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SNAYU SHARIR IN AYURVEDA AND APPLIED ANATOMY OF JANU SANDHI – A REVIEW

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ABSTRACT

Snayu is a basic part of the body in Ayurveda that helps keep the bones, muscles, and joints strong, stable, and working together smoothly. It acts as a connecting material that supports the bones, joints, and muscles. Among all the joints in the body, the knee joint, also called Janu Sandhi, is the largest joint that supports the body's weight.Its stability mainly comes from ligaments, tendons, and the soft tissues around it. Connecting the Ayurvedic idea of Snayu with today's anatomy helps give a clearer picture of how the knee joint is built and works. Objective: To examine the Ayurvedic idea of Snayu Sharir and connect it with the practical anatomy of Janu Sandhi, highlighting its structure, function, and importance in medical practice. Materials and Methods: This review is based on a thorough study of classical Ayurvedic texts, standard anatomy and orthopedic books, and scientific articles that discuss the structure of the knee joint, connective tissues, how the knee works mechanically, and disorders affecting the bones, muscles, and joints. The review shows that the structure and function of Snayu are very similar to modern connective tissues like ligaments, tendons, fascia, and aponeuroses. These structures together help keep the joint stable, moving smoothly, and working efficiently. Conclusion: The Ayurvedic idea of Snayu has important connections to the structure and function of the Janu Sandhi in applied anatomy. Combining traditional Ayurvedic wisdom with modern knowledge about body structure helps better understand how the knee joint works and can lead to better teaching, more effective treatment, and new research that brings different fields together.

KEYWORDS: Snayu, Snayu Sharir, Ayurveda, Janu Sandhi, Ligament, Knee Joint.

INTRODUCTION

The study of Sharir Rachana is very important in Ayurveda because knowing how the human body is structured helps doctors to find out, stop, and take care of diseases properly. The classical Ayurvedic experts said that having correct knowledge about the body's parts is important for understanding how the body works and how diseases develop. In Ayurvedic texts, Snayu is seen as one of the key supporting tissues that help keep the musculoskeletal system strong and steady. It helps connect different parts of the body, gives support to the joints, and allows the body to move in a coordinated way.[1–4]

The word Snayu is often talked about in old Ayurvedic writings, especially in the Sushruta Samhita. It is described as a strong connecting part that helps keep bones, joints, and muscles in place. Sushruta believed that Snayu was very important for keeping the body's structure strong and healthy. He said that if Snayu got injured, it could cause a lot of pain, change the shape of the body, limit movement, and lead to losing the ability to function properly. Similarly, the Charaka Samhita, Ashtanga Hridaya, and Ashtanga Sangraha all mention that Snayu is a key part of the body that helps with movement and keeps the body steady. These descriptions show that Snayu is important both in structure and function according to the Ayurvedic view of the human body.[1–4,9,10]

From today's understanding of body structure, the role of Snayu is similar to how ligaments, tendons, aponeuroses, and fascia work. These tissues help keep the body stable, carry the force from muscles, keep joints in the right place, and stop movements that could cause harm. New discoveries in the study of body structures show that

these parts are very important for helping joints work smoothly and efficiently during everyday tasks and when exercising. By connecting the Ayurvedic idea of Snayu with modern anatomy, we can better understand its role in a scientific way.[11–20]

Among all the joints in the human body, the knee joint, also known as Janu Sandhi, is one of the biggest, strongest, and most important types of synovial joints. It supports the body's weight, lets you move around, helps you stay balanced, and enables more complicated actions like bending, straightening, and a little twisting. The knee joint stays stable because of the ligaments, tendons, menisci, joint capsule, and the muscles around it. Damage to any of these structures can make it harder for joints to work properly and lower the overall quality of life. So, knowing how Snayu connects with the supporting parts of Janu Sandhi is very important for both study and treatment.[11–23]

Musculoskeletal issues affecting the knee, like osteoarthritis, ligament damage, meniscus tears, and injuries from sports, are becoming more common. This is due to factors such as getting older, being overweight, not moving much, and more people taking part in sports and physical activities. These conditions cause pain, weakness, limited movement, and difficulty in doing everyday tasks, which makes them a big problem for public health around the world. Combining knowledge of Ayurvedic principles with modern anatomy can help in better diagnosis, prevention, and overall treatment of these conditions.[21–30]

Even though many studies have talked about Snayu or the structure of the knee joint on their own, there isn't much information that connects Snayu Sharir with the real-world anatomy of Janu Sandhi. Finding this connection can help teach anatomy better, make the science behind Ayurveda clearer, and give a strong base for future research that combines different fields. So, this review is meant to closely examine the old descriptions of Snayu and connect them with the structure and function of Janu Sandhi, using current anatomical information and scientific research that is available.[1–30]

AIM

To review the concept of Snayu Sharir in Ayurveda and connect it with the applied anatomy of Janu Sandhi, focusing on its structure, how it works, and its importance in medical practice.

