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Applied Anatomical Insights Of Asthi And Sandhi From Sushruta Samhita: A Review With Clinical Correlations

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ABSTRACT

Anatomy forms the foundational basis of medical science, both in modern and traditional systems like Ayurveda. The Sushruta Samhita, a classical text of Ayurveda, is acclaimed for its comprehensive exploration of human anatomy and surgical principles. Among its various contributions, the descriptions of Asthi (bones) and Sandhi (joints) stand out for their clarity and clinical applicability. This review article aims to revisit and critically analyze the concepts of Asthi and Sandhi as delineated in the Sushruta Samhita, comparing them with contemporary anatomical understanding, and highlighting their relevance in Ayurvedic clinical practice.Sushruta classified bones based on structure and function into five types and detailed 360 bones in the human body, including teeth, nails, and hair roots, which differ from modern counts. Sandhis were categorized into movable and immovable types, resembling synovial and fibrous joints in modern science. The text also connects Asthi and Sandhi with Dhatu Poshana (tissue nourishment), Marma (vital points), and various disease processes.This review evaluates the applied aspects of these structures in clinical contexts such as fracture (Bhagna) management, joint disorders (Sandhigata Vata), and Panchakarma therapies like Basti and Abhyanga. The timeless insights of Sushruta offer valuable perspectives for modern orthopedics and integrative approaches. Emphasizing these classical anatomical concepts fosters a better understanding of musculoskeletal health, enhancing diagnostic and therapeutic outcomes in Ayurveda. The review concludes that revisiting these traditional anatomical frameworks can inform and enrich contemporary medical and surgical practices.

Keywords: *Asthi, Sandhi, Sushruta Samhita, Applied Anatomy, Ayurveda, Clinical Correlation*

1. INTRODUCTION

Anatomy (Sharira Rachana) serves as the fundamental pillar of both diagnostic and therapeutic sciences across all medical traditions. In Ayurveda, it plays a crucial role in understanding the structure, function, and pathological changes occurring in the human body. The classical Ayurvedic texts approach human anatomy not merely as a structural discipline but as a dynamic field interlinked with physiology (Sharira Kriya), pathology (Samprapti), and therapeutics (Chikitsa). Among these, the Sushruta Samhita stands out for its elaborate and systematic discussion on anatomy, particularly focusing on Asthi Sharira (osteology) and Sandhi Sharira (arthrology) [1].

Acharya Sushruta, often hailed as the 'Father of Surgery', emphasized practical dissection and surgical training as indispensable tools for mastering anatomy. His detailed classification of bones (Asthi) into five types—Kapala, Ruchaka, Taruna, Valaya, and Irregular—exemplifies his clinical insight into skeletal variability [1,2]. Similarly, Sandhis (joints) were classified based on structural and functional parameters, indicating a profound understanding of biomechanics relevant to surgical interventions and rehabilitation practices [2].

In the context of modern science, applied anatomy refers to the clinical application of anatomical knowledge, particularly in surgery, orthopedics, physical therapy, and diagnostic imaging. Sushruta's exposition of anatomical details, when correlated with modern osteology and arthrology, reveals a significant degree of clinical relevance. For instance, his observations on Bhagna Chikitsa (fracture management) and Sandhi Vikara (joint disorders) closely resemble modern orthopedic protocols [3].

This review aims to explore the anatomical insights of Asthi and Sandhi as delineated in Sushruta Samhita and examine their application in contemporary clinical practice. It further endeavors to synthesize these classical descriptions with modern anatomical science, thereby reaffirming the enduring utility of Ayurvedic anatomical knowledge in the evolving field of integrative medicine [4]-

2. REVIEW OF CLASSICAL AYURVEDIC LITERATURE

1. Asthi Sharira in Ayurveda

In Ayurveda, Asthi is one of the Dhatus (*seven bodily tissues*) responsible for supporting and maintaining the bodily framework.

Definition: Asthi is described as *"Asthi dharanat dhatavah"* – the structural support providing hardness and stability [5].

Number: *Sushruta Samhita* describes 300 bones, including teeth and cartilage-like structures [6], while modern anatomy acknowledges 206 bones in the adult human body.

