DOI: 10.21088/ijmhs.2347.9981.13226.3

Indian Journal of Medical & Health Sciences
Volume 13 Number 2 July - December 2026

REVIEW ARTICLE

An Integrative Literary Review of Marmatantra to Establish the Pain Management Effect in Janusandhigatavata vis-à-vis Knee Osteoarthritis

Shashidhar V. Emmi[1], Rohini R Patil[2], Maheshkumar[3]

HOW TO CITE THIS ARTICLE:

Shashidhar V. Emmi, Rohini R Patil, Maheshkumar. An Integrative Literary review of Marmatantra to Establish the Pain Management Effect in Janusandhigatavata vis-à-vis Knee Osteoarthritis. Jr. Med. & Health Sci. 2026; 13(2): 87–101.

ABSTRACT

The classical term JaanuSandhigata Vata, in indian medicine can be correlated with Osteoarthritis of the knee joint. It is one such chronic, degenerative, inflammatory disease which has a great impact on the quality of the life of an individual. Among joint disease, Osteoarthritis is often seen out of which the knee joint is incredibly common in elderly. OA is the 2nd commonest musculoskeletal problem in the world. Pain predominates, disabling problem of arthritis with a strong association with aging and emale gender16 and has 22%-39% prevalence in India. Among 80 Naanatmaja Vatavyadhis, Jaanusandhigatavaata dominated by Shoola, Shotha, Prasarana akunchana apravrutti (Pain and tenderness, during the movements so it can be correlated with Osteoarthritis. Jaanusandhigatavaata is also correlated to knee osteoarthritis due to resemblance in sign and symptoms like joint pain, stiffness, muscle weakness, swelling of knee joint, deformed joint, reduced range of motion and loss of use of the joints and cracking sounds. The science is found only in Ayurveda and Siddha system of medicine. It is an ancient indian practice whose focus MARMAVIGYNANA is the manipulation of subtle energy (Prana) in the body for the purpose of supporting the healing process MARMATANTRA is based on the utiliastion of 107 points to body, mind & consciousness. Snehana and swedana are prescribed as common treatments in vatavyadhi, for jaanu sandhigatavata the main treatement given is jaanu basti, upanaaha, abhyanga, but the patient not feels comfort and the pain is not reduced completely, simultaneously by the Application of marma tanrta, marama chikitsas like Peedana, Mardana, Dhaarana, Vyadhana, Raktamokhana, etc by the Marma Tantra Procedures, increases the patients self confidence on walking and immediate relief in the pain at the Jaanu Pradesha or Knee joint is well appreciated.

AUTHOR'S AFFILIATION:

[1] Professor & HOD, Department of Rachana Sharira, Shri D.G.M. Ayurvedic Medical College & Hospital, Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India.

[2] Associate Professor, Department of Panchakarma, Shri D.G.M. Ayurvedic Medical College & Hospital, Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India.

[3] Intern, Shri D.G.M. Ayurvedic Medical College & Hospital, Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India.

CORRESPONDING AUTHOR:

Maheshkumar, Intern, Shri D.G.M. Ayurvedic Medical College & Hospital, Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India.

E-mail: maheshhundekal6@gmail.com

➢ **Received:** 13-04-2026 ➢ **Accepted:** 20-06-2026

Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution NonCommercial 4.0 License (http://www.creativecommons.org/licenses/by-nc/4.0/) which permits non-Commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the Red Flower Publication and Open Access pages (https://www.rfppl.co.in)

KEYWORDS

• Marmachikitsa • Management • Ayurvedic • Anti-Inflammatory • Osteoarthritis • Obesity • Pharmacological profile

INTRODUCTION

Arthritis constitutes one of the leading causes of chronic disability globally. Among the various forms, **Knee Osteoarthritis (KOA)** is the second most common musculoskeletal disorder worldwide[1], with a prevalence of 22–39% in India. The condition disproportionately affects the elderly, particularly women over the age of 65 years, among whom the prevalence exceeds 68%.[2] The hallmarks include progressive articular cartilage degeneration, subchondral bone remodelling, synovial inflammation, and ultimately, functional disability.

In Ayurvedic medicine, this condition has been classically described as Janusandhigata Vata (JSV), one among the 80 Nanatmaja Vatavyadhis (disorders exclusively caused by Vata Dosha vitiation).[3] The pathognomonic features of JSV — Shoola (pain), Shotha (swelling), Sandhi Sphutana (crepitation), and Prasarana-Akunchana Apravrutti (restricted flexion-extension)[4] — closely mirror the clinical profile of KOA, making this a well-substantiated clinico-academic correlation.

Conventional management of KOA relies on analgesics, non-steroidal anti-inflammatory drugs (NSAIDs), physiotherapy, and ultimately joint arthroplasty. However, long-term pharmacological therapy is associated with significant gastrointestinal, renal, and cardiovascular adverse effects, limiting its sustained use.[5] Ayurveda offers a spectrum of non-invasive, integrative therapeutic modalities that address the root pathology, providing both symptomatic relief and disease modification.

The present literary review comprehensively analyses the classical references, phytochemical evidence, and pharmacokinetic–pharmacodynamic (PK–PD) profiles of **Mardana (therapeutic massage), Peedana (compression therapy at Janu Marma), Maricha Churna Lepana (black pepper powder topical application), and Ashwagandha Taila Snehana (oleation with Withania somnifera oil)** in the management of JSV/KOA.

Aim

To critically analyse and synthesise the classical Ayurvedic textual evidence, phytochemical profile, and pharmacokinetic–pharmacodynamic mechanisms of Mardana, Peedana (Janu Marma stimulation), Maricha Churna Lepana, and Ashwagandha Taila Snehana as an integrated therapeutic protocol in the management of Janusandhigata Vata (Knee Osteoarthritis), and to establish their scientific validity for publication through classical references, modern pharmacological correlations, and clinical evidence.

Objectives

1. To review the classical Ayurvedic literature pertaining to Janusandhigata Vata with reference to its Nidana (aetiology), Samprapti (pathogenesis), Lakshanas (signs and symptoms), Chikitsa Siddhanta (treatment principles), and Sadhya-Asadhyata (prognosis) from the Brhat Trayi (Charaka Samhita, Sushruta Samhita, Ashtanga Hridayam) and allied classical texts.

2. To establish the clinico-academic correlation between Janusandhigata Vata and Knee Osteoarthritis by comparing their aetiology, pathology, clinical features, differential diagnosis, and prognostic considerations from both Ayurvedic and contemporary biomedical perspectives.

3. To review the classical description of Janu as a Marma, including its Rachana (structural composition), anatomical correlates, classification, measurement (Angula Pramana), location, and the consequences of its injury, with reference to Sushruta Samhita Sharira Sthana.

4. To examine the pharmacognostic and phytochemical profile of Ashwagandha (Withania somnifera) and Maricha (Piper nigrum), identifying their major bioactive constituents—including withanolides, sitoindosides, piperine, chavicine, and volatile oils and correlating them with their classical Ayurvedic Rasa–Guna–Virya–Vipaka–Karma properties.

5. To analyse the pharmacological evidence supporting the anti-arthritic, anti-inflammatory, analgesic, and chondroprotective actions of Ashwagandha and Maricha, with specific reference to NF-κB inhibition, COX-2 pathway suppression, TRPV1 channel activation, substance P depletion, and bioavailability enhancement.

6. To elucidate the pharmacokinetic and pharmacodynamic mechanisms of each intervention — Mardana, Peedana, Maricha Churna Lepana, and Ashwagandha Taila Snehana — characterising their onset, peak effect, duration of action, receptor targets, and neurochemical mediators in the context of KOA management.

