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JANU SANDHI: A COMPREHENSIVE REVIEW FROM AYURVEDIC AND MODERN CLINICAL PERSPECTIVES

Dr. Praveen Nandal*[1], Dr. Murali K.[2], Dr. Neha Saini[3], Dr. Deepak Kumar[4]

[1]PhD Scholar /Assistant Professor Department of Kayachikitsa, The Glocal College of Ayurvedic Medical Science and Research Centre, Mirzapur Pole, Saharanpur U.P/Shri Baba Mastnath Ayurvedic College and Hospital, Rohtak.
[2]Distinguished Professor, Department of Kayachikitsa, The Glocal University, Research Wing, Mirzapur Pole, Saharanpur U.P.
[3]Assistant Professor, Department of Kayachikitsa, Shree Baba Mastnath Ayurvedic College and Hospital, Rohtak.
[4]PhD Scholar /Assistant Professor, Department of Samhita Siddhant, The Glocal College of Ayurvedic Medical Science and Research Centre, Mirzapur Pole, Saharanpur U.P/Shree Baba Mastnath Ayurvedic College and Hospital, Rohtak.

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***Corresponding Author**

Dr. Praveen Nandal

PhD Scholar /Assistant Professor Department of Kayachikitsa, The Glocal college of Ayurvedic Medical Science and Research Centre, Mirzapur Pole, Saharanpur U.P/Shri Baba Mastnath Ayurvedic College and Hospital, Rohtak.

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ABSTRACT

Background: *Janu Sandhi*, anatomically correlated with the knee joint, is one of the most complex and weight-bearing synovial joints of the human body. It plays an essential role in locomotion, stability, posture maintenance, and functional mobility. Due to continuous biomechanical stress, aging, obesity, inflammatory conditions, trauma, and degenerative changes, the knee joint is highly susceptible to a wide spectrum of disorders. Ayurveda describes various pathological conditions affecting *Janu Sandhi* under disease entities such as *Sandhigata Vata*, *Amavata*, and *Vatarakta*. Modern medicine correlates these conditions with osteoarthritis, rheumatoid arthritis, gouty arthritis, ligament injuries, and meniscal pathologies. **Objective:** The present review aims to comprehensively analyze *Janu Sandhi* from both Ayurvedic and modern clinical perspectives, emphasizing anatomy, physiology, etiopathogenesis, disease correlation and diagnostic approaches. **Data Sources:** Data for this review were collected from classical Ayurvedic texts including *Charaka Samhita*, *Sushruta Samhita*, and *Ashtanga Hridaya*, along with modern medical literature retrieved from PubMed, Scopus, Google Scholar, AYUSH

Research Portal, orthopedic textbooks, and rheumatological databases. **Review Methods:** A PRISMA-guided narrative review methodology was adopted. Relevant articles related to *Janu Sandhi*, *Sandhigata Vata*, *Amavata*, osteoarthritis, rheumatoid arthritis, ligament injuries, and integrative management were systematically screened and analyzed based on predefined inclusion and exclusion criteria. **Results:** The review demonstrates significant conceptual similarities between Ayurvedic descriptions of *Sandhigata Vata* and modern osteoarthritis, as well as between *Amavata* and rheumatoid arthritis. Ayurvedic concepts such as *Vata* vitiation, *Shleshaka Kapha* depletion, Ama formation, and *Dhatukshaya* show notable correlation with degenerative and inflammatory mechanisms described in modern medicine. **Conclusion:** *Janu Sandhi* disorders represent a major global health burden due to their chronicity, disability, and impact on quality of life. An integrative understanding combining Ayurvedic principles with modern orthopedic and rheumatological perspectives may offer more holistic, patient-centered, and sustainable management strategies for knee joint disorders.

KEYWORDS: *Janu Sandhi*, Knee Joint, *Sandhigata Vata*, *Amavata*, *Vatarakta*, Osteoarthritis, Rheumatoid Arthritis, Ayurveda, *Panchakarma*, Orthopedics.

1. INTRODUCTION

1.1 Overview of *Janu Sandhi*

Janu Sandhi, corresponds to the knee joint in modern anatomy. It is among the largest and most intiricate joints of the human body. It plays very crucial role in movement, weight bearing, balance, posture maintenance, and functional mobility.[1] From an anatomical perspective, the knee joint is formed by the articulation between the femur, tibia, and patella, supported by multiple ligaments, menisci, synovial structures, bursae, and surrounding musculature. Due to its significant functional demand and continuous exposure to mechanical stress, the knee joint is highly susceptible to degenerative, inflammatory, traumatic, and metabolic disorders.[2]

In Ayurveda, *Janu Sandhi* is described under *Sandhi Sharira* and is regarded as an important site of *Vata Dosha*, especially *Shleshaka Kapha*, which reduces friction between the articular surfaces and facilitate smooth movement of the joint.[3] Various pathological conditions involving *Janu Sandhi* are described in classical texts under entities namely *Sandhigata Vata*, *Amavata*, and *Vatarakta*. These conditions lead to impaired mobility and quality of life if left untreated.

1.2 Prevalence and Global Burden of *Janu Sandhi* Disorders

Disorders affecting *Janu Sandhi* represent a major public health concern worldwide due to increasing life expectancy, sedentary lifestyle, obesity, occupational stress, sports injuries, and metabolic disorders. Among them, osteoarthritis of the knee is the most prevalent degenerative joint disorder and constitute a major cause of disability in the elderly population.

According to the World Health Organization (WHO), osteoarthritis affects millions of individuals globally, with knee osteoarthritis being the most common form. Epidemiological studies indicate that approximately 10–15% of individuals above the age of 60 years suffer from symptomatic knee osteoarthritis, with a higher prevalence observed in females.[4] In India, community-based studies have reported the prevalence of knee osteoarthritis ranging from 22% to 39%, particularly among elderly and obese populations.

Rheumatoid arthritis, can be correlated with *Amavata* in Ayurveda, affects nearly 0.5–1% of the global population and characteristically involves the knee joint during disease progression.[5] Similarly, gouty arthritis and other inflammatory arthropathies also account for significant morbidity involving *Janu Sandhi*.

Traumatic injuries of the knee joint are commonly observed among athletes and young adults. Anterior cruciate ligament (ACL) injuries, meniscal tears, and collateral ligament injuries are often observed in sports involving sudden pivoting and rotational movements. These injuries persistent long-term instability, early osteoarthritis, and functional disability.

The rising prevalence of knee joint disorders has created substantial socioeconomic burden due to chronic pain, reduced productivity, disability, healthcare expenditure, and impaired quality of life. Therefore, understanding *Janu Sandhi i*n context of both Ayurvedic and modern clinical perspectives becomes essential for comprehensive prevention, diagnosis, and management.