Types of Asthi:

Kapala Asthi (Flat bones – e.g., skull)

Ruchaka Asthi (Long bones – e.g., femur)

Tanka Asthi (Short bones – e.g., phalanges)

Taruna Asthi (Cartilage – flexible)

Valaya Asthi (Irregular bones – e.g., vertebrae) [7]

2. Sandhi Sharira in Ayurveda

Sandhi refers to the joints formed by the union of two or more bones. They are essential for movement, stability, and functionality of the skeletal system.

Number of Sandhi: *Sushruta* mentions 210 joints in the body [8].

3. CLASSIFICATION OF SANDHI

Acharya Sushruta, in the *Sushruta Samhita*, has provided a detailed classification of Sandhi (joints) based on their structure and function rather than purely on mobility or tissue type. He enumerates eight types of joints, each named metaphorically to indicate the nature of union and movement. These can be correlated with various modern anatomical joint types, offering deep insight into Ayurvedic structural understanding and clinical utility [9].

Kora SandhiThis type resembles a hinge or folding joint. It permits flexion and extension in one plane, closely resembling the hinge joints of modern anatomy.*Examples*: Elbow (Koorpara), Knee (Janu), Ankle (Gulpha), and Finger joints (Anguli Sandhi).

Ulukhal SandhiThe term *Ulukhal* refers to a mortar, indicating a concave-convex arrangement. This type is interpreted as similar to ball-and-socket joints or gomphosis in modern terms.*Examples*: Hip joint (Kati Sandhi), Shoulder joint (Amsa Sandhi), and teeth sockets.Samudga SandhiThese joints resemble a lid on a box, implying a compact, slightly mobile joint.They are comparable to plane joints or symphyses, where limited movement occurs.*Examples*: Acromioclavicular joint, Pubic symphysis, and Sacroiliac joint.Pratara Sandhi

Described as layered or stacked joints, similar to the structure of intervertebral discs in the spine. These allow limited glidingmovements and function to absorb shock.*Examples*: Intervertebral joints of the neck (Greeva) and back (Prushtavansha).Tunnasevani Sandhi

Named after a “needle-hole,” these joints are immobile and are typically sutures found in the skull. They allow for fusion and protection

Examples: Cranial sutures.

Vayastunda Sandhi

This joint allows rotary and gliding movement, often compared with complex joints such as the temporomandibular joint (TMJ).

Example: Mandibular joint [10].

Mandala Sandhi

Circular joints that may represent ring-like cartilaginous structures allowing limited mobility and elasticity. *Examples*: Joints in the trachea (Clomnadi), throat (Kantha), and around the heart (Hridaya).

Shankhavarta Sandhi

This joint is likened to a spiral or conch-like structure, suggesting complex coiling formations, possibly reflecting inner ear structures or nasal turbinates

Examples: Cochlea, nasal conchae [11].

Eight Types of Sandhi (Joints) in Ayurveda – with Modern Correlations

Sanskrit Name	Description	Modern Correlation	Examples
1. Kora Sandhi	Resembles a hinge; permits flexion and extension	Hinge joints	Ankle (Gulpha), Elbow (Koorpara), Fingers (Anguli)
2. Ulukhal Sandhi	Mortar-and-pestle-like; some interpret as gomphosis or ball-and-socket joint	Ball-and-socket joint / Gomphosis	Teeth in sockets, Hip joint
3. Samudga Sandhi	Compact or tightly fit joints	Plane or symphysis joints	Sacroiliac joint, Pubic symphysis, Acromioclavicular joint
4. Pratara Sandhi	Slightly mobile, layered articulation	Gliding or cartilaginous joints	Intervertebral joints (Neck & Spine)
5. Tunnasevani Sandhi	Seam-like immobile joints	Fibrous joints / Sutures	Skull sutures
6. Vayastunda Sandhi	Complex, rotary joint	Condyloid joint	Temporomandibular joint (TMJ)
7. Mandala Sandhi	Circular, ring-like joints	Cartilaginous ring structures	Trachea (Clomnadi), Throat (Kantha), Heart (Hridaya)
8. Shankhavarta Sandhi	Spiral/coiled or twisted structures	Spiral/conchae structures	Cochlea (inner ear), Nasal conchae