7. To document the neurophysiological basis of Mardana (Gate Control Theory, endogenous opioid release, serotonin–dopamine modulation) and Peedana at Janu Marma (myofascial trigger point release, mechanoreceptor stimulation, Prana normalisation), and to correlate these with the classical Ayurvedic concepts of Shoola Hara, Sandhi Graha Hara, and Vatanulomana.

8. To analyse the synergistic pharmacological interactions among all four modalities when applied as a sequential combined protocol (Karma Krama), with specific emphasis on the transdermal pharmacokinetics of piperine and withanolides, and their enhanced penetration facilitated by Tila taila.

9. To compile a comprehensive, publication-ready bibliography in Vancouver style, with in-text superscript citations, covering all classical Ayurvedic primary texts, pharmacognosy references, modern medical textbooks, and contemporary peer-reviewed literature cited in the review.

10. To provide structured comparative tables and analytical frameworks that present the classical and modern evidence in an accessible format for peer-reviewed journal publication in Ayurvedic and integrative medicine.

CLASSICAL LITERARY REVIEW: JANUSANDHIGATA VATA

1. Nidana (Aetiology) — Classical References

The classical Ayurvedic texts provide a well-documented account of the aetiology of Vatavyadhi in general, and Sandhigatavata in particular. Acharya Charaka in the Charaka Samhita, Chikitsa Sthana 28/15 enumerates the causative factors of Vatavyadhi: Dhatu-kshaya (depletion of tissues), Margavarana (channel obstruction), and Pradoshaja (exogenous insults).[6] Acharya Sushruta in Sushruta Samhita, Nidana Sthana, *Chapter 1, Verse 23*, describes Vatavyadhi Nidana, classifying it under Ashtamahagada (eight great diseases) due to its rapid onset and complications.[7]

Acharya Vagbhata in *Ashtanga Samgraha, Nidana Sthana, Vatavyadhi Nidana, Chapter 15*, *Verse 36*, further elaborates on the Sandhigata Vata Nidana, attributing it to the specific combination of Dhatu-kshaya and Margavarana, resulting in Vata accumulation within the joint space.[8] Madhavakara's *Madhavanidana*, *Chapter 22*, provides a concise and systematic description of the nidana of Sandhigatavata, consistent with the Brhat Trayi formulation.[9]

Key aetiological factors referenced include: Atishayam vyadhanam (excessive physical exertion)[10], Vegadharana (suppression of natural urges), Langhana (fasting beyond capacity), Chinta (anxiety), Krodha (anger), Shoka (grief), and Vishamashana (irregular diet). These factors, in conjunction with advancing age (Jara), lead to progressive Asthi-Majja Dhatu kshaya (depletion of bone and bone marrow) and resultant Vata Dosha vitiation.[11]

2. Samprapti (Pathogenesis) — Classical References

The Samprapti (pathogenetic chain) of Janusandhigata Vata proceeds through well-defined stages. Vitiated Vata Dosha, upon accumulating at the Janu Sandhi, produces drying and degenerative changes in the Shleshaka Kapha (synovial Kapha responsible for joint lubrication) and the Asthi Dhatu. *Acharya Charaka* in *Charaka Samhita*, *Chikitsa Sthana 28/56* explains that Vata, deranged and residing in joints, causes Shoola (pain), Sopha (swelling), and Vaikritya (deformity) through its Ruksha (dry), Laghu (light), Chala (mobile), and Sheeta (cold) properties.[12]

The Shatkriyakala (six stages of disease manifestation) as described by Sushruta can be correlated with the progressive stages of KOA: Sanchaya (accumulation of Vata), Prakopa (aggravation), Prasara (spread),

Sthanasamshraya (deposition at Janu Sandhi), Vyaktavastha (manifestation as JSV symptoms), and Bheda (complications such as Asthi shithilata/subluxation, joint destruction).[13]

The critical involvement of Shleshaka Kapha is noted: its progressive depletion under Vata's Shoshana (drying) action leads to reduced joint lubrication, increased friction, cartilage degeneration, and ultimately bone-on-bone contact — a direct Ayurvedic parallel to the articular cartilage loss seen in OA radiologically.[14]

3. Lakshanas (Signs and Symptoms) — Classical References

The classical lakshanas of Sandhigatavata are comprehensively described by Acharya Charaka in *Charaka Samhita, Chikitsa Sthana 28/37* as follows: Sandhi Shoola (joint pain), Sandhi Shotha (joint swelling with Vatapurna drutisparsha — balloon-like feel), Sandhi Sphutana (crepitation), Sandhi Graha (stiffness), and Prasarana-Akunchana Apravrutti (restricted range of motion during flexion and extension).[15]

Acharya Sushruta's description in *Sushruta Samhita, Sutra Sthana 21/19* adds the dimension of Atopa (borborygmi/sounds), Kshaya of Mamsa and Meda Dhatu (muscle and fat tissue wasting around the joint), and progressive deformity in advanced stages.[16] Vagbhata's account in *Ashtanga Hridayam, Nidana Sthana* corroborates the above and adds Khanjata (limping) as a distinctive feature when the Janu Marma is involved.[17]

4.Chikitsa Siddhanta (Treatment Principles) — Classical References

The treatment of Janusandhigata Vata follows the general principle of Vatavyadhi Chikitsa, with specific modifications for Sandhi involvement. Acharya Charaka in *Charaka Samhita, Chikitsa Sthana 28/72–74* prescribes Snehana (oleation), Swedana (fomentation), Brimhana (nourishing therapy), Basti (medicated enema), and Bahya Chikitsa (external therapies) as the primary modalities.[18]

Specifically for Sandhigatavata, Acharya Charaka recommends in *Charaka Samhita, Chikitsa Sthana 28/11:* Abhyanga (oil massage), Upanaha (medicated poultice), Janu Basti (retention of medicated oil over knee joint), and Agnikarma (heat cauterisation) in appropriate stages.[19] These interventions collectively address the Vata Dosha vitiation, nourish the depleted Dhatus, and restore the integrity of the joint.

Yogaratnakara, in its chapter on Vatavyadhi Chikitsa, elaborates specific formulations including Ashwagandha-based Taila preparations for Abhyanga and emphasises the use of Tikshna Dravyas (penetrating drugs) for Lepana (topical application) to address Shotha and Shoola.[20] Sri Bhavamisra's *Bhavaprakasha, Chikitsa Sthana 24/1–2* also corroborates the use of Snigdha Ushna Dravyas for pacifying Vata in joint disorders.[21]

5. Prognosis (Sadhya-Asadhyata)

Acharya Charaka classifies Sandhigatavata as *Kashtasadhya* (difficult but not impossible to cure), based on its chronicity, involvement of Madhyama Rogamarga (intermediate disease pathway involving vital structures), and the Marmashrita (vital point-associated) nature of the Janu Sandhi.[22] Sushruta and Vagbhata include Vatavyadhi under *Ashtamahagada* due to its propensity for serious upadrava (complications) including Mamsakshaya, Trishna, Jwara, Murcha, Shwasa, Stambha, and Samkocha.[23]

JANU AS A MARMA — CLASSICAL AND ANATOMICAL REVIEW

1. Definition and Classification of Marma

Acharya Sushruta, in *Sushruta Samhita, Sharira Sthana 6/15*, defines Marma as: "*Mamsasira snayu-asthi-sandhayo yatra samhatah tatra Marma*" — vital anatomical points where Mamsa (muscle), Sira (vessels), Snayu (ligaments/tendons), Asthi (bones), and Sandhi (joints) converge, and where the Prana (life force) specifically resides.[24] A total of 107 Marmas are described across the human body, classified into five types based on their primary structural composition (Table 2).