OBJECTIVES

1. To understand the idea of Snayu as explained in the ancient Ayurvedic texts.
2. To review the classification of Snayu and function of it.
3. To describe how the Janu Sandhi joint works in the body.
4. To correlate the Ayurvedic idea of Snayu with modern anatomical structure.
5. To discuss clinical significance of Snayu in knee disorders.

MATERIALS AND METHODS

This study is a review that tells a story, based on a thorough look at both old Ayurvedic writings and modern anatomy books. Classical references were gathered from Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya, Ashtanga Sangraha, Sharangadhara Samhita, Bhavaprakasha, Madhava Nidana, and Bhaishajya Ratnavali. Modern anatomical information came from standard textbooks on human anatomy, anatomy focused on clinical use, orthopedic surgery, kinesiology, and musculoskeletal medicine. In addition, relevant review articles and original research papers about Snayu, connective tissue anatomy, Janu Sandhi, knee joint biomechanics, ligament injuries, and osteoarthritis were looked at. The information gathered was carefully studied, compared, and arranged in a clear way to understand how the Ayurvedic idea of Snayu Sharir connects with the actual anatomy of the knee joint.

REVIEW OF LITERATURE

Nirukti and Definition of Snayu

The word Snayu comes from the Sanskrit word "Sna," which means "to bind" or "to hold together." In Ayurveda, Snayu is a tough, fibrous tissue that helps connect bones, joints, and muscles. This tissue plays an important role in keeping the body's structure strong, allowing for smooth movement, and supporting overall physical activity. Because of its ability to bind and stabilize, Snayu plays a significant role in Sharir Rachana.[2,3]

The Sushruta Samhita gives the most detailed explanation of Snayu, explaining that it is the main structure that holds bones, joints, and muscles together and stops joints from moving too much. Acharya Sushruta explains that damage to Snayu leads to pain, changes in shape, limited movement, and problems with how the body functions, showing how important it is in clinical terms.[2,9] The Charaka Samhita, Ashtanga Hridaya, and Ashtanga Sangraha also agree that Snayu is a key tissue that helps keep the body steady, maintain proper posture, and allow normal movement.[1,3,4,10]

From today's understanding of body structure, Snayu is very similar to ligaments, tendons, fascia, and aponeuroses. These tissues help the body stay strong, keep joints in place, pass on force from muscles, and support the whole musculoskeletal system. So, the Ayurvedic idea of Snayu works closely with the connective tissues that modern anatomy talks about.[11–20]

Description of Snayu in Ayurvedic Classics

The idea of Snayu is talked about in all the main Ayurvedic texts, and the Sushruta Samhita gives the most detailed explanation of it. Acharya Sushruta considered Snayu as a vital part that helps connect Asthi,

Sandhi, and Peshi, keeping the body stable and allowing movements to work together smoothly. He also categorized Snayu according to its shape and how it is spread out, showing a clear and organized way of understanding connective tissues.[2,9]

Charaka Samhita, Ashtanga Hridaya, and Ashtanga Sangraha all talk about Snayu as a key supporting tissue that helps keep the body structured, maintains proper posture, allows movement, and supports joint function. These old descriptions are very similar to the modern ideas of ligaments, tendons, fascia, and aponeuroses, which help with holding things together, giving support, and passing along force. This similar function helps connect the Ayurvedic idea of Snayu with the practical study of Janu Sandhi.[1–4,10–20]

Classification of Snayu

Acharya Sushruta grouped Snayu based on their shape and how they work, showing how they help keep the musculoskeletal system stable, movable, and strong. Snayu are divided into four types based on their structure: Pratanavati, Vrutta, Prithula, and Sushira. Each type has a specific job in how the body works and helps joints and supporting tissues work correctly.[2,9]

Pratanavati Snayu

Pratanavati Snayu are wide, thin, and spread out fibrous structures that form a network-like pattern. They help support muscles and joints by spreading out the pressure over a bigger area. In terms of function, they are similar to fascia and aponeuroses, which help strengthen the nearby soft tissues and keep the structure connected.[2,9,11–16]

Vrutta Snayu

Vrutta Snayu are shaped like cylinders and look like ropes, and they are very strong when stretched. Their main job is to attach muscles to bones and help pass on the force from the muscles to move the body. These traits are very similar to the tendons that are studied today in anatomy.[2,9,11–20]