Comparative Anatomy: Ayurveda vs. Modern Science

The Ayurvedic understanding of musculoskeletal anatomy, particularly Asthi (bones) and Sandhi (joints), offers a holistic approach incorporating structural, physiological, and metaphysical aspects. Modern anatomy, grounded in histological and biomechanical principles, complements and contrasts with these views. A comparative outline is presented below:

Concept of Asthi (Bones)

Feature	Ayurveda	Modern Anatomy
Definition	*Asthi* is one of the seven Dhatus, formed from *Majja Dhatu*, governed by *Vata Dosha*, providing structural integrity and organ protection.	Bone is a specialized connective tissue composed of collagen, calcium phosphate, and bone cells (osteoblasts etc.).
Number	Sushruta mentions 300 bones, while Charaka mentions 360, including teeth and cartilage [12].	Adult humans have 206 bones; foetuses start with ~270, which fuse during development.
Formation	Derived from *Anna Rasa* via *Asthivaha Srotas*, nourished by metabolic conversion of nutrients.	Bone develops through intramembranous or endochondral ossification, influenced by hormones and nutrition.

2. Concept of Sandhi (Joints)

Feature	Ayurveda	Modern Anatomy
Definition	*Sandhi* is a joint or union of bones facilitating movement, supported by *Vata Dosha*.	Joint is the structural articulation between two bones allowing various degrees of mobility.
Classification	Sushruta classifies 8 types of joints based on shape and function (e.g., Kora, Ulukhalaka, Samudga, etc.) [13].	Joints are classified by structure (fibrous, cartilaginous, synovial) and function (e.g., synarthroses).
Pathology	Joint disorders include *Sandhigata Vata*, *Ama Vata*, caused by *Vata* imbalance.	Common disorders include osteoarthritis, rheumatoid arthritis, gout, and bursitis.

3. Marma and Applied Anatomy

Feature	Ayurveda	Modern Anatomy
Relevance	*Marma* points are vital anatomical junctions where muscles, vessels, ligaments, bones, and joints meet [14].	No direct equivalent, but comparable to neurovascular bundles and anatomical danger zones.
Clinical Importance	Marma knowledge is vital in surgery, trauma, and therapies like *Siravyadha*, *Agnikarma*, and *Abhyanga*.	Surgical precision relies on anatomical landmarks (e.g., McBurney's point, inguinal triangle).

4. Development and Physiology

Feature	Ayurveda	Modern Science
Embryology	*Asthi* forms from *Majja* and *Panchamahabhuta* via *Garbha Sharira* principles.	Bone tissue arises from mesoderm, initially cartilaginous, later ossifies through osteogenesis.
Maintenance	Balanced *Vata* and proper *Ahara* promote bone health. Therapies like *Asthi Rasayana* and *Basti* are used.	Bone health depends on nutrition (Ca, Vit D), hormones, and mechanical loading.

4. APPLIED CLINICAL CORRELATIONS IN AYURVEDA

1. Fracture Management (Bhagna Chikitsa)

Sushruta classifies fractures into 12 types (*e.g., Kanda Bhagna, Ashwakarna Bhagna*) [6].

Techniques such as traction, splinting (Kusha bandhana), and immobilization (Sthirikarana) are detailed.

These principles are parallel to modern orthopedics: traction, casting, and physiotherapy.

2. Joint Disorders (Sandhi Vikara)

Conditions like Sandhigata Vata (osteoarthritis) are explained in terms of vitiated Vata in joints leading to pain and stiffness.

Panchakarma therapies like Basti (enema) and Snehana-Swedana (oleation and sudation) are used for managing joint disorders.

Clinical results show improvement in mobility and pain reduction, correlating with modern non-steroidal and anti-inflammatory therapies [15].

3. Marma Points and Surgical Relevance

Sushruta lists 107 Marma points, out of which many are located near joints and bony prominences [16].

These are vital points where trauma can cause functional disability or fatality.

Modern-day surgeries, particularly orthopedic and neurosurgery, respect these points during incisions to avoid neurovascular damage.