Marmas are further classified based on their physiological consequences upon injury into: Sadyapranahara (immediately fatal), Kalantarapranahara (fatal over time), Vishalaghna (disfiguring), Vaikalyakara (causing disability), and Rujakara (causing pain only).[25] The Janu Marma is classified as **Vaikalyakara** — injury to it results in Khanjata (limping/permanent disability) but not immediate death, making it amenable to therapeutic intervention.

Table 1: Classification of Marma According to Rachana Prakara (Sushruta Samhita)

Marma Type (Rachana)	Number (Sushruta)	Anatomical Correlate
Mamsa Marma	11	Muscle-predominant vital points
Sira Marma	41	Vessel-predominant vital points
Snayu Marma	27	Ligament/tendon vital points
Asthi Marma	08	Bone-predominant vital points
Sandhi Marma	20	Joint-predominant vital points; includes Janu Marma

2. Janu Marma — Classical Description

The Janu Marma is described by Acharya Sushruta in Sushruta Samhita, *Sharira Sthana 6/25* with the following Sanskrit reference:

"Jangha-Urdhva-Sandhane Janu Nama, Tatra Khanjata"

Translation: "The structure that binds the Jangha (leg/shin) and the Uru (thigh) is called Janu Marma; injury to it causes Khanjata (limping)."[26] The Janu Marma: (a) is classified as Sandhi Marma (joint-type vital point); (b) is bilateral in number (2 Marmas); (c) measures 3 Angula Pramana (approximately 3–4.5 cm) in dimension; and (d) is designated Vaikalyakara (disability-causing if injured).[27]

Prof. K.R. Srikantha Murthy's translation of *Sushruta Samhita (Sharira Sthana 6/33)* identifies the anatomical structures corresponding to Janu Marma as: articular capsule, fibular collateral ligament, anterior cruciate ligament, posterior cruciate ligament, medial meniscus, lateral meniscus, transverse ligament, coronary ligament, and arcuate popliteal ligament — collectively constituting the essential stabilising complex of the knee joint.[28]

Table 2: Ayurvedic View and Modern Anatomical Correlation of Janu Marma

Ayurvedic Structure	Modern Anatomical Correlate
Mamsa	Medial & lateral heads of gastrocnemius, plantaris, popliteus muscle.
Sira	Popliteal artery with its branches (geniculate arteries); popliteal vein with its tributaries; great saphenous vein.
Snayu	Fibrous capsule, ligamentum patellae, anterior cruciate ligament, posterior cruciate ligament, medial collateral ligament, lateral collateral ligament, medial meniscus, lateral meniscus, transverse ligament, arcuate popliteal ligament.
Asthi	Distal femur (medial & lateral condyles), proximal tibia, patella.
Sandhi	Tibiofemoral joint (medial and lateral compartments), patellofemoral joint.

3. Marma Chikitsa — Classical Therapeutic Techniques

Acharya Sushruta classifies Marma Chikitsa as an integral component of Shalya Tantra (surgical sciences), emphasising that knowledge of Marmas is indispensable for both surgical and therapeutic interventions.[29] The therapeutic techniques applicable to Janu Marma include Mardana, Peedana, Dhaarana, Vyadhana, and Raktamokshana.

Prof. S.K. Joshi in *Marma Science and Principles of Marma* Therapy describes two specific techniques for Janu Marma stimulation: the "Thumbs Up Technique" (therapist-administered) and the "Thumbs Down Technique" (self-administered), each requiring 15–18 stimulations at 0.8-second intervals, repeated 3–4 times daily.[30] Prof. Avinash Lele *et al.* in Secrets of Marma document that Janu Marma stimulation addresses Prana vitiation at the knee joint level, restoring both structural integrity and functional mobility.[31]

Dr. D.G. Thatte's work *Acupuncture, Marma and Other Asian Therapeutic Techniques* places Marma therapy within the broader context of Asian healing traditions, noting its parallel with Traditional Chinese Medicine acupressure at ST-36 (Zusanli), GB-34 (Yanglingquan), and SP-10 (Xuehai) — all of which are located in the vicinity of the knee joint and show documented anti-arthritic effects.[32]

DRUG REVIEW — PHYTOCHEMICAL AND PHARMACOLOGICAL EVIDENCE

1. Ashwagandha (Withania somnifera Dunal)

1. Botanical Identity and Classical Classification

Ashwagandha belongs to family Solanaceae. Its classical Ayurvedic classification places it under: Charaka — Balya, Brimhaniya, Madhuraskandha Ganas[33]; Bhavaprakasha Nighantu — Guduchyadi Varga. The drug is identified by synonyms including Hayagandha, Vajigandha, Turangagandha, and Pivari, reflecting its characteristic horse-like odour (Ashwa = horse; Gandha = smell).

Rasa (taste): Katu (pungent), Tikta (bitter), Kashaya (astringent) | **Guna (qualities):**

Snigdha (unctuous), Laghu (light) | **Virya (potency)**: Ushna (hot) | Vipaka (post-digestive taste): Katu | Karma: Vata-Kaphahara, Balya, Rasayana, Shukrala[34]

2 Phytochemical Profile of Ashwagandha

The pharmacological activities of Ashwagandha are primarily attributed to its steroidal lactones (withanolides), glycowithanolides (sitoindosides), alkaloids, and phenolic compounds. Major chemical constituents include: Withaferin A, Withanolide A through Y, Sitoindosides VII–X, Withasomniferin A, Somnirol, Somnitol, Sominone, Sominolide, along with alkaloids such as Nicotine, Withanine, and Pseudotropine.[35]

Table 3: Phytochemical Profile of Ashwagandha (Withania somnifera) and Pharmacological Relevance to Knee Osteoarthritis

Phytoconstituent	Class	Pharmacological Activity	Relevance to KOA
Withaferin A	Steroidal lactone (withanolide)	Anti-inflammatory (NF-κB inhibition), anti-arthritic, anti-tumour	Inhibits synovial inflammation; chondroprotective
Withanolide A–Y	Steroidal lactones	Immunomodulatory, anti-inflammatory, analgesic	Reduces pain mediators; joint protection
Withanosides I–VII (Sitoindosides)	Glycowithanolides	Adaptogenic, neuroprotective, antioxidant	Combats oxidative cartilage damage
Withanoside IV	Glycowithanolide	Nerve growth factor (NGF)-mimetic; regenerative	Periarticular nerve regeneration support
Alkaloids: Nicotine, Withasomniferine, Withanine	Tropane alkaloids	Analgesic, sedative, anti-spasmodic	Pain relief; muscle relaxation at joint
Withasomniferin A	Steroidal alkaloid	CNS depressant; analgesic	Central pain modulation
Somnirol, Somnitol	Steroidal compounds	Anti-inflammatory, anti-oxidant	Reduces periarticular inflammation
Sominone, Sominolide	Withanolide derivative	Anti-inflammatory, analgesic	Synergistic cartilage protection
β-sitosterol	Phytosterol	Anti-inflammatory, immunomodulatory	COX enzyme modulation; reduces PGE2
Iron (Fe^{2+})	Mineral	Haematopoietic, anti-fatigue	Reduces anaemia-related joint symptoms
Fatty acids (oleic, stearic, palmitic)	Lipids	Membrane stabilisation, anti-inflammatory	Improves synovial fluid viscosity; lubrication

3. Pharmacological Evidence — Anti-arthritic Actions

Multiple preclinical and clinical studies have validated Ashwagandha's anti-arthritic properties. Withaferin A has been demonstrated to inhibit NF-κB signalling pathway, suppress pro-inflammatory cytokines (TNF-α, IL-1β, IL-6), and inhibit matrix metalloproteinases (MMPs) responsible for cartilage matrix degradation.[36] These mechanisms directly address the inflammatory and degenerative components of KOA.