Prithula Snayu

Prithula Snayu are thick and wide fibrous tissues that give support and strength to the main joints. They stop too much movement in the joints and keep the joints aligned when you are using your body weight. In terms of function, they work similarly to the main ligaments found in the knee, hip, and ankle joints.[2,9,11–20]

Sushira Snayu

Sushira Snayu are described as hollow or perforated fibrous structures that are found in specific parts of the body. Even though we aren't sure exactly what they are today, they are thought to be similar to certain types of connective tissues that surround nerves, blood vessels, and joints.[2,9,11–16]

The way Snayu is classified shows how well Acharya Sushruta understood the body's structure. Together, these four types help support, keep things steady, allow for controlled movement, and offer protection to the muscles and bones system. Their structure and function are very similar to ligaments, tendons, fascia, and aponeuroses, which shows a strong scientific link between Ayurvedic anatomy and modern anatomy of connective tissues.[2,9,11–20]

Embryological Concept, Panchabhautika Composition and Importance of Snayu

Embryological Concept of Snayu

Ayurveda describes how the body's structures develop through the combined efforts of Shukra, Shonita, the five great elements, the maternal and paternal energies, and the concept of conception. Even though the specific development of Snayu during embryonic stages isn't discussed in detail on its own, it is seen as a key part of the growing musculoskeletal system. It's important to form the Snayu correctly to keep the body supported, joints stable, and movement normal.[1–4]

Modern embryology shows that ligaments, tendons, fascia, and other connective tissues mostly come from the mesoderm. Mesenchymal cells turn into fibroblasts, which make collagen fibers and the extra cellular material that help connective tissues stay strong and flexible. This idea is very similar to the role of Snayu as described in Ayurveda, which is about supporting and holding things together.[11–18]

Panchabhautika Composition of Snayu

In Ayurveda, Snayu is made up of the five great elements, with the earth element being the main one. The earth element gives it strength and firmness, while the water element helps it stay flexible and healthy. Vayu Mahabhuta helps with movement and flexibility, while Teja and Akasha support the body's tissue processes and how structures are organized. This balanced makeup allows Snayu to work well as a supporter and stabilizer.[2–4]

Importance of Snayu

Snayu connects bones, muscles, and joints together to form a working unit that helps keep the body stable, maintains proper posture, and allows for smooth movement. If the Snayu becomes damaged or starts to break down, it can cause pain, make the area unstable, lead to a bad shape, and limit how well someone can move. In Janu Sandhi, having a healthy Snayu is important for keeping the body's mechanics normal and avoiding problems in the muscles and bones.[2–4,11–30]

Structural and Functional Anatomy of Snayu

Snayu has features that are very similar to the strong, tightly packed tissues found in today's anatomy, especially structures like ligaments, tendons, fascia, and aponeuroses. These tissues are mainly made up of collagen fibers, fibroblast cells, elastin fibers, and other

materials outside the cells. This helps the tissues be strong, stretchy, and able to handle pulling forces.[11–20]

Snayu helps hold Asthi, Sandhi, and Peshi together, which keeps the body parts in the right position and stops the joints from moving too much. Ligaments attach one bone to another and help keep joints steady, while tendons connect muscles to bones and pass on the force from the muscles to help with movement. Fascia and aponeuroses offer extra support by covering muscles and the nerves and blood vessels that go along with them. These similarities strongly show that Snayu is connected to modern connective tissues.[2,9,11–20]

Snayu helps with keeping joints stable, managing movement, passing on force, maintaining posture, and reducing shock. These functions are especially important in Janu Sandhi, because the ACL, PCL, MCL, LCL, patellar ligament, quadriceps tendon, hamstring tendons, and the surrounding fascia all work together to keep the knee stable when you stand, walk, run, or do any activity that puts weight on the legs. When these structures get damaged, it causes pain, makes movement unstable, changes the way the body moves, and limits how well someone can move.[11–23]

So, both Ayurvedic texts and modern anatomy agree that fibrous supporting tissues are very important for keeping the musculoskeletal system strong and working properly. Even though the connections suggested are not based on exact physical matching but instead on how structures and functions are similar, they offer a scientific reason to combine Snayu Sharir with the practical study of Janu Sandhi. This helps pave the way for more research that crosses different areas of anatomy and musculoskeletal medicine.[2–4,11–30]