1.3 Ayurvedic Perspective of Joint Disorders

Ayurveda considers *Sandhi* as a vital anatomical and functional structure responsible for movement and stability. Vitiation of *Doshas*, especially *Vata*, along with *Dhatu Kshaya* and *Srotodushti*, results in occurance of various *Sandhigata* disorders. Classical Ayurvedic texts describe conditions such as *Sandhigata Vata*, *Amavata*, and *Vatarakta* with detailed

etiopathogenesis, symptomatology, and management principles.

According to Ayurveda, *Vata Dosha* function as a key mediator in maintaining normal joint movements. *Shleshaka Kapha* present within the Sandhi provides lubrication and nourishment to the articular surfaces.[6] Depletion of *Kapha* or aggravation of *Vata* leads to degeneration, dryness, pain, crepitus, and restricted movement. Moreover, *Ama* accumulation due to impaired *Agni* contributes to inflammatory conditions affecting the joints.

Ayurveda also reinforces the significance of individualized treatment based upon *Dosha* predominance, disease stage, strength of the patient, and associated systemic involvement. Therapeutic modalities such as *Panchakarma*, *Basti Karma*, *Janu Basti*, *Swedana*, herbal medications, and *Rasayana* therapy are widely utilized in the management of knee joint disorders.

1.4 Modern Perspective of Knee Joint Disorders

Modern medicine enumerates knee joint disorders based on degenerative, inflammatory, autoimmune, traumatic, infectious, and metabolic mechanisms. Osteoarthritis is characterized by progressive degeneration of articular cartilage, subchondral bone remodeling, osteophyte formation, and synovial inflammation.[7] Rheumatoid arthritis involves autoimmune-mediated chronic synovial inflammation leading to cartilage destruction and deformity.

Sports-related injuries such as ACL tears, meniscal injuries, and collateral ligament injuries are principal causes of knee instability and functional limitations in younger populations.[8] Advancements in imaging techniques such as MRI and arthroscopy have significantly improved the diagnosis and management of knee disorders.

Modern therapeutic approaches include pharmacological management, physiotherapy, intra-articular injections, arthroscopic procedures, ligament reconstruction, osteotomy, and total knee replacement. Despite these advancements, chronic pain, recurrence, rehabilitation challenges, and adverse effects associated with prolonged medication use continue to remain major concerns.

1.5 Rationale for Integrative Review

Although substantial advancements have been made in orthopedic surgery and rheumatological management, knee joint disorders continue to impose significant physical, psychological, social, and economic burden worldwide. Long-term pharmacotherapy is often

associated with adverse effects, while surgical interventions may not always provide complete functional restoration.[9]

Ayurveda offers a holistic and patient-oriented approach focusing on *Dosha* balance, tissue nourishment, detoxification, and restoration of functional integrity. The integrative application of Ayurvedic therapies alongside modern rehabilitation and orthopedic management may enhance therapeutic efficacy, improve patient outcomes, and reduce disease progression.

Therefore, a comprehensive review integrating Ayurvedic concepts with modern clinical understanding is essential for developing a comprehensive prspective regarding the prevention, diagnosis, and management of *Janu Sandhi* disorders.

1.6 AIM AND OBJECTIVES

Aim

To comprehensively review *Janu Sandhi* from Ayurvedic and modern clinical perspectives.

Objectives

- To study the Ayurvedic concept of *Janu Sandhi*.
- To analyze the modern anatomy and biomechanics of the knee joint.
- To correlate Ayurvedic disorders with modern knee pathologies.
- To evaluate diagnostic approaches in Ayurveda and modern medicine.

2. MATERIALS AND METHODS

2.1 Study Design

The present study was conducted as a PRISMA-guided narrative review integrating classical Ayurvedic literature with contemporary modern medical research related to *Janu Sandhi* and knee joint disorders.

2.2 Data Sources

Data for the present study were collected from both Ayurvedic and modern scientific sources. Ayurvedic literature was reviewed from *Brihattrayi* and *Laghutrayi* texts to obtain classical references and conceptual understanding. Modern scientific data were gathered through electronic databases and academic resources including PubMed, Scopus, Google Scholar, AYUSH Research Portal, published research articles, standard orthopedic textbooks, and rheumatology journals.

2.3 Search Strategy

A systematic literature search was conducted using keywords such as *Janu Sandhi*, *Sandhigata Vata*, *Amavata*, *Vatarakta*, Osteoarthritis, Rheumatoid Arthritis, Knee Joint, ACL Injury, Meniscal Injury, *Panchakarma*, and Integrative Medicine.

Boolean operators including "AND," "OR," and "NOT" were used to refine and optimize the search results.

2.4 Inclusion Criteria

- Articles related to knee joint disorders
- Ayurvedic classical references
- Clinical studies and review articles
- Original publications in english language
- Studies involving integrative approaches
- Research related to osteoarthritis and rheumatoid arthritis

2.5 Exclusion Criteria

- Unpublished abstracts
- Studies lacking scientific validity

2.6 Study Selection Process

The identified articles were screened based on title, abstract, relevance, and availability of full text. Relevant studies fulfilling inclusion criteria were selected for qualitative synthesis.

2.7 Data Extraction

Data related to anatomy, pathogenesis, clinical features and diagnosis approaches were systematically extracted and categorized under Ayurvedic and modern perspectives.

2.8 PRISMA Flow Diagram

The selection and screening process of the literature was conducted according to PRISMA guidelines involving:

- Identification
- Screening
- Eligibility assessment
- Final inclusion of studies

3. Anatomical and Physiological Concept of *Janu Sandhi*

3.1 Ayurvedic Concept of *Janu Sandhi*

3.1.1 *Nirukti* and Definition

The term *janu* in Sanskrit is derived from the verb '*janee praadurbhaave'* with the meaning to 'grow'- possibly suggesting that the development of knee reflects the overall growth of the individual. '*Uruparva*' is a synonym which means that it is joint below the thigh. *Jaanu* has another synonym '*ashteevat*'.[10] It signifies that the knee contains a distinct type of bone.

The term "*Janu*" corresponds to the knee region, while "*Sandhi*" denotes the union or articulation between two anatomical structures. Thus, *Janu Sandhi* represents the articulation situated at the knee region that facilitates stability, flexibility, and movement of the lower limb.[11] Ayurveda considers Sandhi as an essential structural and functional entity responsible for maintaining bodily movements and supporting posture. *Acharya Sushruta* has described *Sandhi* as the meeting point of *Asthi* where controlled movements occur. *Sandhi* not only permits mobility but also contributes significantly to stability and weight transmission. Among all body joints, *Janu Sandhi* is one of the most clinically significant joints because of its vital function in locomotion and constant mechanical stress.