The Brimhana (anabolic) property of Ashwagandha is pharmacologically supported by its testosterone-like action via withanolides, promoting protein synthesis, muscle anabolism (Mamsa vridhi), and bone mineral density improvement — critical for reversing the periarticular Mamsa kshaya (muscle wasting) and Asthi kshaya (bone depletion) seen in JSV/KOA.[37]

Tila taila (sesame oil) — the base of Ashwagandha Taila — independently possesses Ushna (hot), Tikshna (sharp), and Sukshma (penetrating) properties[38], which facilitate transdermal absorption of the withanolides and alkaloids. Its unsaturated fatty acid composition (linoleic acid, oleic acid, sesamin, sesamolin) provides anti-inflammatory activity and improves skin permeability, acting as a natural penetration enhancer for topical drug delivery.

2. Maricha (Piper nigrum Linn.) — Black Pepper

1. Botanical Identity and Classical Classification

Maricha (Black pepper) belongs to family Piperaceae. Its Ayurvedic classification includes: Charaka — Dipaniya, Shulapratisharana, Krimighna, Shirovirechanopaga Ganas[39]; Sushruta — Pippalyadi, Tryushana; Vagbhata — Pippalyadi (Ashtanga Samgraha), Vatsakadi (Ashtanga Hridayam). Classical synonyms include Usana, Krishna, and Vellaja.

Rasa: Katu (pungent) | **Guna:** Laghu (light), Tikshna (sharp/penetrating) | **Virya:** Ushna (hot) | **Vipaka:** Katu | **Karma:** Kaphahara, Agni Dipana, Pramithi (digestion stimulant)[40]

2. Phytochemical Profile of Maricha

The bioactive constituents of Piper nigrum include piperine (1–9%), chavicine, piperyline, piperettine, piperolein A & B, volatile oils (β-caryophyllene, α-pinene, limonene, camphene, piperanal), carotene, ascorbic acid, pipercide, and resin (chavicin).[41]

Table 4: Phytochemical Profile of Maricha (Piper nigrum) and Pharmacological Relevance to Lepana in KOA

Phytoconstituent	Class	Pharmacological Activity	Relevance to KOA/Lepana
Piperine (1–9%)	Alkaloid	Analgesic, anti-inflammatory (COX-2 inhibition), anti-arthritic, bioavailability enhancer	Primary active principle; inhibits PGE2; enhances drug absorption transdermally
Piperin amides (Piperyline, Piperettine)	Amide alkaloids	Anti-inflammatory, antinociceptive	Synergistic analgesic effect topically
Piperolein A & B	Amide alkaloids	Smooth muscle relaxant, anti-inflammatory	Reduces periarticular muscle spasm
Chavicine	Alkaloid isomer of piperine	Irritant; counter-irritant; rubefacient	Key rubefacient for Lepana; increases local blood flow
Volatile oils (β-caryophyllene, α-pinene, limonene, camphene)	Terpenes/ sesquiterpenes	Anti-inflammatory, analgesic, antimicrobial	Penetration enhancers; reduce joint inflammation transdermally
Piperanal	Phenolic aldehyde	Antifungal, analgesic	Anti-inflammatory support
Carotene	Carotenoid	Antioxidant	Scavenges free radicals in inflamed joint
Ascorbic acid (Vitamin C)	Vitamin	Antioxidant, collagen synthesis	Cartilage matrix collagen protection
Pipercide	Alkaloid	Insecticidal, analgesic	Anti-inflammatory support
Resin (Chavicin)	Resinous compound	Rubefacient, counter-irritant	Topical heat generation; vasodilation for Shotha
Saponins	Glycoside	Anti-inflammatory, surfactant	Enhances transdermal penetration of active ingredients

3. Pharmacological Evidence — Topical and Systemic Effects

Piperine, the principal bioactive compound of Maricha, has been extensively studied for its anti-inflammatory and anti-arthritic properties. It inhibits arachidonic acid metabolism via COX-1 and COX-2 pathways, suppresses PGE2 production, and reduces leukocyte infiltration into inflamed joints.[42] Piperine also acts as a **bioavailability enhancer**, inhibiting glucuronidation and enhancing intestinal absorption — making it a synergistic agent when co-administered with other anti-arthritic drugs.

The rubefacient action of Maricha Churna Lepana is mediated primarily through **piperine and chavicine**, which activate Transient Receptor Potential Vanilloid 1 (TRPV1) channels on cutaneous sensory neurons. This initially causes a burning sensation (counter-irritant effect) but is followed by **substance P depletion** from peripheral nerve terminals, resulting in profound and sustained analgesia — a mechanism similar to that of capsaicin cream, a well-established treatment for KOA pain.[43]

The Ushna Virya (hot potency) of Maricha translates into localised cutaneous vasodilation, increased capillary permeability, and enhanced lymphatic drainage — collectively reducing periarticular Shotha (oedema) and facilitating resolution of inflammatory exudate from the joint space. The Tikshna Guna (penetrating property) ensures that active constituents reach deeper periarticular tissues.[44]

3. Ashwagandha Taila — Preparation, Rationale, and Properties

Table 5: Ashwagandha Taila: Classical Preparation Method and Pharmacological Rationale

Component	Drug / Substance	Quantity (Classical Ratio)	Pharmacological Rationale
Sneha Dravya (base oil)	Tila taila (Sesame oil)	4 parts	Ushna, Tikshna, Sukshma; base for withanolide solubilisation; penetrates deeper tissue layers (Sukshma guna)
Kalka Dravya (paste)	Ashwagandha root (Withania somnifera)	1 part	Withanolides (anti-inflammatory, analgesic, adaptogenic); alkaloids (muscle relaxant); Brimhana (anabolic)
Drava Dravya (decoction)	Ashwagandha kvatha or water	16 parts	Aqueous extraction of water-soluble active constituents; vehicle for Paaka (processing)
Processing	Manda Agni Paaka (slow cooking at low heat) until Mridupaka siddhi lakshanasare achieved	Until correct consistency	Ensures full transfer of active phytoconstituents into oil base; Paaka ensures shelf stability and therapeutic potency
Preservative	Self-preserving due to oil base	As per Pak	Potency retained for 1 year (Taila shelf life as per classical texts)
Siddhi Lakshana (completion signs)	Kalka forms varti (thread-like structure); non-aqueous consistency; characteristic smell	Qualitative assessment	Confirms complete evaporation of moisture; proper emulsification of active principles in oil base

The Bhaishajya Kalpana (pharmaceutical science) of Taila preparation ensures that the active phytoconstituents are efficiently extracted into the oil base through the Taila Paaka (oil processing) methodology. The classical ratio of Kalka: Sneha: Drava = 1:4:16 ensures optimal extraction of both lipophilic and amphiphilic constituents.[45] Acharya Charaka in *Charaka Samhita, Chikitsa Sthana 28/56* specifically recommends medicated Taila for external application in Vatavyadhi, noting its ability to penetrate the Tvak (skin), reach Mamsa (muscle), Meda (fat), Sandhi (joint), and Asthi (bone) levels through sequential absorption.[46]

MARMA THERAPY TECHNIQUES — MARDANA AND PEEDANA

Mardana (Therapeutic Massage)

1. Classical Definition and Reference

Mardana is described in Ayurvedic texts as a therapeutic procedure involving rhythmic deep pressure and stroking of body parts. *Charaka Samhita, Sutra Sthana 12/8 lists Abhyanga and Mardana* among the daily health-maintaining regimens (Dinacharya) with specific therapeutic outcomes including: Jaravinaashana (anti-aging), Vata Shamana (pacification of Vata Dosha), Drishti Prasadana (visual clarity), Ayushkara (longevity), and Deha Pushti (body nourishment).[47]

Mardana at Janu Pradesha (knee region), as applied in the present study, encompasses specific techniques: (a) effleurage strokes along the medial and lateral aspects; (b) petrissage (kneading) of periarticular muscles; (c) circular friction over patellar borders; (d) deep transverse friction along the medial collateral ligament insertion; and (e) passive joint mobilisation movements within pain-free range.

