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# ANATOMICAL CONSIDERATION OF JANU SANDHI AND JANU SANDHIGATA VATA

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## ABSTRACT
Ayurveda is one of the ancient sciences not only pertaining to the medicine but beyond that. Acharya Sushruta in Sharir Sthana explained about the Sandhi and their importance. Janu Sandhi is one of the important Sandhi amongst them.[1] In Ayurveda, Sandhi is a technical word indicating that it is a place where two or more bones meet together and the joint may be fixed type or with less or more movement. The Janu Sandhi (knee joint) is a condylar synovial joint. It is a modified hinge joint that connects the rounded condyles (bony ends) of the femur (thigh bone), tibia (shin bone) and is bounded in front by the patella (knee cap). Various ligaments, muscles and tendons help to confine joint motion within safe limits, while the menisci and cartilage, cushion the joint against considerable forces that bear on the knee. Due to aggravation of Vata dosha in Sandhi result a diseased condition known as "Janu Sandhigata Vata". Osteoarthritis is defined as a degenerative non inflammatory joint disease characterized by destruction of articular cartilage and formation of new bone at the joint surfaces and margins.[2]

**KEYWORDS:** Sandhi, Janusandhi, Janu Sandhigata Vata, Knee joint, knee Osteoarthritis.

## INTRODUCTION
Ayurveda is a science of life which can be taken as a vast sea of knowledge which till date has not been fully explode or known. Sandhi is defined as "Asthi Sanyog Sthanam"[3] that means Sandhi is formed by junction of two or more Asthi (bones). Vyana Vayu[4] present in all Sandhi responsible for various movements of joint like Prasarana (extension) and Akunchana (flexion). Shleshak kapha[5] situated in internal structure of a Sandhi meant for lubrication to minimize friction during movements, give nutrition, protection and to stabilize the Joint. Janu Sandhi can be compared with Knee joint. The term "Janu" is described as one amongst two hundred ten (210) Sandhi[6] as well as among hundred seven (107) Marma.[7]

## MATERIAL AND METHOD
It is a literary review to explore the Anatomy of Janu Sandhi and Janu Sandhigata Vata with the help of literature collected from classical and contemporary Ayurvedic texts and published research articles. Then after comparative points were analysed and interpreted.

## LITERARY REVIEW
**SANDHI:** Sushruta Samhita has explained that where two or more bones articulate with each other in the body it is called the 'Sandhi'. Acharya Sushruta has described various types of Sandhi viz. Peshi Sandhi, Snayu Sandhi and Sira Sandhi. In this context, we are dealing with Asthi Sandhi only. Acharya Sushruta has classified the movable bony joints into eight types[8], they are: Kora, Ulukhal, Samudga, Pratar, Tunnasevani, Vayastund, Mandal, Shankhavarta. Structures that constitute a Sandhi are Asthi, Snayu, Sleshma dhara kala, Sleshma, Peshi, Sira, Dhamani.

**JANU SANDHI**: Janu means kneeling on the ground.[9] Jan means to be produced (walking, motion). Sandhi word is derived from the root Sam + Dha + Ki which means Sandhanamiti - holding together, joining, and binding.[10]

**PRAKARA (TYPE):** Janu Sandhi is a type of Kora Sandhi. Kora Sandhi resembles a Bud of flower (Kalika) where union with less movement will be present.[11] Janu Sandhi is a type of Chestavanta Sandhi. Chestavanta or moving joints are present in extremities, jaws and waist region.[12]

## PRAMANA (DIMENSION)
Circumference of the middle portion of knee is 14 Angulas[13], according to Acharya Charaka Length of Janu is 4 Angula and its circumference is 16 Angulas.[14]

Asthis taking part in formation of Janu Sandhi are
1. JANGHASTI (TIBIA) 2. JANVASTI (PATELLA) 3. URVASTHI (FEMUR)
Acharya Charaka has explained Janu Asthi and Janu Kapalika Asthi' separately.[15] According to this view four bones can be considered including Janu Kapalika. The main function of Asthi is Dharana of Sharira.[16]

In Sandhigata Vata the Prakupita Vata results in Asthi Ksaya. Vata is only one, but based on Sthana and Karma it attains five different names viz. Prana, Udana, Samana, Vyana, Apana. Out of these five there is no direct reference regarding the Vata residing in the Sandhi. The Vyana Vata is said to be krsna deha charah i.e., it moves all over the body, but based on its function of Gati or movement we may consider Sandhi as one of its sites.[17]

**2) SNAYU:** Snayu is a structure that binds Asthi, Mamsa and Meda.[18] As a boat consisting of 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. Out of the different types of Snayu, the Pratanavati [branched] Snayu is present in the Sandhi.