3.1.2 *Sandhi Sharira*

Sandhi Sharira is an important subdivision of Ayurvedic anatomy dealing with the structural organization, classification, and physiological importance of joints. According to Ayurveda, *Sandhi* is formed by the union of *Asthi* and corroborated by associated structures such as *Snayu*, *Kandara*, *Mamsa*, and *Sandhibandhana*. The two principal functions of *Sandhi* are *Sthirata* and *Cheshta*, which refers stability and movement respectively.[12] *Janu Sandhi* is classified under *Chala Sandhi* because it exhibits wide range of motion. The proper functioning of this *Sandhi* depends upon the balanced state of *Doshas*, healthy *Dhatus*, and unobstructed *Srotas*. *Asthi* forms the skeletal framework of the joint and provides structural support, whereas *Snayu* contributes to stability and limits excessive movement. *Kandara* assists in carrying muscular force and may be correlated with tendinous structures. *Mamsa* provides cushioning, support, and dynamic stability around the joint. Ayurveda emphasizes that disturbance in any of these structural components can impair the functional capacity of the joint and predispose it to pathological conditions.

3.1.3 *Panchabhautika* Composition[13]

Table 1: *Panchabhautika* Composition of Janu Sandhi.

Ayurvedic Component	Contribution in *Janu Sandhi*	Functional Significance	Modern Correlation
Prithvi Mahabhuta	Provides firmness to bones, ligaments, and supportive tissues	Structural stability and strength	Bones, ligaments, connective tissue
Jala Mahabhuta	Maintains lubrication and nourishment through Shleshaka *Kapha*	Flexibility and smooth articulation	Synovial fluid and cartilage lubrication
Agni Mahabhuta	Regulates tissue metabolism and inflammatory responses	Cellular transformation and metabolic activity	Metabolic and inflammatory processes
Vayu Mahabhuta	Governs movement and neuromuscular coordination	Flexion, extension, and mobility	Neuromuscular and kinetic functions
Akasha Mahabhuta	Forms joint cavity and inter-articular spaces	Space for articulation and movement	Joint cavity and intra-articular space

3.1.4 *Dosha* Dominance in *Janu Sandhi*[14]

Table 2: *Dosha* dominance in *Janu Sandhi.*

Dosha	Role in *Janu Sandhi*	Manifestations of Vitiation	Modern Correlation
Vata Dosha	Governs all movements, joint mobility, neuromuscular coordination, and functional flexibility of Janu Sandhi. Vyana Vata controls movement and circulation, while Apana Vata supports lower limb activities and stability.	*Sandhi Shoola* (pain), *Stambha* (stiffness), *Atopa* (crepitus), restricted movements, dryness, instability, and degenerative changes in the joint.	Osteoarthritis, cartilage degeneration, neuromuscular dysfunction, impaired joint biomechanics
Kapha Dosha (Shleshaka Kapha)	Maintains lubrication, nourishment, cushioning, smooth articulation, and stability of the joint.	Dryness, friction during movement, heaviness, reduced flexibility, painful movements, and progressive degeneration due to loss of lubrication.	Synovial fluid, articular cartilage lubrication, shock absorption, joint stabilization
Pitta Dosha	Regulates metabolic and inflammatory activities within the joint tissues.	Burning sensation, redness, swelling, tenderness, increased local temperature, and inflammatory changes in the joint.	Synovitis, inflammatory mediators, inflammatory joint pathology

3.1.5 *Dhatu* and *Upadhatu* Involvement

The structural and functional integrity of *Janu Sandhi* depends on the proper nourishment and maintenance of multiple *Dhatus* and *Upadhatus*. *Asthi Dhatu* forms the bony framework of the joint and provides stability, support, and weight-bearing capacity. Degeneration of *Asthi* leads to weakening, deformity, and loss of structural integrity of the joint. *Majja Dhatu* nourishes *Asthi* and enhances lubrication, cushioning, and maintenance of bone marrow integrity.[15] *Kshaya* of *Majja* results in dryness and degeneration within the joint structures.

Mamsa Dhatu encloses the joint and provides muscular support, stability, and shock absorption. Weakness of *Mamsa* may lead to instability and impaired movement. *Snayu* provides strength and stability to the joint and can be correlated with ligaments and fibrous supporting tissues. *Kandara* assists in the transmission of muscular force and coordinated movements and may be equated with tendinous structures.[16] Proper nourishment and equilibrium of these *Dhatus* are essential for maintaining healthy joint physiology.

3.1.6 *Janu Marma* and Its Clinical Significance

According to *Sushruta Samhita*, *Janu* is considered an important *Sandhi Marma*. *Marma* are vital anatomical locations where injury can produce serious structural and functional consequences. *Janu Marma* is formed by the combination of *Asthi*, *Snayu*, *Sandhi*, *Mamsa*, and *Sira*.[17] Trauma to *Janu Marma* may result in severe pain, swelling, restricted movement, deformity, and permanent disability. The *Marma* concept emphasizes the vital functional importance of the knee joint and highlights the need for preserving its anatomical integrity during both preventive and therapeutic interventions.

3.2 Modern Anatomy of the Knee Joint

3.2.1 Overview of Knee Joint

The knee joint is the largest synovial joint and is reowned for its complex anatomical structure. It functions primarily as a modified hinge joint allowing flexion, extension, and limited rotational movements.[18] The knee supports a substantial portion of body weight during standing, walking, running, climbing, and various physical activities. Due to continuous mechanical loading and mobility demands, it is highly susceptible to degenerative and traumatic injuries.

The knee joint consists of multiple structural components including bones, articular cartilage, menisci, ligaments, synovial membrane, bursae, muscles, and tendons. Proper coordination

among these structures is essential for maintaining stability, mobility, and smooth movement. Any condition affecting these components may lead to pain, instability, deformity, and functional disability.

3.2.2 Osteology of Knee Joint

The knee joint is constituted by the articulation between the femur, tibia, and patella. The distal end of the femur comprises medial and lateral condyles separated posteriorly by the intercondylar notch. These condyles articulate with the tibial condyles to form the tibiofemoral joint. The proximal tibia contains medial and lateral tibial condyles along with the tibial plateau, which provides a stable articulating surface for weight transmission.

The patella is the largest sesamoid bone of the body and is enclosed within the quadriceps tendon. It protects the anterior aspect of the knee joint and improves the mechanical efficiency of the quadriceps muscle during extension of the knee. The anatomical configuration of these bones ensures joint stability while allowing controlled movement necessary for locomotion and weight bearing.