2. Mechanism of Action of Mardana

The analgesic and anti-inflammatory mechanisms of Mardana operate through multiple neurophysiological pathways. The **Gate Control Theory of Pain** (Melzack and Wall, 1965) explains that stimulation of large-diameter A-β mechanoreceptor fibres through massage closes the "pain gate" in the spinal cord dorsal horn, inhibiting the transmission of pain signals from small-diameter C and A-δ nociceptor fibres.[48] This translates into the classical Ayurvedic concept of Shoola Hara (pain relief) through Sparsha Karma (touch therapy).

Mardana activates the **endogenous opioid system**, causing release of endorphins, enkephalins, and dynorphins from both central and peripheral sites. Simultaneously, serotonin and dopamine levels increase, contributing to mood elevation and pain threshold enhancement. Cortisol levels decrease, reducing the stress-related component of pain amplification.[49]

The mechanical effects of Mardana include: (a) promotion of local hyperaemia (increased blood flow) to ischaemic periarticular tissues; (b) enhanced lymphatic drainage reducing oedema; (c) break-up of periarticular adhesions and myofascial restrictions; (d) reduction of periarticular muscle hypertonicity (spasm); and (e) stimulation of fibroblast activity promoting connective tissue remodelling. These effects collectively translate into the classical outcomes of Shotha Hara, Sandhi Graha Hara, and Balya (strengthening).

2. Peedana (Compression Therapy at Janu Marma)

1. Classical Description

Peedana, as a Marma therapeutic technique, involves sustained or rhythmic deep pressure applied specifically at a Marma point. At the Janu Marma, Peedana is applied at the medial aspect of the knee joint (medial collateral ligament insertion region), identified by Prof. J.N. Mishra in Marma and Its Management as the highest point of tenderness corresponding to the Janu Marma location.[50] This corresponds anatomically to the distal insertion of the medial collateral ligament and the medial joint line — the most clinically significant zone of tenderness in KOA.

The procedure described by Prof. S.K. Joshi in *Marma Science and Principles of Marma Therapy* specifies: (a) semi-flexed position of the knee; (b) bilateral thumb placement at the infero-medial and infero-lateral patellar borders; (c) 15–18 stimulations at 0.8-second intervals; (d) 3–4 repetitions per session; and (e) avoidance of direct popliteal fossa compression to prevent Baker's cyst exacerbation.[51]

2. Neurophysiological Mechanisms of Peedana

Peedana at Janu Marma activates multiple neurophysiological mechanisms simultaneously. Deep compression of the periarticular tissues activates muscle spindles, Golgi tendon organs, and joint mechanoreceptors (Ruffini endings, Pacinian corpuscles), triggering reflex muscle relaxation and normalisation of periarticular tone.

From the perspective of Traditional Asian Medicine, Peedana at Janu Marma influences the flow of Prana through the associated Nadis (energy channels), releasing blockages (Avarana) that perpetuate the pathological cycle of Vata accumulation. This concept parallels the acupressure stimulation of ST-36 and GB-34 points documented in Traditional Chinese Medicine to modulate knee joint pain.[52]

The compression-induced **ischaemic preconditioning** at the Marma point, followed by reperfusion upon release, promotes localised anti-inflammatory mediator release and activates endogenous healing cascades. Trigger point release mechanisms — involving sarcomere "unlocking" and restoration of normal motor end-plate chemistry — contribute to the sustained post-therapy improvement in ROM observed clinically.

PHARMACOKINETIC AND PHARMACODYNAMIC ANALYSIS OF COMBINED INTERVENTION

1. Conceptual Framework — Kinetics and Dynamics in Ayurvedic Therapeutics

The Ayurvedic concepts of drug action can be systematically correlated with modern pharmacokinetic (PK) and pharmacodynamic (PD) principles. The classical Guna–Karma doctrine describes how drug properties (Gunas) determine their pharmacodynamic effects (Karma), while Rasa-Vipaka-Virya govern the pharmacokinetic distribution and duration of action. The combined intervention of Mardana, Peedana, Maricha Churna Lepana, and Ashwagandha Taila Snehana represents a multi-modal, sequentially integrated therapeutic approach with distinct but complementary PK–PD profiles.

Table 6: Comparative Pharmacokinetic–Pharmacodynamic Analysis of Mardana, Peedana, Maricha Churna Lepana, and Ashwagandha Taila Snehana

Parameter	Mardana	Peedana at Janu Marma	Maricha Churna Lepana + Ashwagandha Taila Snehana
Route of action	Transcutaneous mechanical stimulation → peripheral nerve → CNS	Point compression → marma stimulation → Prana activation → CNS modulation	Transdermal absorption: piperine + withanolides → systemic and local effects
Onset of action	Rapid (5–10 minutes after Mardana begins)	Immediate (reflex arc during Peedana)	Moderate (15–30 minutes for transdermal penetration to peak)

table Cont....

Parameter	Mardana	Peedana at Janu Marma	Maricha Churna Lepana + Ashwagandha Taila Snehana
Peak effect	20–30 minutes into session; persists up to 4–6 hours	During and immediately post-Peedana (acute analgesia within 2 min)	30–60 minutes post-application for Maricha; 60–90 min for Ashwagandha Taila
Duration of effect	Analgesic: 4–8 hours; cumulative with repeated sessions	Analgesic: 2–4 hours; Sandhi Graha improvement: cumulative	Counter-irritant (Maricha): 1–2 hours; Anti-inflammatory (Ashwagandha): 4–12 hours
Primary receptor target	Ruffini endings, Pacinian corpuscles, A-β fibres (mechanoreceptors)	Nociceptors (A-δ, C fibres), proprioceptors at Janu Marma; Prana channels (Nadis)	TRPV1 (piperine/chavicine); NF-κB pathway (withaferin A); COX-1/COX-2
Dosha-pharmacodynamic correlation	Shamana of Vata (reduces Ruksha, Chala guna); increases Snigdhata, Sthirata	Vatanulomana; restores Prana circulation at Janu Marma; reduces Avarana	Lepana: Vata-Kapha shamana (Ushna, Tikshna); Snehana: Vata shamana (Snigdha, Ushna)
Neurochemical mediators	↑ Endorphins, ↑ Serotonin, ↑ Oxytocin; ↓ Substance P, ↓ Cortisol	↑ Endogenous opioids; ↓ PGE2; Gate Control Theory activation	↓ Substance P (piperine); ↓ TNF-α, IL-1β (withaferin A); ↓ PGE2 (COX-2 inhibition)
Effect on joint biomechanics	Reduces muscle hypertonicity; improves joint kinematics; enhances proprioception	Myofascial release; improves patellar tracking; normalises joint mechanoreception	Reduces periarticular oedema; improves synovial fluid quality; tissue trophism
Safety profile	Safe; avoid with acute inflammation, fractures, DVT	Contraindicated over Baker's cyst; avoid excess popliteal fossa pressure	Avoid on broken skin; skin sensitivity testing recommended; safe for intact skin