**3) SLESHMA DHARA KALA**
Fourth Kala is Slesmadhara (Kapha supporting) which is situated in all joints of living beings. As wheel moves on well by lubricating the axis, joints also function properly if supported by Kapha.[19]

**4) SLESHMA**
The Sleshma that resides in Sandhi is named as Sleshaka Kapha. It facilitates free movements of the Sandhi and lubricates it as well.[20] Above mentioned structures are directly involved in the formation of Sandhi. The structures which help in movements & supporting and supplying nutrition to Knee joint are.

**5) PESHI**
The Peshi covers the different structures of the Body such as Sira, Snayu, Asthi parva and Sandhi and imparts strength to these structures including the Sandhi. Five Peshi (muscles) are present in Knee.[21]

**6) SIRA**
Kaphavaha Siras carrying normal Kapha produces the unctuousness, firmness in joints, and increases its strength. Rakta Vaha Siras carrying normal blood does Dhatu Purana, bring complexion and helps in positive sensation of touch.[22] Asthi is a dhatu hence this function is applicable for Asthi Dhatu Poshana also.

**7) DHAMANI:** Adhogata Dhamanis carrying Vata, Pitta, Kapha, Rakta and Rasa sustain and maintains parts below umbilicus-Pakwashaya, Kati, urine, faeces, anus, urinary bladder, pennis & legs (Knee joint).[23]

**SANDHI GATA VATA**
Sandhi gata Vata is one of the Vata Vyadhi, which is described as a separate clinical entity. Sandhigata Vata comes under Sthana Gata Vyadhi. Here in, the Dusta Vayu gets located in the Sandhi Pradesha and results in the Vyadhi, Sandhigata Vata.

**ETYMOLOGY**
The term Sandhigatavata has its origin from the combination of three words viz. 'Sandhi', 'Gata' and 'Vata'.

**SYNONYMS**
No synonym of Sandhigatavata is there in Ayurvedic classics. However, the possible synonyms of Sandhigatavata found in the contexts or considered by the commentator equal to Sandhigatavata are as follows.
- Sandhigata Anila (Charaka)[24]
- Sandhivata (Bhavaprakash)[25]

**CLASSIFICATION OF SANDHIGATAVATA**
Sandhigatavata has no reference for classification because it falls under Vatavyadhi and is mostly caused by Vata Prakopa, hence it can be divided into two categories based on its Nidana:
1. Nija Sandhigatavata
2. Agantuja Sandhigatavata.

**MODERN REVIEW**
JOINT: Joint is present where two Bones come together whether there is movement between them or not. Synovial joints are of following types: Plane or gliding, hinge joint, pivot joint, condylar joint, ellipsoid joint, saddle joint, ball and socket joint.

**KNEE JOINT ANATOMY**: Knee joint is largest and more complex joint of the Body. Complexity is the result of fusion of 3 joints in one Lateral femorotibial, medial femorotibial and femoro- patellar joints.

**Type** – Condylar synovial joint, Two Condylar joint between Condyles of femur and Tibia and one saddle joint between femur & patella.[26]

**Sub Type** – Modified hinge variety.

**OSTEOARTHRITIS**
**DEFINITION:** It is defined as a degenerative non inflammatory joint disease characterized by destruction of articular cartilage and formation of new bone at the joint surfaces and margins.[27]
Two main varieties of osteoarthritis are recognized.
1) Primary osteoarthritis
2) Secondary osteoarthritis

**SYMPTOMS OF OSTEOARTHRITIS**
**1. Pain**
a) Occurs after a night's rest and gradually disappears after use.

b) As disease progress pain becomes more severe and more constant and disturbs sleep. At this time pain gets more severe as joint is used. Pain at night is an important symptom.
c) As pain increases joint gradually loses movement due to spasm.

**2. Stiffness**

a) Beginning it is noticed only after the joint has been immobile for some time.
b) Later on, stiffness gradually increases and becomes constant.

**3.Deformity**: Genu varus (bow leg) is the deformity observed in Osteoarthritis of Medial Compartment and Genu valgus (knock knee) deformity in Osteoarthritis of lateral compartment.