4. Postural and Rehabilitative Importance

The structural alignment described in Ayurvedic texts helps in understanding postural deformities like Kyphosis, Lordosis, etc.

Ayurvedic physiotherapy (e.g., Abhyanga, Kati Basti) works on musculoskeletal support, comparable with modern physical rehabilitation practices.

5. DISCUSSION

The *Sushruta Samhita*, one of the most authoritative classical texts in Ayurveda, offers profound anatomical insights into *Asthi* (bones) and *Sandhi* (joints), demonstrating both structural and functional understanding of the human musculoskeletal system. Although the total count and classification differ from those in modern anatomy, the fundamental principles described remain clinically relevant.

Sushruta's enumeration of 360 bones includes structures such as teeth, cartilage, and other hard tissues, reflecting an expanded concept of *Asthi Dhatu*. While modern anatomy identifies 206 bones, it is notable that Sushruta emphasized the physiological functions, marrow content (*Majja*), and nourishment (*Asthivaha Srotas*) in his classification. This deeper physiological integration is lacking in the purely structural approach of modern texts.

The classification of joints (*Sandhi*) into eight types—based on movement, stability, and structure—provides a remarkable precursor to modern joint classifications such as synovial, cartilaginous, and fibrous joints. Sushruta's understanding of joint function, movement (*Chalana*), and stability (*Sthirata*) plays a significant role in the diagnosis and management of conditions such as *Sandhigata Vata*, where degenerative changes occur due to Vata vitiation.

The clinical application of this anatomical knowledge is particularly evident in *Bhagna Chikitsa* (fracture management). Sushruta's descriptions of fracture types, dislocations, and appropriate management techniques—like traction (*Akarshana*), immobilization (*Sthirikarana*), and bandaging methods (*Kusha Bandhana*)—illustrate a sophisticated surgical approach. These methods find parallels in modern orthopedics, where fracture stabilization, casting, and rehabilitation are primary interventions.

Another significant area of overlap is the concept of *Marma* (vital points), many of which are located at bony prominences and joint regions. Injury to these points results in serious outcomes, underscoring an early understanding of neurovascular structures and their surgical implications. Modern surgical techniques, especially in orthopedic and neurosurgical fields, also emphasize the importance of avoiding major nerves and vessels near joints, supporting the timeless value of Sushruta's teachings.

Moreover, the application of therapies such as *Abhyanga*, *Swedana*, and *Basti* in musculoskeletal disorders demonstrates a comprehensive treatment model that integrates anatomical, physiological, and therapeutic dimensions. These interventions not only provide symptomatic relief but also aid in functional recovery, much like modern rehabilitative strategies.

In essence, the anatomical insights from *Sushruta Samhita* are not just theoretical but offer practical guidance for the diagnosis, treatment, and rehabilitation of bone and joint disorders. When examined through the lens of modern clinical anatomy and orthopedics, Sushruta's work emerges as a sophisticated and holistic framework that continues to inform and inspire integrative approaches in musculoskeletal medicine.

6. CONCLUSION

The anatomical descriptions of *Asthi* (bones) and *Sandhi* (joints) in the *Sushruta Samhita* reflect a remarkably advanced understanding of the human musculoskeletal system. These classical insights are not merely theoretical but hold substantial practical relevance in clinical applications, especially in the diagnosis and management of orthopedic conditions within Ayurvedic practice.Sushruta's classification of bones, joints, and their functional interrelations demonstrates a holistic perspective that aligns with many modern anatomical and surgical concepts. The therapeutic applications such as *Bhagna Chikitsa*, *Sandhigata Vata Chikitsa*, and *Marma Chikitsa* underscore the utility of these anatomical frameworks in real-time clinical decision-making and rehabilitation.By bridging the foundational knowledge of Ayurvedic anatomy with contemporary biomedical insights, a synergistic approach to musculoskeletal healthcare can be fostered. This integrative model not only revitalizes the classical teachings but also opens avenues for interdisciplinary collaboration and research. Embracing the anatomical wisdom of Ayurveda enhances the efficacy and scope of both traditional and modern healthcare

systems

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