3.2.3 Articulations of the Knee Joint

The knee joint comprises two principal articulations: the tibiofemoral joint and the patellofemoral joint. The tibiofemoral articulation is formed by the articulation of femoral and tibial condyles and bears the majority of body weight. The patellofemoral articulation is formed between the patella and the femoral trochlea and plays an important role in enhancing the efficiency of the extensor mechanism.

These articulations work together to facilitate smooth flexion, extension, and rotational movements while maintaining stability during dynamic activities. Proper congruity of these articulating surfaces is essential for normal biomechanical functioning of the knee joint.

3.2.4 Menisci

The menisci are crescent-shaped fibrocartilaginous structures situated between the femoral and tibial condyles. Two menisci are located within the knee joint: the medial meniscus and the lateral meniscus. These structures play an important role in maintaining joint congruity, distributing body weight, absorbing shock, stabilizing the joint, and reducing friction during movement. The menisci also contribute to lubrication and proprioception of the knee joint.

The medial meniscus is C-shaped, broader posteriorly, and firmly attached to the medial collateral ligament, making it comparatively less mobile and more prone to injury.[19] In contrast, the lateral meniscus is nearly circular, more mobile, and less frequently injured due to its relatively loose attachments. Degeneration or tears involving the menisci commonly result in pain, locking, clicking sensation, swelling, and instability of the knee joint.

The integrity of menisci is necessary for normal biomechanics of the knee. Loss or damage of meniscal tissue significantly increases stress on the articular cartilage and predisposes the joint to early osteoarthritic changes.

3.2.5 Ligaments of the Knee Joint

Knee joint stability is ensured by a complex network of intracapsular and extracapsular ligaments. These ligaments prevent excessive movements and preserve proper alignment during weight-bearing activities.

The anterior cruciate ligament (ACL) extends from the anterior intercondylar area of the tibia to the posterior aspect of the lateral femoral condyle. It prevents anterior displacement of the tibia relative to the femur and provides rotational stability to the joint. ACL injuries are among the most common sports-related injuries and usually occur during sudden twisting or pivoting movements.[20]

The posterior cruciate ligament (PCL) extends from the posterior intercondylar area of the tibia to the medial femoral condyle. It prevents posterior displacement of the tibia and has a major impact to posterior stability of the knee joint. PCL injuries commonly occur following dashboard injuries or trauma to the flexed knee.[21]

The medial collateral ligament (MCL) is situated on the medial aspect of the knee joint and resists valgus stress. It also offers medial stability and supports the joint during rotational movements. The lateral collateral ligament (LCL) is located on the lateral aspect of the knee and resists various stress while maintaining lateral stability.

Together, these ligaments function in coordination to maintain mechanical stability, prevent abnormal displacement, and support dynamic movements of the knee joint.

3.2.6 Synovial Membrane and Synovial Fluid

The knee joint is enclosed by a fibrous capsule lined internally by a synovial membrane. The

synovial membrane is richly vascularized and secretes synovial fluid, which occupies the joint cavity. Synovial fluid performs several important functions including lubrication of articular surfaces, nourishment of avascular cartilage, reduction of friction, and shock absorption during movement.[22]

The viscosity and composition of synovial fluid are essential for maintaining smooth joint function. Inflammatory disorders such as rheumatoid arthritis lead to synovial hypertrophy and excessive inflammatory exudate, whereas degenerative disorders may alter both the quality and quantity of synovial fluid, contributing to stiffness and restricted movement.

From an Ayurvedic perspective, the lubricating function of synovial fluid may be correlated with the action of *Shleshaka Kapha* present within the *Sandhi*.[23]

3.2.7 Bursae Around the Knee Joint

Bursae are synovial fluid-filled sacs located between structures subjected to friction, such as tendons, muscles, ligaments, and bones. They reduce friction and facilitate smooth movement around the knee joint. Several bursae are present around the knee, including the suprapatellar bursa, prepatellar bursa, infrapatellar bursa, semimembranosus bursa, and pes anserine bursa.[24]

The suprapatellar bursa lies between the femur and quadriceps tendon and communicates with the knee joint cavity. The prepatellar bursa is situated anterior to the patella and commonly becomes inflamed in individuals with repeated kneeling activities, leading to prepatellar bursitis. The infrapatellar bursae reduce friction around the patellar ligament, while the pes anserine bursa is situated between the tendons of sartorius, gracilis, semitendinosus, and the medial tibia.

Inflammation of bursae may produce localized pain, tenderness, swelling, and restriction of movement.

3.2.8 Blood Supply and Nerve Supply

The blood supply of the knee joint is derived mainly from the genicular branches of the popliteal artery, which form a rich periarticular anastomotic network around the joint. Additional contributions arise from the descending genicular artery, recurrent branches of the anterior tibial artery, and circumflex femoral branches. This extensive vascular network ensures adequate nourishment to the joint structures.[25]

The nerve supply of the knee joint is provided by branches from the femoral, tibial, common peroneal, and obturator nerves. These nerves supply the capsule, ligaments, synovial membrane, and periarticular tissues, contributing to pain sensation and proprioception. Any injury or inflammatory of these structures can result in significant pain and functional impairment.[26]

3.2.9 Biomechanics of the Knee Joint

The knee joint has a central role in transmitting body weight, enabling locomotion, absorbing shock, and maintaining balance. During activities such as walking, running, climbing stairs, and squatting, the knee is subjected to considerable compressive and rotational forces. Proper biomechanics of the knee depends on coordinated interaction among bones, cartilage, menisci, ligaments, muscles, and neural control mechanisms.[27]

Flexion and extension constitute the primary movements of the knee joint. During flexion, slight rotational movements also occur, allowing smooth adaptation to dynamic activities. The menisci spread mechanical load across the tibial plateau, whereas ligaments maintain stability by preventing abnormal displacement.

The quadriceps muscle group acts as the primary extensor mechanism of the knee, whereas hamstring muscles contribute to flexion and stabilization.[28] Any imbalance in muscular strength, ligament integrity, or alignment may alter normal biomechanics and predispose the joint to degeneration, instability, and pain.

Obesity, trauma, malalignment, repetitive strain, and aging significantly increase biomechanical stress on the knee joint and aid in development of degenerative conditions such as osteoarthritis.

3.3 Physiological Importance of *Janu Sandhi*

Janu Sandhi is essential for maintaining normal mobility and functional independence. The knee joint participates in various daily activities including walking, running, sitting, standing, climbing stairs, squatting, and maintaining posture. Its proper functioning is essential for significant locomotion and transmission of body weight from the trunk to the lower limbs.