2. Pharmacokinetics of Topical Drug Delivery

The transdermal delivery of active compounds in Maricha Churna Lepana and Ashwagandha Taila Snehana follows a sequential absorption model: (1) stratum corneum penetration (lipid pathway for lipophilic withanolides; aqueous pathway for piperine); (2) epidermal absorption; (3) dermal microvascular uptake; (4) systemic distribution to synovial tissues. The **Sukshma Guna (penetrating quality)** of Tila taila and the Tikshna Guna of Maricha facilitate each of these steps, acting as natural penetration enhancers that increase stratum corneum permeability and enhance drug flux across the skin barrier.[53]

Piperine has been demonstrated experimentally to enhance the transdermal permeation of co-applied drugs by 150–200%, attributed to its ability to modify lipid lamellar structure in the stratum corneum and inhibit skin efflux pumps. This bioavailability-enhancing property of Maricha Churna, when used as a Lepana vehicle, synergistically enhances the transdermal absorption of Ashwagandha constituents from the simultaneously applied Taila.[54]

3. Sequential Therapeutic Logic (Karma Krama)

The sequence of interventions in the present study follows a classical Ayurvedic therapeutic logic known as Karma Krama (sequential procedure). This sequence is: (1) Snehana with Ashwagandha Taila (Poorva Karma — preparatory step: softening of tissues, Vata pacification); (2) Mardana (main therapeutic action: pain relief, ROM improvement); (3) Peedana at Janu Marma (targeted vital point stimulation: immediate analgesia, normalisation of Prana); (4) Maricha Churna Lepana (Paschat Karma — follow-up: counter-irritation, sustained anti-inflammatory effect).

This sequential approach ensures: (a) progressively deeper tissue penetration; (b) synergistic enhancement of each subsequent intervention's efficacy; (c) minimisation of adverse effects through proper preparation; and (d) comprehensive address of all components of JSV — Shoola, Shotha, Sandhi Graha, Sphutana, and Prasarana-Akunchana Apravrutti.

4. Synergistic Pharmacological Interactions

The combined intervention demonstrates synergistic pharmacological interactions at multiple levels. At the receptor level: piperine

(TRPV1 agonist) and withaferin A (NF-κB inhibitor) target different but complementary inflammatory pathways, providing broader anti-inflammatory coverage. At the cellular level: Mardana-induced endorphin release potentiates the analgesic effect of substance P depletion by piperine. At the tissue level: Ashwagandha's Brimhana action (tissue anabolism) is enhanced by improved local blood flow from Mardana and Peedana, ensuring better delivery of anabolic substrates to the joint.

COMPARATIVE ANALYSIS — AYURVEDIC AND MODERN PERSPECTIVES ON KOA

Table 7: Comparative Clinical Features of Janusandhigata Vata and Knee Osteoarthritis

Parameter	Janusandhigata Vata (Ayurvedic)	Knee Osteoarthritis (Modern)
Aetiology	Vata Dosha vitiation, Dhatu kshaya (depletion of tissues), aging (Jara), trauma (Abhighata)	Age-related cartilage degeneration, trauma, obesity, genetic factors, repetitive stress
Primary pathology	Srotodushti (channel obstruction), Asthi-Majja kshaya, Sandhi vishlesha	Progressive articular cartilage loss, subchondral bone remodelling, synovitis
Pain character	Shoola during Prasarana-Akunchana (flexion-extension); Vataprakopa vedana	Deep aching pain aggravated by movement, relieved by rest; noctural pain in advanced stages
Swelling	Shotha (Vatapurna drutisparsha – balloon-like feel)	Joint effusion, synovial thickening, periarticular soft-tissue swelling
Stiffness	Sandhi Graha (joint stiffness)	Morning stiffness <30 minutes; gelling phenomenon after rest
Sound	Sandhi Sphutana (cracking/crepitation)	Crepitus on movement due to irregular cartilage surfaces
Tenderness	Sparsha asahatva (tenderness on touch)	Joint-line tenderness, especially medial compartment
Muscle changes	Mamsa kshaya (muscle wasting)	Quadriceps wasting; periarticular muscle weakness
Functional loss	Prasarana-Akunchana apravrutti (restricted ROM)	Reduced range of motion; instability; difficulty weight-bearing
Prognosis	Kashtasadhya (difficult to cure); madhyama rogamarga	Chronic progressive; total knee replacement in end-stage
Treatment principle	Vata shamana; Snehana, Swedana, Brimhana; Marma stimulation	Analgesics, NSAIDs, physiotherapy, joint replacement surgery

Table 8: Differential Diagnosis of Janusandhigata Vata from Allied Conditions

Factor	Janusandhigata Vata	Amavata (RA)	Kroshtuka Shirsha	Vatarakta (Gout)
Ama (metabolic toxin)	Absent	Present	Absent	Absent
Jwara (fever)	Absent	Present	Absent	Present (acute gout)
Hridgourava (heaviness)	Absent	Present	Absent	Absent
Age of onset	Old age (>40 years)	Any age	Any age	Any age
Vedana character	During Prasarana-Akunchana; Vataprakopa	Vishchika Damsavata (moving pain)	Teevra (intense)	Mushikadamsa (rat-bite like); Vatapeeda
Shotha (swelling)	Vatapurna drutisparsha; balloon-like	Sarva shareera sandhigata	Krostuka shirsha (jackal-head deformity)	Mandala yukta (circular redness)
Joints affected	Weight-bearing joints; Knee joint (Janu)	Small to large; polyarticular	Janu Pradesha (knee exclusively)	Small joints predominantly; first MTP
Upashaya	Snehana, Swedana, Vata shamana	Ruksha Sweda; Ama pachana	Rakta Shodhana	Rakta Shodhana; Vata-Pitta shamana
Radiological findings	Joint space narrowing; osteophytes	Periarticular erosions; osteoporosis	Fluid in suprapatellar pouch	Urate crystal deposition (tophus)

1. Epidemiological Correlation

Osteoarthritis is the 2nd most common musculoskeletal disease globally, with knee OA representing the largest burden. Pal *et al.* in their epidemiological study published in the *Indian Journal of Orthopaedics (2016)*

documented KOA prevalence in India at 28.7% in urban populations and 39.4% in rural populations, with strong associations with age, female sex, and BMI >25 kg/m².[55] These epidemiological findings resonate with the Ayurvedic aetiology emphasising Jara (aging), Stri (female predisposition), and Sthaulya (obesity through Medo Dhatu imbalance) as risk factors for JSV.

Pathological Correlation

Modern pathology of KOA demonstrates: (1) articular cartilage fibrillation and loss; (2) subchondral bone sclerosis and cyst formation; (3) osteophyte formation; (4) synovial membrane inflammation (secondary synovitis); and (5) periarticular soft tissue changes including muscle atrophy and ligamentous laxity.[56] Each of these pathological features has a direct Ayurvedic correlate: articular cartilage loss = Shleshaka Kapha kshaya; subchondral sclerosis = Asthi Dhatu vikara; synovitis = Pitta Dosha involvement in Tridoshaja cases; muscle atrophy = Mamsa Dhatu kshaya; ligamentous laxity = Snayu dourbalya.

CLINICAL ASSESSMENT PARAMETERS IN JSV/KOA

1. Subjective Parameters (Ayurvedic Scoring)

The clinical assessment of JSV employs a validated scoring system encompassing the cardinal signs and symptoms: Sandhi Shoola (graded 0–4 on VAS), Sandhi Shotha (graded 0–3 based on circumferential measurement), Sandhi Graha (graded 0–3 based on morning stiffness duration), Sandhi Sphutana (graded 0–3 based on frequency), Sparsha Asahatva (graded 0–3), and Prasarana-Akunchana Apravrutti (graded 0–3 based on goniometric ROM measurement).

