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Sandhi Sharir in Ayurveda and Applied Anatomy of Ankle Joint - A Review

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Abstract: ***In Ayurvedic literature, the concept of Sandhi (joints) has been described with varying enumerations by different Aacharyas. Aacharya Sushruta identifies 210 Sandhis, distributed throughout the body, which are essential for facilitating diverse movements. The term Sandhi is traditionally defined as "union," "to unite," or "the meeting point of two or more structures," with emphasis placed on Asthi Sandhi (bony joints) as the primary category for enumeration [1]. Classical texts classify Sandhi broadly into two types—based on Kriya (function) and Rachana (structure)—and consistently describe them as the meeting place of two or more bones (Asthi Samyoga Sthana). While Atreya, Dhanvantari, and Sushruta highlight the importance of anatomical knowledge for understanding the human body, detailed descriptions of joint anatomy are limited in the Ayurvedic Samhitas. In contemporary times, the incidence of joint disorders has markedly increased, posing significant challenges to individuals and society. This underscores the necessity of comprehensive knowledge regarding the structure and function of joints, which is vital for accurate diagnosis and effective management of joint-related diseases.***
Keyword: Asthi, Ayurveda, Sandhis, Rachana, Asthi Samyoga Sthana

I. INTRODUCTION

The term *Sandhi* originates from the root *Sam + Dha + Ki*, signifying the act of holding together, joining, or binding (*Sandhana-Miti*). In Ayurveda, *Sandhi* is regarded as the seat of *Kapha* and is located at the junction of bones. It represents the intersection or union of two or more structures, serving the essential function of maintaining the integrity of body components. If this broad definition is applied, the body would contain an infinite number of *Sandhis*. To simplify enumeration, only *Asthi Sandhi* (bony joints) are considered, while those formed by *Peshi* (muscles), *Snayu* (ligaments), and *Sira* (vessels) are innumerable and excluded from counting. According to *Sharir Rachana*, *Sandhi* is defined as the union of two or more bones, and Acharya Charaka describes it as *Sanyoga Sthana* in *Asthi*. Importantly, a *Sandhi* cannot be formed by more than two bones. The structures constituting a joint—such as *Asthi*, *Snayu*, *Slesma Dhara Kala*, and *Slesma*—require additional support from *Sira*, *Dhamni*, and *Peshi* to maintain stability, bear weight, and facilitate movement (*Gati*)[1].

Classical Ayurvedic texts like *Charaka Samhita* and *Sushruta Samhita* provide extensive knowledge of *Shareera* (the human body), along with *Nidana* (diagnosis) and *Chikitsa* (treatment). However, detailed anatomical descriptions of *Sandhi* are limited in these works. In the modern era, the prevalence of joint disorders has significantly increased, posing a major challenge to individuals, families, and society. Effective diagnosis and treatment of such conditions demand a comprehensive understanding of joint structure and function. Ayurveda, which aims to promote universal well-being, can only be fully appreciated by those who possess a profound knowledge of *Shareera*—the anatomy and physiology of the human body.

II. MATERIALS AND METHODS

Distinctive books of Ayurveda including Classical literatures like Charaka Samhita, Sushruta Samhita,

A. *Ayurvedic Review* [2]

Gulpha Sandhi (Ankle Joint) – Ayurvedic Review

1) Definition: Gulpha Sandhi is the union (*Sanyoga Sthana*) of the tibia, fibula, and talus bones, forming the ankle joint.
2) Seat of Kapha: Like all *Sandhis*, it is considered the seat of *Kapha dosha*, ensuring lubrication, stability, and smooth movement.
3) Marma Significance: Gulpha is classified as a *Marma* (vital point). Injury here causes severe pain and functional disability.
4) Constituents: Formed by *Asthi* (bones), *Snayu* (ligaments), *Slesma Dhara Kala* (synovial membrane), and *Slesma* (synovial fluid), supported by *Sira*, *Dhamani*, and *Peshi*.

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5) Functions: Provides mobility (dorsiflexion, plantarflexion), balance, and weight-bearing capacity.

6) Disorders: Commonly affected in *Sandhivata* (osteoarthritis), *Amavata* (rheumatoid arthritis-like condition), sprains, and fractures.

7) Vata is responsible for the different ways that Sandhi moves and performs. This suggests that Vayu Mahabhuta is present. [3]

Number of Asthi Sandhis In Various Samhita [4] [5] [6] [7]

- Sushruta Samhita - 210
- Charak Samhita - 200
- Astanga Hridaya - 200
- Astanga Samgraha - 210
- Kasyapa Samhita - 381

According to shadanga

1. In four limbs: 17 x 4 =68
2. In trunk: 59
3. Above head and neck: 83

Total = 210

Since Sushruta Samhita is considered the most authoritative text in Ayurveda for anatomical study, In this framework, the Sandhis (joints) are primarily categorized into two broad types:

- *Kriyanusar* – classification based on their *function or activity*.
- *Rachananusar* – classification based on their *structural arrangement*.