The physiological integrity of the knee depends upon synchronized functioning of the articulating bones, ligaments, menisci, muscles, synovial membrane, bursae, and nervous system. Stability of the joint is maintained by coordinated neuromuscular control and

balanced muscular activity surrounding the knee.

According to ayurveda, the physiological functioning of *Janu Sandhi* is maintained through equilibrium of *Doshas*, proper nourishment of *Dhatus*, unobstructed *Srotas*, and adequate action of *Shleshaka Kapha*.[29] Disturbance in these factors results in reduced mobility, pain, stiffness, and progressive degeneration of the joint.

Owing to its high finctional demand and continuous exposure to mechanical stress, *Janu Sandhi* is highly vulnerable to degenerative, inflammatory, metabolic, and traumatic disorders. Preservation of its structural and functional integrity is therefore essential for maintaining quality of life and physical independence.

4. Ayurvedic and Modern Correlation of *Janu Sandhi* Disorders

4.1 *Sandhigata Vata* and Osteoarthritis

Sandhigata Vata is a common *Vatavyadhi* affecting weight-bearing joints, particularly the *Janu Sandhi*. It is marked by pain (*Sandhi Shoola*), stiffness (*Stambha*), crepitus (*Atopa*), swelling, and restricted movement.[30] The condition occurs due to *Vata* aggravation caused by aging, excessive joint use, trauma, irregular diet, fasting, and *Dhatukshaya*. Localization of aggravated *Vata* in vulnerable joints, along with depletion of *Shleshaka Kapha*, results in degeneration and reduced lubrication.

Osteoarthritis is a chronic degenerative joint disorder characterized by progressive cartilage loss, osteophyte formation, joint space narrowing, and subchondral bone changes. Common symptoms include activity-related pain, crepitus, stiffness, and restricted movement.

The correlation between *Sandhigata Vata* and osteoarthritis is based on common features of degeneration, pain, reduced joint lubrication, stiffness, and functional impairment. The *Ruksha* and *Khara* qualities of aggravated *Vata* are similar to the degenerative nature of osteoarthritis.

4.2 *Amavata* and Rheumatoid Arthritis

Amavata is an inflammatory joint disorder resulting from the accumulation of *Ama* due to *Mandagni* and its association with aggravated *Vata Dosha*. *Ama-Vata* complexes localize in the joints, producing pain, swelling, stiffness, and systemic symptoms. Factors including improper digestion, incompatible diet, sedentary habits, and stress contribute to its development.

Clinically, *Amavata* presents with *Sandhi Shoola*, *Sandhi Shotha*, morning stiffness, *Angamarda*, *Aruchi*, *Alasya*, and *Jwara*.[31] Multiple joints are usually affected symmetrically, and chronic disease may lead to deformity and disability.

Rheumatoid arthritis is a chronic autoimmune disease characterized by persistent synovial inflammation, cartilage destruction, and progressive joint deformity.[32] Patients commonly experience symmetrical joint involvement, prolonged morning stiffness, pain, swelling, fatigue, and elevated inflammatory markers.

The similarity between *Amavata* and rheumatoid arthritis lies in their inflammatory nature, systemic manifestations, chronic progression, and potential for joint deformity. *Ama* may be conceptually understood as inflammatory and immune-mediated pathological processes.

4.3 *Vatarakta* and Gouty Arthritis

Vatarakta is caused by simultaneous vitiation of *Vata Dosha* and *Rakta Dhatu*, leading to severe joint pain, swelling, redness, burning sensation, and tenderness.[33] Dietary indiscretions, alcohol intake, sedentary lifestyle, and psychological factors are important etiological contributors.

Although initially affecting smaller joints, *Vatarakta* may involve larger joints such as the knee. Chronic disease may lead to recurrent attacks and restricted mobility.

Gouty arthritis is a metabolic disorder caused by deposition of monosodium urate crystals secondary to hyperuricemia.[34] It is manifest by acute episodes of severe pain, redness, swelling, warmth, and tenderness, which may progress to chronic joint damage.

The clinical features of *Vatarakta* bears a close resemblance to gouty arthritis, particularly severe pain, inflammation, redness, burning sensation, and recurrent joint involvement.

5. Structural and Traumatic Disorders of Janu Sandhi

5.1 Anterior Cruciate Ligament (ACL) Injury

ACL injury is a common traumatic knee injury, particularly among athletes, resulting from sudden twisting, pivoting, hyperextension, or deceleration movements. Patients typically experience a popping sensation, pain, swelling, and knee instability. Clinical diagnosis is aided by the Lachman, anterior drawer, and pivot shift tests, while MRI confirms the injury.[35]

Management consists of rest, bracing, physiotherapy, and surgical reconstruction in cases of significant instability. In Ayurveda, ACL injury can be compared with *Abhighatajanya Vatavyadhi*, involving *Snayu* and *Sandhi Dushti* with aggravated *Vata* causing pain, instability, and restricted movement.

5.2 Posterior Cruciate Ligament (PCL) Injury

PCL injuries usually occur due to direct trauma to a flexed knee, such as dashboard injuries or sports-related accidents. Symptoms include pain, swelling, posterior instability, and difficulty walking. Diagnosis is established by clinical examination and MRI.

Mild injuries are managed conservatively with bracing and rehabilitation, while severe injuries may need to undergo surgical reconstruction. Rehabilitation is essential to restore joint stability and function.

5.3 Collateral Ligament Injuries

The medial and lateral collateral ligaments provide mediolateral stability to the knee joint. Injuries usually result from valgus or varus stress during sports or trauma. Medial collateral ligament injuries are more commonly occurs and present with pain, tenderness, swelling, and instability.

Diagnosis is based on stress tests and MRI findings. Most cases respond well to conservative management, whereas severe tears may require surgical repair. According to Ayurveda, these injuries may be considered *Snayu Dushti* associated with aggravated *Vata Dosha*.

5.4 Meniscal Injuries

Meniscal injuries are common internal derangements of the knee caused by repetitive stress, twisting trauma or age-related degeneration. The medial meniscus is more frequently affected because of its limited mobility.

Patients typically present with joint-line pain, swelling, locking, clicking, restricted movement, and occasional instability. Clinical tests such as McMurray and Apley tests, along with MRI, aid diagnosis.[36]

Management includes rest, physiotherapy, activity modification, and arthroscopic repair when clinically indicated. In Ayurveda, meniscal injuries may be interpreted as *Sandhi-Abhighata* involving *Snayu* and *Asthi-Sandhi Dushti*, leading to pain and impaired joint

function.