CONCEPT OF JANU SANDHI

Nirukti and Definition of Janu Sandhi

Janu is a term that refers to the knee area, and Sandhi means the point where two or more bones connect. In Ayurveda, Sandhi is the place where bones meet. It helps the body stay stable and move smoothly because of the teamwork between Snayu, Peshi, Sandhi Bandhana, and other parts that support it. So, Janu Sandhi means the knee joint, which is a key movable joint that helps with supporting body weight, moving around, and keeping balance in posture.[2–4]

From today's understanding of the body, the knee joint is the biggest and one of the most complicated types of hinge joints that have a synovial structure in the human body. The knee joint is made by the connection of the lower part of the thigh bone, the upper part of the shin bone, and the kneecap. This allows the leg to bend, straighten, and make small twisting movements, while still keeping the joint stable during everyday tasks.[11–18]

Classification of Janu Sandhi

Acharya Sushruta grouped Sandhi based on both how it is formed and what it does. In terms of function, joints are categorized into Cheshtavanta Sandhi, which are movable, and Sthira Sandhi, which are immovable. Janu Sandhi is part of the Cheshtavanta Bahuchala Sandhi category because it allows for a variety of movements needed for moving around. In terms of structure, Sushruta outlined eight types of Sandhi, and among them, Janu Sandhi is classified as Kora Sandhi, which is known for allowing movement similar to a hinge.[2,9]

In modern anatomy, the knee is considered a type of hinge joint that has some special features and is classified as a synovial joint. It allows for smooth, flexible movement while still being very stable.[11–20]

Anatomical Components of Janu Sandhi

The proper working of Janu Sandhi relies on how all its body parts fit together and work together. These parts include the femur, tibia, patella, articular cartilage, medial and lateral menisci, joint capsule, synovial membrane, synovial fluid, cruciate ligaments (ACL and PCL), collateral ligaments (MCL and LCL), patellar ligament, quadriceps tendon, hamstring tendons, bursae, the muscles around it, fascia, blood vessels, and nerves. These structures work together to keep the joint in place, give it support, handle the pressure from movement, and allow movement to happen smoothly.[11–20]

Functions of Janu Sandhi

Janu Sandhi helps support body weight and allows for smooth movement. Its main jobs are bending, straightening, a little twisting, absorbing shocks, keeping balance, passing on force, and helping stay steady when standing, walking, running, climbing, or squatting. According to Ayurveda, these functions happen because of the working together of Asthi, Snayu, Peshi, and Sandhi. In modern anatomy, the same functions are due to the combined work of bones, ligaments, tendons, cartilage, menisci, muscles, and synovial tissues. The smooth working together of these parts helps keep the knee joint stable, movable, and efficient in its movement.[2–4,11–23]

APPLIED ANATOMY OF JANU SANDHI

The Janu Sandhi, which is the knee joint, is the biggest and one of the most complicated synovial joints in the human body. It mainly helps with supporting body weight, moving around, keeping balance, and staying upright. The knee's ability to work properly relies on all these parts working together: bones, ligaments, tendons, menisci, cartilage, muscles, synovial tissues, and nerves and blood vessels. From an Ayurvedic point of view, these functions are kept working properly by Asthi, Snayu, Peshi, and Sandhi Bandhana. Together, they help keep the joint's structure and function strong and healthy.[2–4,11–20]

Osteology

Janu Sandhi is made when the lower part of the thigh bone, the upper part of the shin bone, and the kneecap come together. The joints between the shin bone and thigh bone, as well as the kneecap and thigh bone, help the knee stay stable and move smoothly. Even though the fibula isn't part of the knee joint itself, it helps by connecting to key ligaments and muscles. These connections help keep the knee stable.[11–18]

Articular Structures

The moving parts are covered with a smooth tissue called hyaline cartilage. This tissue helps reduce rubbing between the parts, spreads out the pressure from movement, and cushions the joints to protect them from damage. The medial and lateral menisci are tough, flexible tissues that help make the ends of the bones in the knee fit better, keep the joint stable, and allow the knee to move smoothly. When these structures become damaged or injured, it is often linked to conditions like osteoarthritis and torn menisci.[11–20,22,26–30]

Ligaments and Tendons

The stability of Janu Sandhi largely relies on the support from its ligaments. The ACL stops the tibia from moving forward, and the PCL stops it from moving backward. The medial collateral ligament (MCL) helps keep the knee stable on the inner side, while the lateral collateral ligament (LCL) helps keep it stable on the outer side. The patellar ligament, quadriceps tendon, and hamstring tendons help by passing the force from the muscles and managing how the joint moves. These stabilizing structures are very similar to the supportive role of Snayu as described in Ayurveda.[2,11–23]

