasthi*
2. *Janvasthi*
3. *Urvasthi*

Acharya Charaka has seperately explained *Janu Asthi* and *Janu Kapalika Asthi*. According to this view four bones formed the *Janu asthi* including *Janu Kapalika*. The supreme function of *Asthi* is *Dharana* of *Sharira*.

2) *Snayu*

Snayu is a structure that binds *Asthi, Mamsa* and *Meda*. Like a boat loaded with planks becomes capable of carrying load of passengers in river after it is tied properly with bundle of ropes. All joints in the body are tied with many ligaments by which persons are capable of bearing load[15]. Among different types of *Snayu*, the *Pratanavati* (branched) *Snayu* is present in the *Sandhi*. *Snayu* present in knee are ten in number [16].

3) *Slesma Dhara Kala*

Fourth *Kala* is *Slesmadhar Kala* which is situated in all joints of living beings. As wheel moves freely on well after lubricating the axis, joints also function properly if helped by *Kapha* [17,18].

4) *Sleshma*

The *Sleshma* that resides in *Sandhi* is named as *Sleshaka Kapha*. It helps in free movements of the *Sandhi* and lubricates it as well. Above mentioned structures are directly involved in the formation of *Sandhi*. The structures which help in movements and supporting and supplying nutrition to knee joint. Unification of joints unction healing saturation and supporting these functions are performed by *Kapha* and which supports the body with the function of water.

5) Pesi

The *Peshi* covers the different structures of the body such as *Sira, Snayu, Asthi, Parva* and *Sandhi* and provides strength to these structures including the *Sandhi.* In the body blood vessel, ligaments, bones, small and big joints all are covered with muscle that is why they are strong. Five *Peshi* (muscles) are present in knee.

6) *Sira*

Kaphavaha Sira carrying *Kapha* in normal state produces the unctuousness, firmness in joints, and increases its strength. *Rakta Vaha Sira* carrying normal blood does *Dhatu Purana* bring complexion and helps in positive sensation of touch. Likewise *Asthivaha sira* helps in *Asthi Dhatu Poshana* also.

7*) Dhamani*

Adhogata Dhamanis carrying *Vata, Pitta, Kapha, Rakta* and *Rasa* sustains and maintains parts below umbilicus *Pakwashaya, Kati*, urine, faeces, anus, urinary bladder, penis and legs (knee joint).

DISCUSSION

Total no. of *Sandhi* in Ayurveda according to *Shusruta* 210, *Charaka* 200 and *Vagbhata* mentioned 200 *Sandhi*. Total number of joints present in the human body depends on age and definition. After puberty its changes occurs in joints. Classifications of *Sandhi* depend on based on range of movements and its function.

Anatomical features of knee joint described in Ayurveda can be correlated with the contemporary sciences to a certain extent as follows:

- *Janu Sandhi* is a type of *Kora Sandhi. Kora* means union with less movement. *Kora* type of joints are present in inter phalangeal joints, wrist joint, ankle joint, knee joint and elbow joint. Hinge joint, ellipsoid joint, saddle joint and condyloid joints can be correlated with *Kora Sandhi.* Here movements will be lesser as compared to ball and socket variety which is multi axial.
- *Chestavanta Sandhi* is present in extremities. Knee joint is considered as a movable joint according to modern science.
- Acharya *Charaka* has mentioned *Janu Kapalika Asthi* and *Janu Asthi* are separately present in knee region. *Kapala* means flat bones or that which resembles half of a water jar. *Janu Kapalika Asthi* can be correlated to patella as *Sushruta* has explained that *Kapala* types of bones are present in *Janu*.
- Ten *Snayu* are present in *Janu Sandhi*. According to modern science including small ligaments 12 Ligaments are explained which is near to *Sushruta* view.
- Five muscles are present in knee region. According to modern science mainly 5 muscles gastrocnemius, sartorius, semitendinosus, semi-membranosus, plantaris muscles are related which is near to *Sushruta's* view. Other muscles like quadriceps femoris, biceps femoris, gracilis,

popliteus their tendons are related which may be considered *Kandara*.

- *Sleshma Dhara Kala* can be compared to synovial membrane which is situated in joints which secretes the synovial fluid and provides strength to the joint.
- *Sleshma (Sleshaka Kapha*) can be correlated to synovial fluid. As wheel moves on well by lubricating the axis, joints also function properly if supported with *Kapha.* Synovial fluid acts as a lubricant which increases joint efficiency and reduces joint erosion of articular surfaces. It is a nutritive source for the articular cartilage and menisci.
- *Kaphavaha sira, Rakta vaha sira, Vata vaha sira* & *Adhogata Dhaman* supplying the knee region can be correlated to the arterial blood supply, venous drainage and nerve supply of knee joint.

CONCLUSION

In Ayurveda detail of *Sandhi Sharir* and joints are close to each other on the basis of function and structure of joints. *Janu Sandhi* is an example of *Kora Sandhi. Sleshma dhara Kala* can be correlated to synovial membrane of knee joint. *Sleshma (Sleshaka Kapha*) can be correlated to synovial fluid. *Adhogata Dhamanis, Kaphavaha sira, Rakta vaha sira* and *Vata vaha sira* supplying the knee region can be correlated to the arterial blood supply, venous drainage and nerve supply of knee joint. Literal and fundamental work has aim to correlate the age old knowledge into more clinician friendly as per terms of this new era but to retain its principles and their basics. To understand the deformity in joints in different diseases detail knowledge about anatomical structure of joint is necessary. In this article we have collected various anatomical concepts related to *Sandhi Sharir* specially *Janu Sandhi*.

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