2. Objective Parameters (Modern Correlation)

Modern objective assessment utilises: (1) Visual Analogue Scale (VAS) for pain — 0 (no pain) to 10 (worst imaginable pain); (2) Goniometric measurement of knee flexion-extension ROM; (3) WOMAC (Western Ontario McMaster Universities Osteoarthritis Index) — validated functional scale; (4) Timed 21-metre walk test; (5) Radiological assessment (Kellgren-Lawrence grading, X-ray features); and (6) Laboratory investigations (inflammatory markers: ESR, CRP; metabolic parameters: RA factor, serum uric acid for exclusion).

DISCUSSION

1. Rationale for the Combined Intervention

The selection of the combined intervention of Mardana, Peedana, Maricha Churna Lepana, and Ashwagandha Taila Snehana for JSV/KOA management is supported by a convergence of classical Ayurvedic wisdom and contemporary pharmacological evidence. The intervention is non-invasive, cost-effective, free of the systemic adverse effects associated with NSAIDs and COX-2 inhibitors, and directly addresses the underlying Samprapti (pathogenetic mechanism) of JSV.

Ashwagandha Taila, through its withanolide content, provides disease-modifying anti-arthritic drug (DMARD)-like action — a property not achievable with conventional analgesics alone. Maricha Churna Lepana provides immediate counter-irritant analgesia, bridging the gap between the onset of Ashwagandha's slower-acting anti-inflammatory effects. Mardana and Peedana at Janu Marma provide the neurophysiological framework — activating endogenous pain control systems — which synergistically enhances the pharmacological effects of the topical agents.

2. Addressing the Kinetics–Dynamics Gap in Ayurvedic Research

One of the significant gaps in Ayurvedic research has been the lack of systematic pharmacokinetic–pharmacodynamic characterisation of traditional interventions. The present review attempts to bridge this gap by applying the concepts of onset, peak, duration, receptor target, and dose-response relationship to each component of the combined intervention. The sequential therapy design also addresses the classical Ayurvedic concept of Karma — where the sequence of interventions is as pharmacologically important as the individual interventions themselves.

3. Comparative Advantage Over Conventional KOA Management

Davidson's Principles and Practice of Medicine (22nd edition) acknowledges that the

treatment of OA is directed towards reducing pain, maintaining mobility, and minimising disability[57] — objectives that are co-shared by the Ayurvedic intervention. However, conventional management lacks the disease-modifying potential of Ashwagandha's withanolides, the direct Marma-level neurological intervention of Peedana, or the combined synergistic approach available in this multi-modal Ayurvedic treatment protocol. The API Textbook of Medicine (8th edition) similarly recognises that pharmacological therapy (NSAIDs) is associated with significant gastrointestinal, renal, and cardiovascular risks, particularly in the elderly population most affected by KOA.[58]

CONCLUSION

The present comprehensive literary review establishes a robust, multi-dimensional evidence base for the use of Mardana, Peedana (Janu Marma stimulation), Maricha Churna Lepana, and Ashwagandha Taila Snehana in the management of Janusandhigata Vata/ Knee Osteoarthritis. The review demonstrates: (1) solid classical Ayurvedic textual support from Charaka Samhita, Sushruta Samhita, Ashtanga Hridayam, and allied texts for each intervention; (2) well-characterised phytochemical profiles for Ashwagandha and Maricha with demonstrable anti-arthritic pharmacology (NF-κB inhibition, COX-2 inhibition, substance P depletion, TRPV1 activation); (3) validated neurophysiological mechanisms for Mardana (Gate Control Theory, endorphin release) and Peedana (Janu Marma stimulation, trigger point release, myofascial release); and (4) synergistic pharmacokinetic–pharmacodynamic interactions among all four modalities that produce comprehensive pain relief, anti-inflammatory effects, and tissue nourishment superior to any single-modality intervention.

The review further confirms the clinical validity of correlating Janusandhigata Vata with Knee Osteoarthritis based on the striking concordance in aetiology, pathology, clinical features, and prognostic considerations. The proposed combined intervention offers a safe, effective, and scientifically grounded alternative to conventional pharmacological management of KOA, with potential disease-modifying properties that warrant further investigation through well-designed randomised controlled trials with adequate sample size and follow-up period.

REFERENCES

1. Markel DC. Introduction to Musculoskeletal Medicine. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2018.
2. Pal CP, Singh P, Chaturvedi S, Pruthi KK, Vij A. Epidemiology of knee osteoarthritis in India and related factors. Indian J Orthop. 2016;50(4):518–22.
3. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Chikitsa Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 28, Verse 11. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 29.
4. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Chikitsa Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 28, Verse 37. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 616–617.
5. Davidson SJ, editor. Davidson's Principles and Practice of Medicine. 22nd ed. Edinburgh: Elsevier; 2014. Chapter 25. p. 1083.
6. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Chikitsa Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 28, Verse 15. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 693.
7. Acharya JT, editor. Commentary Nibandhasangraha of Dalhanacharya on Sushrutha Samhita of Sushrutha. Nidana Sthana; Vatavyadhi Nidanam: Chapter 1, Verse 23. 2nd ed. Varanasi: Chaukhamba Orientalia; 2014. p. 8.
8. Sharma Shivaprasad, editor. Commentary Shashilekha on Ashtanga Sangraham of Vriddhavagbhata. Nidana Sthana; Vatavyadhi Nidana: Chapter 15, Verse 36. 3rd ed. Varanasi: Chaukhamba Sanskrit Series Office; 2012. p. 416.
9. Yadunandana Upadhyaya, editor. Madavanidana of Sri Madhavakara. Madhukosha Sanskrit Commentary by Sri Vijayarakshita and Srikantadatta with Vidhyotini Hindi Commentary. Volume 1, Chapter 22. Varanasi: Chaukhamba Prakashan; 2016 reprint. p. 448.
10. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on

Charakasamhita of Agnivesha. Sutra Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 12, Verse 8. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 79.

11. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Chikitsa Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 28, Verse 11. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 29.

12. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Chikitsa Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 28, Verse 56. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 619.

13. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Chikitsa Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 28, Verse 56. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 158.

14. BD Chaurasia. Human Anatomy Regional and Applied Dissection and Clinical. Volume 2, Chapter 12. 5th ed. New Delhi: CBS Publishers and Distributors; p. 150–156.

15. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Chikitsa Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 28, Verse 56. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 158.

16. Acharya JT, editor. Commentary Nibandhasangraha of Dalhanacharya on Sushrutha Samhita of Sushrutha. Sharira Sthana; Sharira Sankya: Chapter 5, Verse 16. 2nd ed. Varanasi: Chaukhamba Orientalia; 2014. p. 365.

17. Sharma Shivaprasad, editor. Commentary Shashilekha on Ashtanga Sangraham of Vriddhavagbhata. Nidana Sthana; Vatavyadhi Nidana: Chapter 15, Verse 36. 3rd ed. Varanasi: Chaukhamba Sanskrit Series Office; 2012. p. 416.

18. Vaidya Jadavaji Trikamji Acharya, editor. Charaka Samhita. Chikitsa Sthana, Chapter 28, Shlokas 72–74. Reprint ed. Varanasi: Chaukhamba Prakashan; 2008.

19. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Chikitsa Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 28, Verse 19. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 617.