**4. Swelling of Joint**

**5. Limping**.

**6. Locking**: Terminal movements of knee are restricted. Inability to extend the knee for last few degrees.

**Physical Signs**

**Inspection:** Swelling and deformity of Joint.

**Palpation:** Joint may be mildly tender but it is not warm. Synovial thickening may be felt in superficial joints, so also swelling due to effusion. Osteophytes may be felt. Typical 'crepitus' – a sensation of grating may be felt when joint is moved.
Movements become more & more restricted as disease progress. Muscle weakness & Muscle wasting may be present.[28]

**PATHOLOGY**

**1) Changes in Articular Cartilage and Bone:** Cartilage becomes soft and irregular at pressure points. Minute flecks of cartilage called 'detritus' are shed into joint. Fibrillation of cartilage occurs followed by complete loss of articular cartilage. This puts enormous pressure on under lying bone which causes sclerosis and later eburnation. Cysts may develop in subchondral area due to micro fractures that degenerate. New bone formation takes place in non-pressure areas at periphery of Joints results in osteophyte formation.

**2) Changes in Synovial Membrane:** Synovial membrane shows changes when lipping of articular cartilage starts. Membrane hyper trophies and thickens it becomes shaggy (rough haired) Villi become enlarged. Detritus deposits on Synovial membrane gradually penetrates into the sub Synovial layer & induces fibrosis.Many tags appear particularly at places of attachment with capsule and may detach giving rise to loose bodies in joint called ' Joint mice'.

**3. Changes in Capsule and Ligaments:** Fibrous tissue of capsule becomes dense. Transforms into fibro cartilage at point of attachment to articular cartilage. Sometimes nodules appear at these places.
These changes restrict mobility of Joint. Ligaments show gradual process of dissolution causing disorganization of joint.

**4) Changes in Neighbouring tendons and Peri articular Tissues:** Neighbouring tendons show attrition (abrasion). Wasting of surrounding muscles is often noticed. Overlying tissue becomes oedematous.
Skin looks pale, tight and shiny. Knee joint Osteoarthritis may involve predominantly medial femoro tibial, lateral femorotibial or patellofemoral compartment. It is usually unilateral but becomes bilateral over a period of time.

**RADIOLOGICAL ANATOMY VARIATIONS OF KNEE OA AND THE PATHOLOGY BEYOND IT IS AS FOLLOWS**

**1] Joint space narrowing more common in Medial femorotibial compartment:** The width of a joint space seen radiologically is due to radiolucent cartilage, joint space narrowing is therefore the result of cartilage destruction. This change characteristically occurs in areas of excessive weight bearing.[29] A normal kn**ee** joint is never straight. It has an average 7 $^{o}$ valgus (Men 3 to 5 $^{o,}$ Women 5 to 7 $^{o)}$ So the weight bearing axis passes through the medial femero tibial compartment more prone to joint space narrowing.[30]

**2] Sub chondral Sclerosis**: This occurs due to increase cellularity and bone deposition.[31] Remodelling and hypertrophy of Bone occurs. Appositional bone growth occurs in subchondral region leading to Bony Sclerosis.[32]
Localized increase in density is presumably due to a) stress induced new bone formation & b) Trabecular collapse.[33]

**3] Sub chondral cysts:** Happens due to Synovial fluid intrusion into the bone.[34]

**4] Osteophytes**: Joint space narrowing due to cartilage destruction is followed by loss of underlying bone in stressed areas and formation of new bone and cartilage in non-stressed areas and at joint margins so that joint alignment alters. New bones formed in joint margins are called Peripheral Osteophytes or with in the joint are called Central Osteophytes. Osteophytic new bone is formed in response to new lines of force and prevents further malalignment.[35]

**6] Loose Bodies:** Arises from 4 Sources
1) Osteo Chondritis dissecans in which a fragment of bone is separated from the femoral condyle and less commonly from other parts of articular surfaces.
2) Osteoarthritis of knee with detachment or fracture of marginal Osteophytes from the patella, femoral condyles or Tibial condyles.
3) Chondrification of the Synovial membrane with formation of large number of loose bodies. (Osteo chondromatosis)
4) Injuries producing Osteo chondral fracture.