Sushruta's anatomical precision set the standard, and his dual approach— functional and structural— became the foundation for understanding joints in Ayurveda.

Kriyanusar Vargeekaraṇa (Classification Based on Movement)

According to Ayurveda, Sandhis (joints) are classified into two main types:

- *Chal / Cheṣṭayukta Sandhi* (Movable joints – Diarthrosis)
- *Achal / Sthira Sandhi* (Immovable joints – Synarthrosis)

The joints located in the limbs *(Sakha)*, hip region *(Kati)*, and jaw *(Hanu)* are considered movable *(Cheṣṭayukta*), while all other joints are regarded as immovable *(Sthira)* in nature.

Movable joints are further divided based on the range of movement: [8]

- *Bahuchala Sandhi – freely movable joints*, such as those in the limbs, hip, and jaw.
- *Alpachala Sandhi – slightly movable joints*, such as those found in the back (*Pṛṣṭha)* and similar regions.

B. Rachananusar Vargeekaran [9]

According to Acharya Sushruta, joints are classified into eight types based on their structural design. These are*: Kora , Ulukhala , Samudga , Pratara, Tunnasevani, Vayastunda , Mandala, Shankhavarta*

Kora Sandhi (Hinge Joint) [10]

According to Haranchandra's commentary on the Sushruta Samhita, the term *Kora* refers to a special device similar to a hinge (*Kabja*), like those used in doors (*Kapat*). In the human body, Kora Sandhi represents hinge-type joints that allow movement in one plane, much like the opening and closing of a door.

These joints are found in the following regions:

- *Anguli* – finger joints (phalanges)
- *Manibandha* – wrist joint
- *Gulpha* – ankle joint
- *Janu* – knee joint
- *Kurpara* – elbow joint
- *Ulukhala Sandhi* (Ball-and-Socket Joint)

The *Ulukhala Sandhi* is named after the traditional stone grinder (*Ulukhala*) used in old kitchens, as its structure closely resembles that device. These joints allow wide-ranging movement in multiple directions, similar to how the grinder's stone rotates freely.

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This type of joint is found in the following regions:

- *Aksha* – Shoulder joint
- *Vankshana* – Hip joint
- *Dashana* – Teeth

Samudga Sandhi (Saddle Joint)

This type of joint resembles a box in structure.

- Locations: Acromioclavicular joint (*Ansapeeth*), Sacrum (*Guda*), Pubis (*Bhaga*), Ilium (*Nitamba*).

Pratara Sandhi (Gliding/Plane Joint)

As described by *Dalhana*, the articulating surfaces are flat, cushioned, and allow slight gliding movements with friction.

- Locations (per Sushruta): Cervical vertebrae (*Greeva*), Vertebrae (*Kasherukha*), Thoracic vertebrae (*Prushthavansha*).

Tunnasevani Sandhi (Sutures)

According to *Gananath Sen*, these joints resemble dentate (tooth-like) edges that interlock firmly, embedding into one another.

- Locations: Skull (*Sirakapala*), Hipbone-sacrum and coccyx (*Katikapala*).

. *Vayastunda Sandhi* (Condylar Joint)

Gananath Sen and *Sushruta* both describe this as the joint of the jaw (*Hanu*) within the temporal bone (*Shankhasthi*), forming the Temporo-Mandibular Joint (TMJ).

- Location: Jaw joint.

5. *Mandala Sandhi* (Round/Oval Joint)

As per *Dalhana*, these joints are oval or circular in shape.

- Locations: Throat (*Kantha*), Heart (*Hrudaya*), Eye (*Netra*), Trachea (*Clomnadi*).

6. *Shankhavarta Sandhi* (Spiral Joint)

Haranachandra likens these joints to the spiral circles of a snail (*Shankha*).

- Locations (per Sushruta): Ear (*Shrotra*), Cavernous sinus (*Shringataka*).

Sandhi Sankhya (Number of Joints in the Body)

- *Acharya Charaka*: 200 joints
- *Acharya Sushruta*: 210 joints
    - 68 in the four extremities
    - 59 in the trunk (*Koshtha*)
    - 83 in the neck and regions above

III. MODERN REVIEW

A. *Review of Joints (Articulations)*

Joints, also called articulations, are the points where two or more bones or rigid parts of the skeleton meet. They occur in different forms and serve varied functions, primarily enabling movement of different ranges and types.

Definition

- A joint is the junction between two or more bones or cartilages.
- An articulation refers to the contact point between bones, between cartilage and bone, or even between teeth and bone.

B. *Classification of Joints*

Joints can be classified in two ways:

- Functionally – based on the degree of movement they allow.
- Structurally – based on their anatomical features.