5.5 Patellar Fracture

Patellar fractures result from direct trauma to the anterior knee or sudden forceful contraction of the quadriceps muscle. As the patella plays an important role in knee extension, fractures can significantly impair mobility.

Clinical presentation includes severe pain, swelling, tenderness, inability to extend the knee, and difficulty in walking. Diagnosis is confirmed by radiographic examination, with CT scans useful in complex cases.

Undisplaced fractures are generally treated conservatively, while displaced fractures often require surgical fixation followed by rehabilitation. In Ayurveda, patellar fractures can be related to *Bhagna*, involving *Asthi* injury and aggravated *Vata Dosha*, manifesting as pain, swelling, deformity, and restricted movement.

6. Diagnostic Approaches in *Janu Sandhi* Disorders

6.1 Ayurvedic Diagnostic Methods

Diagnosis in Ayurveda is based on comprehensive evaluation of *Dosha*, *Dushya*, *Agni*, *Ama*, *Srotas* involvement, disease stage, and patient constitution. Detailed clinical assessment helps in understanding the underlying pathogenesis and planning individualized treatment.

Trividha Pariksha

Trividha Pariksha includes *Darshana*, *Sparshana*, and *Prashna*. *Darshana* involves visual inspection of swelling, discoloration, deformity, gait abnormalities, muscle wasting, and joint alignment. *Sparshana* includes palpation for tenderness, crepitus, warmth, swelling, and consistency of tissues. *Prashna* involves detailed history taking regarding onset, duration, aggravating factors, lifestyle, dietary habits, trauma, and associated systemic symptoms.

*Ashtavidha Pariksh*a

Ashtavidha Pariksha includes examination of *Nadi*, *Mutra*, *Mala*, *Jihva*, *Shabda*, *Sparsha*, *Drik*, and *Akruti*. In disorders involving *Janu Sandhi*, Nadi examination may reveal Vata predominance or *Ama* involvement. *Sparsha* helps identify local warmth, tenderness, stiffness, and swelling. Examination of *Jihva* and *Mala* aids in assessing *Agni* status and presence of *Ama*.

Dashavidha Pariksha

Dashavidha Pariksha is an important Ayurvedic clinical assessment used to evaluate the patient's physical constitution, disease status, tissue strength, and functional capacity in disorders affecting *Janu Sandhi*. It assists in understanding disease severity, prognosis, and selection of appropriate therapeutic interventions.

Table no. 3: *Dashavidha Pariksha* of *Janu Sandhi.*

Parameter	Relevance in *Janu Sandhi* Disorders
Prakriti	*Vata* predominant individuals are more prone to degenerative disorders such as *Sandhigata Vata* due to dryness and tissue depletion.
Vikriti	Assesses the present *Dosha* imbalance responsible for pain, stiffness, swelling, and restricted movement in the knee joint.
Sara	Evaluates the quality of *Dhatus*, especially *Asthi* and *Majja Sara*, which influence joint strength and stability.
Samhanana	Determines compactness and structural integrity of the body and joints, reflecting resistance to degeneration or injury.
Pramana	Assesses body measurements and proportion, which may influence mechanical stress on *Janu Sandhi*.
Satmya	Evaluates adaptability to diet, lifestyle, and therapies, helping in individualized treatment planning.
Satva	Assesses psychological strength and pain tolerance, important in chronic painful conditions of the knee joint.
Ahara Shakti	Evaluates digestive and metabolic capacity, essential for proper nourishment of *Asthi Dhatu* and joint tissues.
Vyayama Shakti	Assesses physical endurance and functional mobility of the patient, including walking and joint movements.
Vaya	Age assessment is important as degenerative changes in *Janu Sandhi* increase with advancing age.

Thus, *Dashavidha Pariksha* provides a holistic understanding of both physiological and pathological aspects of Janu Sandhi and helps in planning personalized Ayurvedic management.

6.2 Modern Diagnostic Methods

Modern diagnosis of knee joint disorders involves a combination of clinical evaluation, imaging modalities, laboratory investigations, and arthroscopic assessment.

Clinical Examination

Clinical examination commences with gait, posture, swelling, muscle wasting, deformity and alignment abnormalities. Palpation identifies tenderness, joint line pain, crepitus, warmth and effusion. Range of motion assessment assesses flexion, extension, and rotational limitations.

Special orthopedic tests are performed to identify ligamentous and meniscal injuries. Lachman test, anterior drawer test, and pivot shift test are valuable l for ACL injuries. Posterior drawer test helps diagnose PCL injuries. McMurray test and Apley grinding test assist in identifying meniscal tears.

Radiological Investigations

Plain radiography remains the initial imaging modality for evaluating degenerative and traumatic disorders. X-ray findings in osteoarthritis include:

- Joint space narrowing
- Osteophyte formation
- Subchondral sclerosis
- Cyst formation

Radiographs also help identify fractures, deformities, and alignment abnormalities.

MRI provides remarkable visualization of soft tissue structures including menisci, ligaments, cartilage, synovium, and bone marrow. It is regarded as the gold standard investigation for internal derangements of the knee.

CT scan may be beneficial in complex fractures and bony deformities, whereas ultrasonography assists in evaluating bursitis, effusions, and superficial soft tissue lesions.

Laboratory Investigations

Laboratory investigations are of particular importance in inflammatory and metabolic disorders affecting the knee joint.

Common investigations include

- ESR
- C-reactive protein
- Rheumatoid factor
- Anti-CCP antibodies
- Serum uric acid
- Complete blood count

Elevated inflammatory markers indicate active inflammation, while elevated serum uric acid supports the diagnosis of gouty arthritis.

Arthroscopy

Arthroscopy is a minimally invasive diagnostic and therapeutic procedure allowing direct visualization of intra-articular structures. It is highly beneficial for evaluating meniscal injuries, ligament tears, cartilage lesions, and synovial pathology. Arthroscopy also permits simultaneous therapeutic interventions such as meniscal repair and ligament reconstruction.

6.3 Comparative Diagnostic Correlation Between Ayurveda and Modern Medicine

Ayurvedic diagnostic methods emphasize functional assessment, *Dosha* involvement, *Agni* status, and systemic evaluation, whereas contemporary medicine focuses mainly on structural abnormalities, inflammatory markers, and imaging findings. Both systems offer complementary perspectives in understanding the pathogenesis and progression of *Janu Sandhi* disorders.

The integrative application of Ayurvedic clinical examination with modern diagnostic tools may contribute to a more comprehensive understanding of disease status and help formulate individualized therapeutic strategies for effective management of knee joint disorders.