Synovial Structures and Neurovascular Supply

The fibrous joint capsule surrounds the knee joint and has a lining on the inside made of the synovial membrane, which produces synovial fluid. This liquid helps the joint move smoothly, feeds the cartilage, and makes movement easier by lowering friction. The knee gets blood from a network of arteries called the genicular arterial anastomosis. It also gets feeling and awareness signals from different nerves like the femoral, tibial, common peroneal, obturator, and saphenous nerves. These nerves help the knee work properly together.[11–20]

Biomechanics and Clinical Relevance

The knee works like a hinge that allows bending, straightening, and a little twisting. When standing, walking, running, or squatting, the bones, ligaments, tendons, muscles, and menisci work together to keep the joints steady and help move the body's weight smoothly. Harm to these structures can lead to injuries in the ligaments, tears in the menisci, problems with the patellofemoral joint, and the development of osteoarthritis. To properly diagnose, treat, plan surgery, and manage knee problems effectively, it's important to have a clear understanding of the anatomy of the Janu Sandhi joint.[11–23,26–30]

SNAYU RELATED TO JANU SANDHI – AN AYURVEDIC AND MODERN CORRELATION

The knee joint, called Janu Sandhi, stays stable and works well mainly because its supporting connective tissues are strong and healthy. In Ayurveda, Snayu is the main structure that holds everything together, linking bones, joints, and muscles. It helps keep the body stable and allows for controlled movement. Acharya Sushruta stressed that keeping the Snayu healthy is very important for maintaining strong and stable joints. If the Snayu gets injured, it can cause pain, weakness, wrong shape, and difficulty in moving. Although classical Ayurvedic texts don't mention individual ligaments or tendons by their modern names, the way these tissues are built and how they work is similar to the idea of Snayu. So, the ligaments and tendons in the knee could be the best modern examples that match Snayu.[2–4,9,11–20]

Anterior Cruciate Ligament (ACL)

The ACL is one of the main ligaments that help keep the knee joint stable. It runs from the front part of the tibia's condyle to the inner side of the outer part of the femur's condyle. The ACL stops the tibia from moving too far forward, limits too much twisting, and helps keep the knee stable when you walk, run, jump, or turn. A torn ACL causes the knee to feel unstable, leads to pain, makes the knee give way again and again, and affects how well the knee works. Because of its strong fiber structure and ability to stabilize, the ACL works similarly to Prithula Snayu, which helps keep major joints stable and supported.[2,9,11–23]

Posterior Cruciate Ligament (PCL)

The Posterior Cruciate Ligament (PCL) is the strongest ligament in the knee joint. It runs from the back part of the tibia near the knee to the side of the inner part of the femur and stops the tibia from moving backward. The PCL plays an important role in keeping the knee stable when you carry weight and helps the knee move properly. Like the ACL, this structure has similar strength and support that match the Ayurvedic idea of Prithula Snayu, which helps keep joints stable when moving.[2,11–23]

Medial and Lateral Collateral Ligaments

The Medial Collateral Ligament (MCL) goes from the medial part of the thigh bone to the inner part of the shin bone and helps prevent the knee from bending inward. The Lateral Collateral Ligament (LCL) goes from the outer part of the thigh bone to the top of the smaller bone in the lower leg and helps prevent the knee from bending outward. These collateral ligaments help keep the knee steady from side to side and stop it from moving too much in that direction. Their wide, thick, and helpful nature is very similar to Prithula Snayu as described by Acharya Sushruta. Injury to these ligaments results in pain, instability, and impaired gait.[2,11–23]

Patellar Ligament and Quadriceps Tendon

The patellar ligament is part of the quadriceps tendon and runs from the top of the kneecap to the bony bump on the shinbone. The quadriceps tendon attaches the quadriceps femoris muscle to the top edge of the kneecap. These structures work together to send the force from the muscles needed to straighten the knee, help keep the body upright, and offer stability during movement. Their shape is like a cord, and the way they transfer force is similar to Vrutta Snayu, which is a strong fibrous structure that connects muscles to bones.[2,11–20]

Hamstring Tendons and Posterior Supporting Structures

The tendons from the Semitendinosus, Semimembranosus, and Biceps Femoris muscles help keep the back part of the knee joint stable during movement. These tendons help with bending, support twisting motions, and keep the joints steady while moving. The Popliteus tendon, along with the oblique popliteal and arcuate popliteal ligaments, helps strengthen the back part of the joint capsule and stops the leg from bending too far backward or twisting too much. These structures together do what Snayu is said to do in Ayurvedic texts, which is help with stability and protection.[2,11–23]

Functional Correlation between Snayu and Knee Connective Tissues

The ligaments and tendons in the knee work together to do the same important jobs that Snayu is known for in Ayurveda. They connect bones and muscles, keep joints in the right position, help with natural body movements, take in pulling forces, and stop wrong movements when you are carrying weight. These functions are very similar to the Ayurvedic concept of Snayu, which is the main tissue that supports the body and helps keep the joints stable and flexible. So, because of this, the ACL, PCL, MCL, LCL, patellar ligament, quadriceps tendon, hamstring tendons, and the structures at the back of the knee are considered the best modern anatomical matches for Snayu.