C. *Functional Classification* [11]

Synarthrosis: Immovable joints.

- Amphiarthrosis: Slightly movable joints.
- Diarthrosis: Freely movable joints.

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D. Structural Classification [12]

a) Fibrous Joints [13]

- No synovial cavity is present.
- Bones are connected by dense irregular connective tissue.
- These joints allow little to no movement.
- Types: sutures, syndesmoses, and interosseous membranes.

b) Cartilaginous Joints

- Like fibrous joints, they lack a synovial cavity and permit minimal movement.
- Bones are joined by hyaline cartilage or fibrocartilage.
- Types: primary cartilaginous joints and secondary cartilaginous joints.

c) Synovial Joints [14]

- Distinguished by the presence of a synovial cavity between articulating bones.
- Functionally, all synovial joints are diarthroses (freely movable).
- Articulating surfaces are covered with articular cartilage (hyaline cartilage), which:
    - Provides a smooth, slippery surface.
    - Reduces friction during movement.
    - Absorbs shock.

E. Synovial Fluid [15]

- Produced by the synovial membrane.
- A viscous, clear to pale-yellow fluid resembling raw egg white.
- Lubricates the joint and nourishes cartilage.

F. Types of Synovial Joints [16]

Although structurally similar, synovial joints differ in the shape of their articulating surfaces, allowing various movements. They are classified into six types [17]:

a) Planar joints

- Surfaces are flat or slightly curved.
- Permit gliding movements (back-and-forth, side-to-side).

b) Hinge joints

- Convex surface of one bone fits into the concave surface of another.
- Allow angular, opening-and-closing motions (like a door hinge).

c) Pivot joints

- A rounded or pointed bone surface articulates with a ring formed partly by another bone and partly by a ligament.
- Enable rotational movement.

d) Condyloid joints (Ellipsoidal joints) [18]

- An oval-shaped projection of one bone fits into an oval depression of another.
- Allow movement in two planes (flexion/extension and abduction/adduction).

e) Saddle Joints –

In this type of joint, one bone has an articular surface shaped like a saddle, while the corresponding surface of the other bone fits into it, much like a rider sitting on a saddle.

G. Applied aspect of Ankle joint [19]

1) Dislocation of the ankle joint.
2) Sprains of the ankle joint.
3) Foot drop - Injury to common peroneal nerve.
4) Injury to the tibia and fibula in the region of the ankle are referred to as Pott's fracture.
5) Injury to medial ligament.
6) Injury to interosseus tibio-fibular ligament.
7) Fracture of malleoli.

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C. BIood Supply [20]

From anterior tibial, posterior tibial, and peroneal arteries.

D. Nerve Supply [21]

From deep peroneal and tibial nerves.

IV. DISCUSSION

Ayurvedic texts describe Sandhi as the point where two or more *Asthis* (bones) come together, highlighting their essential role in maintaining stability and enabling movement of the body. Although the classical *Samhitas* do not provide minute structural or microscopic details, their explanation of joints is systematic and strongly oriented toward function. *Acharya Sushruta's* description of 210 *Sandhis*, distributed across the limbs, trunk, and regions above the neck, reflects a clear and organized anatomical understanding. The differences in the total number of Sandhis mentioned by various Acharyas appear to arise from variations in observation and interpretation rather than any fundamental conceptual difference.

The Ayurvedic classification of Sandhi based on *Kriya* (function) and *Rachana* (structure) shows a close resemblance to modern anatomical classifications. The division into *Chala* (movable) and *Achala* (immovable) *Sandhis* is comparable to the modern concepts of diarthrosis and synarthrosis. Likewise, the structural classification described by *Acharya Sushruta*—such as *Kora, Ulukhala, Pratara, and Tunnasevani Sandhi*—can be directly correlated with hinge, ball-and-socket, plane, and suture joints recognized in contemporary anatomy.

The description of *Gulpha Sandhi* (ankle joint) further supports this parallel understanding. Its components, range of movements, and vulnerability to conditions like *Sandhivata* and traumatic injuries are in agreement with modern anatomical and clinical knowledge. The *Ayurvedic* view of Kapha maintaining lubrication and stability, and *Vata* governing movement, closely aligns with the modern concepts of synovial fluid function and neuromuscular control.

In conclusion, this review emphasizes that *Ayurvedic* and modern perspectives on joints are not contradictory but complementary. *Ayurveda* provides a holistic, functional approach, while modern anatomy offers detailed structural explanations. Together, these perspectives can contribute to a better understanding of joint anatomy and help improve the diagnosis and management of joint-related disorders.