7. DISCUSSION

Janu Sandhi is one of the most significant weight-bearing joints of the body and plays a vital role in locomotion, balance, stability, and functional independence. Due to its continuous exposure to mechanical stress, aging, obesity, trauma, inflammatory processes, and metabolic disturbances, the knee joint is highly susceptible to a wide range of pathological conditions. The present review highlights the structural, functional, pathological, and therapeutic aspects of Janu Sandhi from both Ayurvedic and modern clinical perspectives and illustrate significant conceptual similarities between the two systems of medicine.

Ayurveda provides a detailed understanding of Sandhi through the principles of *Dosha*, *Dhatu*, *Srotas*, and *Panchamahabhuta*. *Janu Sandhi* is considered a *Chala Sandhi* where balanced functioning of *Vata Dosha* and *Shleshaka Kapha* helps ensure smooth and painless movement. Vata governs movement and neuromuscular coordination, whereas *Shleshaka Kapha* provides lubrication, nourishment, cushioning, and stability. Degeneration of these functional components leads to pain, stiffness, crepitus, and restricted mobility.

The concept of *Sandhigata Vata* demonstrates significant similarity with osteoarthritis described in modern medicine. In both conditions, degeneration of joint structures, loss of

lubrication, pain during movement, crepitus, and progressive restriction of mobility are prominent clinical features. The Ayurvedic concepts of *Dhatukshaya* and *Vata Prakopa* closely resemble cartilage degeneration, subchondral bone changes, and biomechanical deterioration occurring in osteoarthritis. Additionally, the dry, rough, and degenerative properties of aggravated *Vata* correlate well with the chronic degenerative pathology observed in osteoarthritis.

Similarly, the pathogenesis of *Amavata* exhibits close resemblance with rheumatoid arthritis. Ayurveda attributes *Amavata* to the formation of Ama due to impaired Agni along with aggravated *Vata Dosha*. Ama circulates through the body and localizes in *Sandhi*, producing inflammation, swelling, pain, stiffness, and systemic manifestations. Modern medicine explains rheumatoid arthritis as an autoimmune inflammatory disorder mediated by synovial inflammation, inflammatory cytokines, pannus formation and progressive cartilage destruction. The inflammatory and systemic nature of both diseases demonstrates strong conceptual overlap.

The review also highlights the importance of traumatic and structural disorders affecting *Janu Sandhi*. Injuries involving ligaments, menisci, cartilage, and periarticular structures are increasingly common due to sports activities, road traffic accidents, and occupational stress. Such injuries not only produce acute pain and instability but also predispose the joint to chronic degeneration and secondary osteoarthritis. According to Ayurveda, these conditions can be interpreted as *Abhighatajanya Vatavyadhi* involving *Snayu*, *Asthi*, and *Sandhi Dushti* associated with aggravated *Vata Dosha*.

Diagnostic approaches in Ayurveda and modern medicine differ in methodology but complement each other significantly. Ayurveda emphasizes functional assessment through Dosha evaluation, *Agni* status, Ama involvement, *Dhatu* examination, and *Samprapti* analysis. Modern medicine primarily focuses on structural abnormalities through imaging modalities and laboratory investigations. Integrating both systems may provide a more comprehensive understanding of disease progression and individualized patient assessment.

The growing prevalence of knee joint disorders due to aging population, sedentary lifestyle, obesity and sports-related injuries has created significant socioeconomic burden worldwide.[37] Therefore, preventive healthcare strategies emphasizing joint preservation, early diagnosis, regular physical activity, balanced nutrition and holistic management are essential for

maintaining the functional integrity of *Janu Sandhi*.

8. CONCLUSION

Janu Sandhi is a vital weight-bearing joint essential for locomotion, posture, stability and functional mobility. Owing to continuous mechanical stress and aging-related changes, it is highly susceptible to degenerative, inflammatory, metabolic, and traumatic disorders, leading to pain, disability, and reduced quality of life.

Ayurveda explains *Janu Sandhi* disorders through the concepts of *Dosha*, *Dhatu*, *Srotas*, and *Sandhi Sharira*. Conditions such as *Sandhigata Vata*, *Amavata*, and *Vatarakta* closely resemble osteoarthritis, rheumatoid arthritis, and gouty arthritis of modern medicine. *Vata* aggravation, *Dhatukshaya*, Ama formation, and depletion of *Shleshaka Kapha* contribute to joint degeneration and dysfunction.

9. Future Perspectives

Future research should focus on:

- Standardization of Ayurvedic diagnostic criteria for *Janu Sandhi* disorders.
- Clinical evaluation of *Panchakarma* therapies in osteoarthritis and inflammatory arthritis.
- Molecular and pharmacological studies on Ayurvedic herbal formulations.
- Integrative rehabilitation protocols combining Ayurveda and physiotherapy.
- Long-term outcome studies comparing integrative and conventional management approaches.
- Development of evidence-based guidelines for integrative management of knee disorders.

10. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this review article.

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14. REFERENCE

1. Gauchard GC, Vançon G, Meyer P, Mainard D, Perrin PP. On the role of knee joint in balance control and postural strategies: effects of total knee replacement in elderly subjects with knee osteoarthritis. Gait & posture, Jun. 1, 2010; 32(2): 155-60.
2. Buckwalter JA, Anderson DD, Brown TD, Tochigi Y, Martin JA. The roles of mechanical stresses in the pathogenesis of osteoarthritis: implications for treatment of joint injuries. Cartilage, Oct. 2013; 4(4): 286-94.
3. Mishra A, Mishra S. Ayurvedic Management of Joint Disorders (Some Case Studies). Authors Click Publishing, 2026 Apr 15.
4. Li D, Li S, Chen Q, Xie X. The prevalence of symptomatic knee osteoarthritis in relation to age, sex, area, region, and body mass index in China: a systematic review and meta-analysis. Frontiers in medicine, Jul. 16, 2020; 7: 304.
5. Almutairi K, Nossent J, Preen D, Keen H, Inderjeeth C. The global prevalence of rheumatoid arthritis: a meta-analysis based on a systematic review. Rheumatology international, May 2021; 41(5): 863-77.
6. Keertan M. A study on the etiopathogenesis of Sandhigata Vata with special reference to osteoarthritis of knee joint[dissertation]. Udupi: Rajiv Gandhi University of Health Sciences (India); 2010. ProQuest Dissertations & Theses. Publication No. 30561908.
7. Chen DI, Shen J, Zhao W, Wang T, Han L, Hamilton JL, Im HJ. Osteoarthritis: toward a comprehensive understanding of pathological mechanism. Bone research, Jan. 17, 2017; 5(1): 1-3.
8. De Carlo M, Armstrong B. Rehabilitation of the knee following sports injury. Clinics in sports medicine, Jan. 1, 2010; 29(1): 81-106.
9. Zhang W, Robertson WB, Zhao J, Chen W, Xu J. Emerging trend in the pharmacotherapy of osteoarthritis. Frontiers in endocrinology, Jul. 2, 2019; 10: 431.
10. Moosath Paramesvaran.T.C. (commentator) Amarakosha (with Parameshwari Malayalam Commentary) National Book Stall, Kottayam, Kerala, 1983; 474.