**OBSERVATIONS:** Differences between the two semi lunar cartilages are as follows[36]

| MEDIAL MENISCUS | LATERAL MENISCUS |
|---|---|
| Semi-circular in shape | Nearly circular in shape |
| Anterior horn narrower than posterior. | Both horns are of equal width. |
| Peripheral margin is adherent to capsule & deep part of tibial collateral ligament | Tendon of Popliteus and the capsule separate this meniscus from the fibular collateral ligament. |
| No groove on Postero lateral aspect. | It is grooved Postero laterally by Tendon of Popliteus. |
| Menisco femoral ligaments are not present. | Posterior end of the meniscus is attached to femur through two Menisco femoral ligaments. |
| Insertion of any muscle is not present. | More Medial part of Tendon of Popliteus is inserted into the lateral meniscus. |
| Two ends are immovable but medial convexity moves during rotation, so it is not immune to injury during rotation. | It is immune to injury because its mobility during rotational movement is controlled by two Menisco femoral ligaments and insertion of Popliteus muscle |
| Concave margin laterally | Convex margin laterally |
| Posterior fibers of anterior end are continuous with Transverse ligament | Transverse ligament is attached to anterior convex margin. |
| Anterior end is attached to anterior intercondylar area of tibia in front of attachment of anterior cruciate ligament. | Anterior end is attached in front of the intercondylar eminence of tibia behind the anterior cruciate ligament. |
| Posterior end is attached to intercondylar area of tibia between the attachment of the lateral meniscus and posterior cruciate ligament. | Posterior end is attached to posterior eminence of tibia in front of medial meniscus. |
| Medial border is thick & convex | Medial border is thin and concave |

**Symptoms of Osteoarthritis and cause beyond it are as follows[37]**

| Source | Mechanism |
|---|---|
| 1) Synovium | Inflammation |
| 2) Sub chondral bone | Micro fractures, Medullar hypertension caused by distortion of Blood flow by thickened Sub chondral bone. |
| 3) Osteophytes | Stretching of periosteal nerve endings. |
| 4) Ligaments | Stretch |
| 5) Capsule | Inflammation and Distension |
| 6) Muscle | Spasm |

**Symptoms seen in Sandhigata Vata according to different Acharyas are as follows.**

| Roopa | Charaka | Sushruta | A.H. | M.N. | Y.R. | B.P. |
|---|---|---|---|---|---|---|
| **Vatapoornadruti Sparsha** | + | - | + | + | - | - |
| **Sandhi Shotha/ Shopha** | + | + | + | + | - | + |
| **Prasaranaakunchana Sa Vedana** | + | - | + | + | - | - |
| **Hanti Sandhigata** | - | + | - | - | + | + |
| **Sandhi Shoola** | + | + | + | + | + | + |
| **Asthi Shosha** | - | + | - | - | - | - |
| **Asthi Bheda** | - | + | - | - | - | - |
| **Atopa** | - | - | - | - | + | - |
| **Sandhi Stabdhata** | - | + | - | - | + | - |
| **Sandhi Vishlesha** | - | - | - | - | + | - |

## DISCUSSION AND CONCLUSION

The following anatomical features of the Janu Sandhi described in Ayurveda can be correlated with modern science to some extent.

1) Janu Sandhi is a type of Kora Sandhi. Kora is a word that signifies "union with less mobility." Interphalangeal joints, wrist joints, ankle joints, knee joints, and elbow joints all have Kora type Sandhi.

2) Chestavanta Sandhis are present in extremities.

3) Acharya Charaka has explained Janu Kapalika Asthi and Janu Asthi's separately present in knee region. Kapala means flat bones. Janu Asthi and Janu Kapalika asthi's have been mentioned separately as tibial

tuberosity (Janu Asthi) and patella bone (Janu Kapalika asthi) on www.easyayurveda.com

4) Out of the different types of Snayu, the pratanavati [branched] Snayu is present in the Sandhi.

5) As per Sushruta Acharya**,** five muscles are present in Knee region, Modern science relates mainly 5 muscles Gastrocnemius, Sartorius, Semitendinosus, Semimembranosus, and Plantaris muscles, which is similar to Sushruta's viewpoint.

6) Sleshma Dhara Kala can be correlated to Synovial membrane which is situated in joints, secretes the Synovial fluid and supports it.

7) Sleshma (Sleshaka Kapha) can be correlated to Synovial fluid.

According to modern science Restriction of joint movement in Osteoarthritis at the beginning is due to muscle spasm, gradually fibrosis of the capsule and formation of Osteophytes restrict movement. Inability to extend the Knee for last few degrees is due to loose bodies in the joint.

9) Sandhi Shoola is the main symptom seen in sandhigata vata, Shoola (Pain) is due to aggravated Vata when gets lodged in Asthi, Snayu, Majja, Siras & Mamsa.

10) According to modern science similar anatomical entities are the source for pain as follows

Synovium, Sub chondral bone, Osteophytes, Ligaments, Capsule, Muscle.

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