However, these connections should be seen as similar in function and structure, not as exact matches, because Ayurvedic texts describe Snayu using a general idea of body parts rather than the specific names and details found in modern anatomy. Finding these connections helps scientists better understand Snayu Sharir, supports learning across different fields, and lays the groundwork for combining Ayurvedic anatomy with modern musculoskeletal science and practical knee anatomy.[2–4,11–23]

MODERN ANATOMY COMPARED TO THE AYURVEDIC CONCEPT OF SNAYU

Ayurveda's notion of Snayu exhibits amazing parallels with the connective tissues identified in contemporary anatomy. Despite the fact that traditional Ayurvedic literature employs a unique anatomical terminology and framework, the functional roles and structural features assigned to Snayu are very similar to those of fascia, aponeuroses, tendons, and ligaments. Snayu is defined as a powerful fibrous tissue that keeps the musculoskeletal system's structural stability, allows for regulated movement, and protects its functional integrity by binding Asthi (bones), Sandhi (joints), and Peshi (muscles). These descriptions lay a strong foundation for connecting Ayurvedic anatomy with modern anatomical science.[2–4,11–20]

Between ligaments and Snayu, one of the most crucial relationships is seen. Ligaments are thick fibrous connective tissues that link one bone to another and provide static stability to joints by preventing excessive or abnormal mobility, according to contemporary anatomy. Like Acharya Sushruta, Snayu was referred to as the main binding structure that maintains joint stability and keeps bones from moving about. The supporting function of ligaments in major joints, especially the knee, is quite similar to the stabilizing function of Prithula Snayu as described in Ayurvedic writings.[2,9,11–20]

Additionally, Snayu demonstrates substantial functional resemblance to tendons, which join skeletal muscles to bones and transfer the force generated by muscular contraction to create movement. Tendons are important for movement, posture, and dynamic joint stability since they have excellent tensile strength. Similarly, Snayu is described in Ayurveda as a structure that maintains continuity between bones and muscles and hence facilitates movement. The traditional explanation of Vrutta Snayu matches the cord-like shape and force-transmitting purpose of tendons quite closely.[2–4, 11–20]

Modern anatomy's description of fascia and aponeuroses and Pratanavati Snayu share a significant relationship. Aponeuroses provide wide, fibrous attachments for muscles, whereas fascia creates a continuous network of connective tissue that wraps around muscles, blood arteries, nerves, and joints. They help maintain tissue continuity, disperse mechanical stress, and promote coordinated body movements. The fascia structures mentioned above are remarkably similar to Pratanavati Snayu's broad, thin, and network-like structure, as described by Acharya Sushruta.[2,9,11-18]

The anatomical association is especially clear in Janu Sandhi, where the stability of the joint is dependent on the coordinated activity of the patellar ligament, quadriceps tendon, hamstring tendons, joint capsule, and the surrounding fascia, as well as the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), and lateral collateral ligament (LCL). These connective tissue constructions prevent abnormal displacement during weight-bearing exercises, absorb mechanical stress, maintain joint congruity, guide physiological movements, and attach

muscles and bones. These tasks are quite similar to Snayu's function as depicted in traditional Ayurvedic writings.[2–4,11–23]

Disorders impacting ligaments, tendons, and various connective tissues often exhibit discomfort, instability, edema, restricted motion, and functional impairment from a clinical standpoint. Ayurveda also details similar symptoms in conditions like Sandhigata Vata and traumatic injuries impacting Snayu. Despite the fact that the two systems have different pathological explanations, both acknowledge that the integrity of supporting connective tissues is necessary for maintaining healthy joint function and avoiding disability.[21-30, 6-10]

Therefore, the connection between Snayu in Ayurveda and the structure of contemporary connective tissue offers a worthwhile scientific framework for comprehending the applied anatomy and biomechanics of Janu Sandhi. However, since Snayu is discussed in Ayurvedic texts from a conceptual and functional standpoint rather than through the extensive nomenclature of modern anatomy, these correlations should be seen as functional and anatomical commonalities rather than direct structural equivalence.[1-30] Yet, this comparative approach enhances scientific understanding of Snayu Sharir, fosters interdisciplinary education, and offers a valuable foundation for future research that combines Ayurvedic principles with contemporary musculoskeletal science.