20. Yogaratnakara. Edited and translated by Suresh Babu. Chikitsa Sthana: Vatavyadhi Chikitsa. 2nd ed. Varanasi: Chaukhamba Krishnadas Academy; 2011. p. 503.

21. Sri Bhavamisra. Bhavaprakasha. Edited with Vidyotini Hindi Commentary by Pandit Sri Brahma Sankar Misra. Part 2. Chikitsa Sthana 24/1-2. 11th ed. Varanasi: Chaukhambha Sanskrit Bhawan; 2009. p. 227.

22. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Chikitsa Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 28, Verse 11. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 29.

23. Acharya JT, editor. Commentary Nibandhasangraha of Dalhanacharya on Sushrutha Samhita of Sushrutha. Sutra Sthana; Vranaprasna Adhyaya: Chapter 21, Verse 19. 2nd ed. Varanasi: Chaukhamba Orientalia; 2014. p. 103.

24. Sushrutha. Sushruta Samhita (English). Translated by Prof. K.R. Srikantha Murthy. Volume I. Sharira Sthana 6/15. Reprint ed. Varanasi: Chaukhambha Orientalia; 2014. p. 107.

25. Sushrutha. Sushruta Samhita (English). Translated by Prof. K.R. Srikantha Murthy. Volume I. Sharira Sthana 6/4. Reprint ed. Varanasi: Chaukhambha Orientalia; 2014. p. 104.

26. Sushrutha. Sushruta Samhita (English). Translated by Prof. K.R. Srikantha Murthy. Volume I. Sharira Sthana 6/25. Reprint ed. Varanasi: Chaukhambha Orientalia; 2014. p. 110.

27. Sushrutha. Sushruta Samhita (English). Translated by Prof. K.R. Srikantha Murthy. Volume I. Sharira Sthana 6/28. Reprint ed. Varanasi: Chaukhambha Orientalia; 2014. p. 116.

28. Sushrutha. Sushruta Samhita (English). Translated by Prof. K.R. Srikantha Murthy. Volume I. Sharira Sthana 6/33. Reprint ed. Varanasi: Chaukhambha Orientalia; 2014. p. 117.

29. Sushrutha. Sushruta Samhita (English). Translated by Prof. K.R. Srikantha Murthy. Volume I. Sharira Sthana 6/15. Reprint ed. Varanasi: Chaukhambha Orientalia; 2014. p. 107.

30. Joshi SK. Marma Science and Principles of Marma Therapy. Delhi: Vani Publications; 2010.

31. Lele A, Ranade S, Frawley D. Secrets of Marma. Reprint ed. Varanasi: Chaukhambha Sanskrit Pratishthan; 2005. p. 56.

32. Thatte DG. Acupuncture, Marma and Other Asian Therapeutic Techniques. Chapter 1. Reprint ed. Varanasi: Chaukhambha Orientalia; 2006. p. 5.

33. Acharya Jadhavji Trikamji, editor. Charaka Samhita of Agnivesha with Commentary of Chakrapanidatta. Sutra Sthana, Chapter 4 (Shadvirechanashatashritiya Adhyaya). 2nd ed. Varanasi: Chaukhamba Orientalia; 2015.

34. Sastry JLN. Study of the Essential Medicinal Plants in Ayurveda. Volume II. Varanasi: Chaukhambha Orientalia; p. 432–440.

35. Chunekar KC. Bhavaprakasha Nighantu of Bhavamishra. Purvakhanda, Guduchyadi Varga. Varanasi: Chaukhambha Bharati Academy; 2006. p. 390.

36. Karunagoda K, Shukla K, Donga S, Tanna C, Dei LP. A comparative study of Dashamoola Taila Matrabasti and Tila Taila Matrabasti in Kashtaartava (dysmenorrhoea). Ayu. 2010;31(3):305–10.

37. Deshpande AP, Ranade S, editors. Textbook of Dravyaguna Vigyan (English). Part 2. Pune: Proficient Publishing House; 2007. p. 509.

38. Davidson SJ, editor. Davidson's Principles and Practice of Medicine. 20th ed. Edinburgh: Elsevier; 2006. Musculoskeletal Disorders. p. 1098.

39. Agnivesha. Charaka Samhita. Chikitsa Sthana, Chapter 28, Shlokas 38. 8th ed. Varanasi: Chaukhambha Sanskrit Sansthan; 2004. p. 697.

40. Shah S, editor. API Textbook of Medicine. 8th ed. Volume 1. Mumbai: The Association of Physicians of India; p. 282–283.

41. Chunekar KC. Bhavaprakasha Nighantu of Bhavamishra. Purvakhanda, Mishraprakaran, Dhanya Varga 63–65. Varanasi: Chaukhambha Bharati Academy; 2006.

42. Agnivesha. Charaka Samhita. Chikitsa Sthana, Chapter 28, Shlokas 19. 4th ed. Varanasi: Chaukhambha Sanskrit Sansthan; 1994. p. 617.

43. Mishra JN. Marma and Its Management. Reprint ed. Varanasi: Chaukhambha Orientalia; 2014. p. 88.

44. Thatte DG. Acupuncture, Marma and Other Asian Therapeutic Techniques. Reprint ed. Varanasi: Chaukhambha Orientalia; 2006.

45. Hiremath SG. A Text of Bhaishajya Kalpana. IBH Prakashana: Bangalore; p. 77.

46. Acharya Vaidya Jadavaji Trikamji, editor. Charaka Samhita with Commentary Chakrapanidatta. Chikitsa Sthana, Chapter 28, Verse 37. Varanasi: Chaukhamba Sanskritha Sansthan; p. 618.

47. Acharya Jadhavji Trikamji, editor. Commentary Ayurveda Deepika of Chakrapanidatta on Charakasamhita of Agnivesha. Sutra Sthana; Vatavyadhi Chikitsa Adhyaya: Chapter 12, Verse 8. 2nd ed. Varanasi: Chaukhamba Orientalia; 2015. p. 79.

48. Melzack R, Wall PD. Pain mechanisms: a new theory. Science. 1965;150(3699):971–8.

49. Field T. Massage therapy research review. Complement Ther Clin Pract. 2016;24:19–31.

50. Mishra JN. Marma and Its Management. Reprint ed. Varanasi: Chaukhambha Orientalia; 2014. p. 88.

51. Joshi SK. Marma Science and Principles of Marma Therapy. Delhi: Vani Publications; 2010.

52. Thatte DG. Acupuncture, Marma and Other Asian Therapeutic Techniques. Reprint ed. Varanasi: Chaukhambha Orientalia; 2006.

53. Gupta LP. Rachana Sharira: A Comprehensive Anatomical Approach. Volume II. 1st ed. Varanasi: Chaukhambha Surbharati Prakashan; 2015. p. 1213.

54. Yadunandana Upadhyaya, editor. Madavanidana of Sri Madhavakara. Volume 1, Chapter 22. Varanasi: Chaukhamba Prakashan; 2016 reprint. p. 380.

55. Pal CP, Singh P, Chaturvedi S, Pruthi KK, Vij A. Epidemiology of knee osteoarthritis in India and related factors. Indian J Orthop. 2016;50(4):518–22.

56. Davidson SJ, editor. Davidson's Principles and Practice of Medicine. 22nd ed. Edinburgh: Elsevier; 2014. Chapter 25. p. 1083.

57. Davidson SJ, editor. Davidson's Principles and Practice of Medicine. 22nd ed. Edinburgh: Elsevier; 2014. Musculoskeletal Disorders. p. 1083.

58. Shah S, editor. API Textbook of Medicine. 8th ed. Volume 1. Mumbai: The Association of Physicians of India; p. 282–383.