V. CONCLUSION

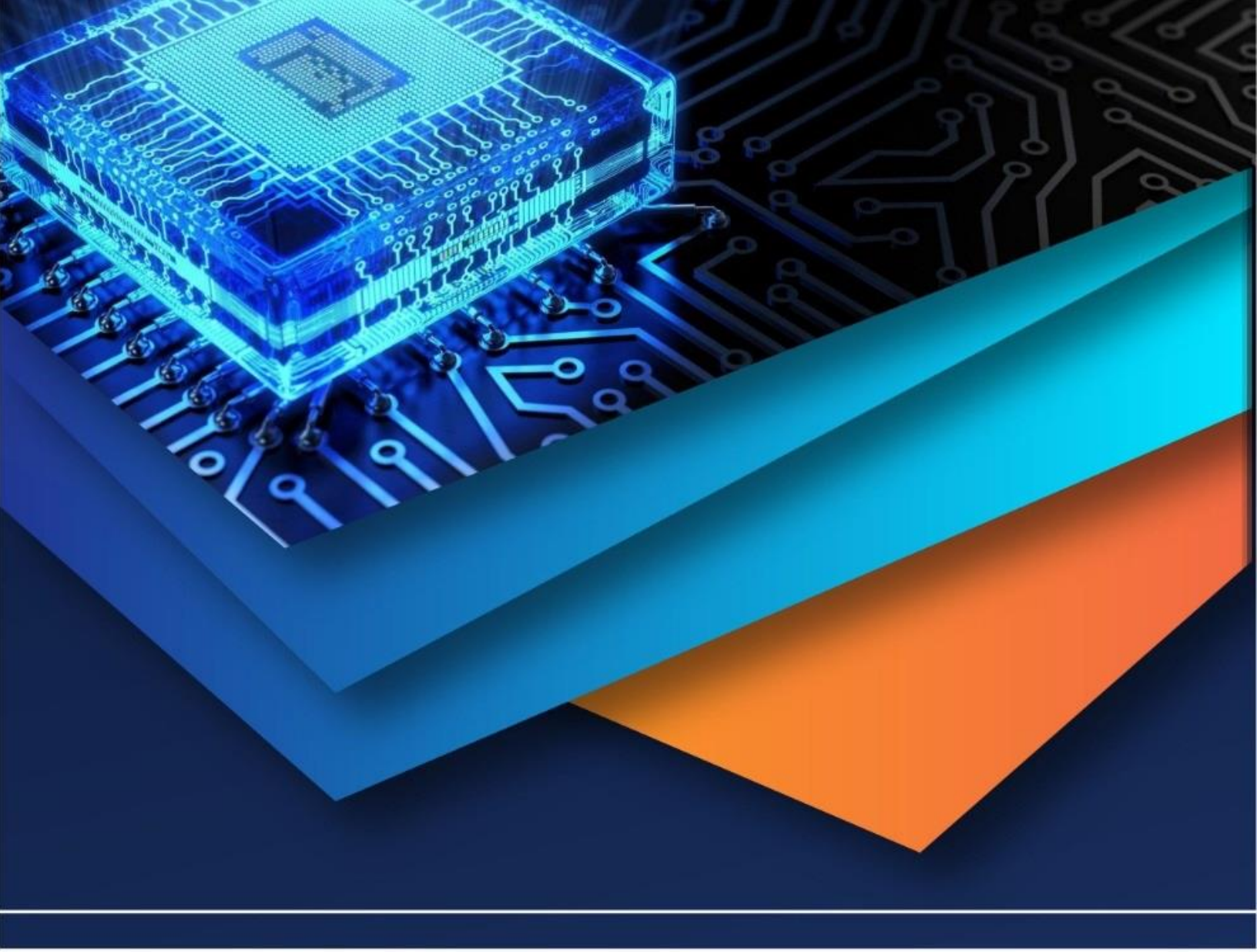
Classical Ayurvedic texts describe Sandhi as the junction where two or more *Asthis* (bones) meet. Both Ayurveda and modern science classify joints on the basis of their structure and function, showing a close parallel between the two systems. *Kora Sandhi* corresponds to the hinge joint, allowing movement in a single plane. *Ulukhala Sandhi* includes joints similar to the ball-and-socket type of synovial joints as well as gomphosis-type fibrous joints. *Samudga Sandhi*, found in regions such as *Ansapeetha, Guda, Bhaga, and Nitamba*, can be compared to the acromioclavicular joint, sacrococcygeal joint, pubic symphysis, and sacroiliac joint respectively. *Pratara Sandhi*, located in the *Greeva* (neck) and *Prushtavansha* (vertebral column), corresponds to the intervertebral joints. Sutures like *Tunnasevani* and *Hanu* in *Vayasatunda* can be equated with the temporomandibular joint (TMJ). *Sankhavartha Sandhi*, which includes *Shrota and Shringataka*, can be correlated with the cochlea of the inner ear and the nasal conchae region.

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