11. Shukla J, Choudhari VM, Muley SK. Structural evaluation of Janu Sandhi according to Ayurveda and modern texts. *World Journal of Pharmaceutical Research*, 2023; 12(5): 1125-1138. doi:10.20959/wjpr20235-27481.
12. Tiwari R, Jaiswal M. Sandhi Sharir – A critical and correlative study with modern science. *World Journal of Pharmaceutical Research*, 2018; 7(9): 321-329. ISSN: 2277–7105.
13. Mishra A, Shrivastava V. Exploring the science of marma-an ancient healing technique-part 2: definition and properties of marma. submitted to the Dev Sanskriti Interdisciplinary International Journal (http://dsiij. dsvv. ac. in/). 2020 Feb.
14. Chetana BD, Kamath TS. An open labelled randomized controlled clinical study on the effect of Rasonadi Kashaya in Janu Sandhigata Vata w.s.r. to osteoarthritis. *World Journal of Pharmaceutical Research*, 2025; 14(3): 658-673. ISSN: 2277–7105.
15. Kulkarni AA, Dohare RAK. Physiological and pathological aspects of Asthi Dhatu. *World Journal of Pharmaceutical Research*, 2023; 12(5). ISSN: 2277–7105.
16. Shukla J, Choudhari VM, Muley SK. Structural evaluation of Janu Sandhi according to Ayurveda and modern texts. *World Journal of Pharmaceutical Research*, 2023; 12(5): 1125-1138. ISSN: 2277–7105.
17. Kulkarni BG, Kanthi GM. MARMA SHAREER AND TRAUMATOLOGY. Book Rivers, 2023 Nov 20.
18. Hirschmann MT, Müller W. Complex function of the knee joint: the current understanding of the knee. Knee Surgery, Sports Traumatology, Arthroscopy, Oct. 2015; 23(10): 2780-8.
19. Kuczyński N, Boś J, Białoskórska K, Aleksandrowicz Z, Turoń B, Zabrzyńska M, Bonowicz K, Gagat M. The meniscus: basic science and therapeutic approaches. Journal of Clinical Medicine, Mar. 16, 2025; 14(6): 2020.
20. Hewett TE, Myer GD, Ford KR. Anterior cruciate ligament injuries in female athletes: Part 1, mechanisms and risk factors. The American journal of sports medicine, Feb. 2006; 34(2): 299-311.
21. Chahla J, Williams BT, Ellman MB, Laprade RF. Posterior cruciate ligament. InEvidence-Based Management of Complex Knee Injuries, Jan. 1, 2022: 90-102. Elsevier.
22. Krakowski P, Rejniak A, Sobczyk J, Karpiński R. Cartilage integrity: A review of mechanical and frictional properties and repair approaches in osteoarthritis. InHealthcare, Aug. 19, 2024; 12(16): 1648. MDPI.

23. Suthar M, Ritesh RR, Roushan R. A Critical Review on Sleshaka Kapha of Ayurveda and its Affiliates in Physiological Perspective. Asian Journal of Biological and Life Sciences, May 2024; 13(2): 267.
24. Hasan M, Berkovich Y, Khatib M, Steinfeld Y, Sleiman A, Ben Zvi L, Abu Alhija A, Ginesin E, Yonai Y. Knee Bursae: A Comprehensive Review of Clinical Evaluation, Imaging Differentiation, and the Expanding Role of Biologic Therapies. Cartilage, Nov. 15, 2025: 19476035251362434.
25. Davies DV, Edwards DA. The blood supply of the synovial membrane and intra-articular structures. Annals of the Royal College of Surgeons of England, Mar. 1948; 2(3): 142.
26. Kennedy JC, Alexander IJ, Hayes KC. Nerve supply of the human knee and its functional importance. The American journal of sports medicine, Nov. 1982; 10(6): 329-35.
27. Nochehdehi AR, Nemavhola F, Thomas S, Maria HJ, editors. Cartilage tissue and knee joint biomechanics: fundamentals, characterization and modelling. Elsevier, 2023 Sep 5.
28. Baratta R, Solomonow M, Zhou BH, Letson D, Chuinard R, D'ambrosia RJ. Muscular coactivation: the role of the antagonist musculature in maintaining knee stability. The American journal of sports medicine, Mar. 1988; 16(2): 113-22.
29. Suthar M, Ritesh RR, Roushan R. A Critical Review on Sleshaka Kapha of Ayurveda and its Affiliates in Physiological Perspective. Asian Journal of Biological and Life Sciences, May 2024; 13(2): 267.
30. Madhavakara. Madhava Nidana with Madhukosha Commentary; Vatavyadhi Nidana. Edited by Yadunandana Upadhyaya. Varanasi: Chaukhamba Prakashan, 2018.
31. Chakrapanidatta. Chakradatta; Amavata Chikitsa Prakarana. Edited by Indradeva Tripathi. Varanasi: Chaukhamba Sanskrit Sansthan, 2014.
32. Firestein GS, Budd RC, Gabriel SE, McInnes IB, O'Dell JR, editors. Kelley and Firestein's Textbook of Rheumatology.11th ed. Philadelphia: Elsevier, 2021.
33. Agnivesha, Charaka, Dridhabala. Charaka Samhita, Chikitsa Sthana; Vatarakta Chikitsa Adhyaya (29). Edited by Yadavji Trikamji Acharya. Varanasi: Chaukhamba Surbharati Prakashan, 2017.
34. Kasper DL, Fauci AS, Hauser SL, Longo DL, Jameson JL, Loscalzo J, editors. Harrison's Principles of Internal Medicine. 21st ed. New York: McGraw Hill, 2022.
35. Campbell WC, Canale ST, Beaty JH, editors. Campbell's Operative Orthopaedics. 14th ed. Philadelphia: Elsevier, 2021.
36. Miller MD, Thompson SR, editors. DeLee, Drez & Miller's Orthopaedic Sports Medicine: Principles and Practice.5th ed. Philadelphia: Elsevier, 2021.

37. Woolf AD, Brooks P, Åkesson K, Mody GM. Prevention of musculoskeletal conditions in the developing world. Best Practice & Research Clinical Rheumatology, Aug. 1, 2008; 22(4): 759-72.