Ayurvedic Concept	Modern Anatomical Structure	Primary Function
Snayu	Ligament	Joint stability and binding of bones
Vrutta Snayu	Tendon	Transmission of muscular force
Pratanavati Snayu	Fascia / Aponeurosis	Structural support and force distribution
Prithula Snayu	Major Knee Ligaments (ACL, PCL, MCL, LCL)	Static stability and prevention of excessive movement

JANU SANDHI DISORDER: CLINICAL SIGNIFICANCE OF SNAYU

Maintaining the Janu Sandhi's functional efficiency and structural stability requires the integrity of Snayu. Pain, instability, limited range of motion, and impaired mobility are the results of damage or deterioration to the connective tissues that support the knee joint, such as the surrounding soft tissues, ligaments, tendons, and menisci. While modern anatomy credits ligaments, tendons, fascia, and muscles with these functions working in concert, Ayurveda considers Snayu to be the main supportive tissue responsible for maintaining joint stability. As a result, a thorough understanding of the clinical importance of Snayu lays a strong foundation for the diagnosis, prevention, and integrated management of knee joint ailments.[2–4,11–23]

Vata, Sandhigata

According to Ayurveda, one of the most prevalent joint ailments is Sandhigata Vata. Sandhi Shoola (pain), Stambha (stiffness), Shotha (swelling), Atopa (crepitus), and reduced joint movement are symptoms. Degeneration of the joint's supporting structures, including Snayu, is brought on by exacerbated Vata Dosha, leading to instability and a gradual loss of function. These clinical indications are quite similar to those of degenerative diseases affecting the knee joint in contemporary medicine.[6–10,26–30]

Osteoarthritis and Ligament Disorders

The most frequent degenerative disease of the knee joint, osteoarthritis, is marked by the gradual breakdown of articular cartilage, the reduction of joint space, the development of osteophytes, and the deterioration of nearby ligaments and tendons. Similarly, trauma or sports activities frequently result in injuries to the ACL, PCL, MCL, and LCL, causing pain, swelling, instability, and functional restriction. Since both Snayu Kshata and these ailments entail damage to the tissues that support joint stability, they may be functionally connected in the Ayurvedic approach.[2,11-30]

Tendinous and Meniscus Disorders

The medial and lateral menisci are important for shock absorption, load distribution, and joint stabilization. Pain, locking, edema, and decreased range of motion are frequent signs of meniscal tears. Likewise, problems that damage the patellar tendon and quadriceps tendon—such as tendinitis and tendinopathy—decrease muscular strength and prevent the knee from working properly. Because these structures have supportive and force-transmitting functions that are comparable to Snayu, their pathology offers additional evidence for the anatomical connection between Ayurvedic and modern concepts.[11–23]

Clinical Evaluation and Sports Injuries

A far larger risk of tendon and ligament damage is posed by sports that demand quick directional changes, jumping, twisting, and running. Preventing chronic instability and secondary osteoarthritis requires prompt diagnosis. The Lachman test, Anterior and Posterior Drawer tests, McMurray test, and Valgus–Varus stress tests are all included in a clinical examination, while imaging methods like X-ray, Magnetic Resonance Imaging (MRI), and arthroscopy can precisely evaluate bones, cartilage, ligaments, tendons, and menisci.[22–25]

Clinical Significance

The notion of Snayu offers a crucial anatomical and functional framework for comprehending illnesses that impact Janu Sandhi. Joint stability, prevention of excessive movement, reduction of injury risk, and maintenance of efficient locomotion all depend on the

preservation of healthy Snayu. To improve knee biomechanics and support an integrated strategy for the prevention, diagnosis, rehabilitation, and long-term care of knee joint disorders, the Ayurvedic notion of Snayu is connected with modern connective tissue anatomy. These correlations, while mostly functional, offer a scientific justification for integrating classical Ayurvedic knowledge with modern orthopedic principles and promote more interdisciplinary research.[2–4, 11–30]

DISCUSSION

This review shows that the Ayurvedic idea of Snayu has notable structural and functional resemblance to the connective tissues described in modern anatomy. While Ayurveda and modern medical research utilize different words and conceptual approaches to explain body parts, they both agree on the crucial role that fibrous supporting tissues play in preserving musculoskeletal integrity, coordinated movement, and joint stability. According to this comparative study, Snayu's traditional description is still pertinent for comprehending Janu Sandhi's functional anatomy.[1-4, 11-20]

The most thorough explanation of Snayu may be found in Sushruta Samhita, one of the classic Ayurvedic texts. Snayu was considered by Acharya Sushruta to be the primary binding structure that links Asthi, Sandhi, and Peshi and maintains body stability and mobility. A methodical understanding of the variety of supporting tissues is reflected in the categorization of Snayu into Pratanavati, Vrutta, Prithula, and Sushira. Their structural and functional characteristics closely resemble the modern understanding of tendons, fascia, aponeuroses, and ligaments, even though these descriptions are based on traditional anatomical observations.[2,9,11-20]

The knee joint is one of the most intricate synovial joints in the human body, and its stability is mainly based on the coordinated action of ligaments, tendons, menisci, muscles, joint capsule, and surrounding connective tissues. These structures connect bones, control physiological movements, take up mechanical stress, and prevent excessive displacement when doing weight-bearing tasks. Ayurvedic works assign identical functions to Snayu, lending credence to the notion that Snayu's nearest contemporary anatomical equivalents are represented by the connective tissues of Janu Sandhi.[2-4,11-23]

Conditions like tendinopathies, meniscal tears, ligament injuries, Sandhigata Vata, and osteoarthritis clearly demonstrate the clinical significance of this link. Both modern medicine and Ayurveda agree that injury to supporting tissues results in discomfort, instability, stiffness, restricted movement, and functional impairment. Both systems emphasize the value of maintaining joint-supporting systems for sustained locomotion and the prevention of chronic handicap, despite the differences in etiopathogenesis.[6–10,21–30]

Despite these parallels, the suggested relationship should be viewed as a functional and conceptual comparison rather than a direct anatomical equivalence. Modern anatomy analyzes connective tissues using histological, embryological, and biomechanical evidence, while classical Ayurvedic scriptures characterize Snayu based on its role and overall morphology. Therefore, more multidisciplinary investigations incorporating imaging, anatomy, biomechanics, and clinical research are required to further validate these correlations scientifically.[2,11–30]

Generally, the current study supports combining the applied anatomy of Janu Sandhi with Snayu Sharir to create a useful scientific framework for comprehending knee joint biomechanics and musculoskeletal illnesses. This integrative strategy might enhance anatomical instruction, promote interdisciplinary research, and support evidence-based Ayurvedic practice in the prevention and treatment of knee joint conditions.[1-30]

CONCLUSION

One of the essential anatomical structures outlined in Ayurveda is snayu, which is very important for preserving the musculoskeletal system's stability, integrity, and functional effectiveness. Snayu, according to ancient Ayurvedic scriptures, particularly the Sushruta Samhita, is the main supporting tissue that keeps bones, muscles, and joints together, ensuring proper posture, synchronized movement, and joint stability.

The current study shows that the structural and functional characteristics of Snayu are very similar to modern concepts of ligaments, tendons, fascia, and other connective tissues. This link is especially obvious in Janu Sandhi, where the coordinated activity of these structures preserves joint stability, helps movement, and supports normal biomechanics. Even though the proposed correlations are based on functional and anatomical similarities as opposed to direct structural equivalence, they offer a useful scientific framework for comprehending the connection between Ayurvedic anatomy and modern musculoskeletal science.

Enhancing anatomical knowledge, improving clinical interpretation, and supporting evidence-based Ayurvedic practice are all benefits of integrating the notion of Snayu Sharir with the practical anatomy of Janu Sandhi. Further multidisciplinary studies in Ayurvedic anatomy and modern orthopedic science might be encouraged by this integrative strategy, which may also help improve understanding, prevention, rehabilitation, and holistic treatment of knee joint conditions.

FUTURE SCOPE AND RECOMMENDATIONS

The anatomical and functional relationship between Janu Sandhi's connective tissue structures and the Ayurvedic notion of Snayu is highlighted in this review. Although existing classical literature and contemporary anatomical evidence corroborate this association, more scientific

verification is required. In order to gain a better understanding of Snayu's structural and functional characteristics, future research should integrate Ayurvedic principles with advanced diagnostic methods like magnetic resonance imaging (MRI), ultrasonography, histological studies, and biomechanical analysis. More evidence for these correlations might come from comparative anatomical investigations, cadaveric dissections, and clinical research on ailments including Sandhigata Vata, osteoarthritis, ligament damage, and knee issues linked to sports. Moreover, scientific acceptance of Ayurvedic therapeutic treatments might be increased by well-designed observational studies and clinical trials. Evidence-based Ayurvedic education, clinical practice, and future orthopedic research will all benefit from this kind of multidisciplinary research, which will also improve the integration of modern musculoskeletal science with Snayu Sharir.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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