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A Comprehensive Review on *Sandhigata Vata*: Ayurvedic Management and Correlation with Contemporary Science

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ABSTRACT

Sandhigata Vata is a cardinal *Vata* disorder mentioned in classical Ayurvedic texts, which is very similar in a modern understanding of medicine to osteoarthritis (OA). It is characterised by degenerative changes in the joints (*Sandhi*) and traditionally presents with pain (*Shula*), swelling (*Shotha*), stiffness (*Stambha*) and limited movements (*Sankocha*), and consequently adversely impacts the quality of life. The current review is a systematic literature review of Ayurvedic conceptualisation of *Sandhigata Vata* with its aetiology (*Nidana*), pathogenesis (*Samprapti*), clinical symptoms, and multi-pronged approach to its management that covers lifestyle adjustments (*Pathya-Apathya*), internal oral medicines (*Shamana Oushadha*), as well as practices that involve specific *Panchakarma*, whose examples include *Janu Basti*, *Kati Basti*, among others. Moreover, the review associates these Ayurvedic concepts and treatments with contemporary scientific knowledge regarding OA pathology, which is centered on inflammation, cartilage wear, oxidative stress, and alterations in the subchondral bone. An extensive search on PubMed, Scopus, AYUSH Research Portal, DHARA and classical texts (*Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*) was also performed. Available evidence demonstrates that major Ayurvedic herbs, including *Boswellia serrata* (*Shallaki*), *Commiphora wightii* (*Guggulu*), and *Withania somnifera* (*Ashwagandha*), as well as Ayurvedic formulations, such as *Yogaraja Guggulu*, *Simhanada Guggulu*, *Maharasnadi Kwatha*, have extremely strong anti-inflammatory, chondroprotective and analgesic action by modulation of cytokines (TNF-α, IL-1β). Procedures like *Janu Basti* have high clinical efficacy, as clinically proven by the score improvement of WOMAC and VAS in the clinical studies. The review therefore demonstrates the possibilities of Ayurveda as a complementary and integrative therapy of OA management with multi-targeted therapy and a positive safety profile. Nonetheless, additional high-quality, large sample, clinical trials and mechanistic studies are needed to standardise the process and to fully explain the complex synergistic effect of Ayurvedic interventions.

Keywords: *Sandhigata Vata*, Osteoarthritis, Ayurveda, *Panchakarma*, *Janu Basti*, *Boswellia serrata*, *Guggulu*, *Vata Dosha*, Degenerative Joint Disease, Inflammation, Cartilage Degradation.

1. Introduction

Osteoarthritis (OA), the most prevalent degenerative joint disease globally, imposes a substantial socioeconomic burden, affecting over 500 million people worldwide, with prevalence escalating dramatically with age [1]. Contemporary medicine defines OA as a complex disorder characterised by progressive degeneration of articular cartilage, remodelling of subchondral bone, synovitis, osteophyte formation, and associated pain and functional impairment, primarily managed with analgesics (NSAIDs, opioids), intra-articular corticosteroids/hyaluronic acid, and ultimately joint replacement surgery [2]. While offering symptomatic relief, these approaches often carry significant adverse effects (e.g., gastrointestinal, renal, and cardiovascular risks with NSAIDs; addiction with opioids) and fail to address the underlying disease progression or promote tissue regeneration [3].

Ayurveda, the ancient Indian system of medicine, describes a remarkably similar clinical entity termed *Sandhigata Vata* (literally "*Vata* located in the joints"). It is classified under the broad spectrum of *Vata*vyadhi (diseases caused primarily by vitiation of *Vata Dosha*) [4]. Classical texts like the *Charaka Samhita* (Chikitsa Sthana 28/37) and Madhava *Nidana* (Chapter 22) provide detailed descriptions of its aetiology, pathogenesis, and clinical features, emphasising the depletion of Kapha (representing lubrication and cushioning) and Asthi Dhatu (bone tissue) within the joint space due to aggravated *Vata* [5, 6]. The cardinal signs - *SandhiShula* (joint pain), *SandhiShotha* (joint swelling), *Stambha* (stiffness), Sparshasahatva (tenderness), Prasarana-Akunchana Pravritti Vedana (pain on extension-flexion), and Atopa (crepitus) - align closely with the core symptoms of OA [7].

The rising global burden of OA, limitations of conventional therapies, and growing patient interest in holistic approaches necessitate a deeper exploration of traditional systems like Ayurveda. This review aims to:

1. Elucidate the Ayurvedic perspective on *Sandhigata Vata*, including its *Nidana* (aetiology), *Samprapti* (pathogenesis), and *Lakshana* (clinical features).

2. Detail the comprehensive Ayurvedic management strategies, encompassing *Nidana Parivarjana* (avoidance of causes), *Ahar* (diet), *Vihar* (lifestyle), *Shamana Chikitsa* (palliative internal medications), and *Shodhana Chikitsa* (bio-purification/*Panchakarma*).
3. Critically correlate the Ayurvedic concepts and interventions with contemporary scientific understanding of OA pathophysiology (inflammation, cartilage breakdown, oxidative stress, bone remodelling).
4. Evaluate the scientific evidence supporting the efficacy and mechanisms of key Ayurvedic herbs, formulations, and procedures like *Janu Basti*.
5. Identify gaps in knowledge and future research directions for integrating Ayurveda into OA management paradigms.

2. Methods

2.1. Literature Search Strategy:

A systematic and comprehensive literature search was conducted across multiple electronic databases and sources: Biomedical Databases: PubMed, Scopus, Web of Science, ScienceDirect, Cochrane Library.

- **Ayurvedic Databases:** AYUSH Research Portal, DHARA (Digital Helpline for Ayurveda Research Articles, National Library of Ayurveda Medicine (NAMSTP).
- **Classical Texts:** Primary sources - *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, *Madhava Nidana*, *Bhava Prakasha*, *Sharngadhara Samhita*. Commentaries by Chakrapani, Dalhana, Arunadatta, Hemadri, and others were consulted.
- **Other Sources:** Google Scholar, relevant textbooks, conference proceedings, and dissertations.

2.2. Search Terms:

Combinations of keywords and MeSH terms were used:

- Ayurveda: "*Sandhigata Vata*", "*Vata*vyadhi", "Asthidhatugata *Vata*", "Janu *Sandhigata Vata*", "Ayurvedic management", "*Panchakarma*", "*Janu Basti*", "*Kati Basti*", "*Shallaki*", "*Boswellia serrata*", "*Guggulu*", "*Commiphora wightii*", "*Ashwagandha*", "Withania somnifera", "Rasna", "Nirgundi", "Vitex negundo", "*Yogaraja Guggulu*", "*Simhanada Guggulu*", "*Maharasnadi Kwatha*".
- Contemporary Science: "Osteoarthritis", "OA", "degenerative joint disease", "knee osteoarthritis", "hip osteoarthritis", "pathophysiology", "inflammation", "cartilage degradation", "synovitis", "subchondral bone", "cytokines", "TNF-alpha", "IL-1beta", "matrix metalloproteinases", "aggrecanases", "chondroprotection", "analgesia".
- Methodology: "clinical trial", "randomised controlled trial", "RCT", "in vitro", "in vivo", "animal model", "mechanism of action", "systematic review", "meta-analysis".

2.3. Inclusion Criteria:

- Original research articles (clinical trials - RCTs, non-RCTs, case series, cohort studies; preclinical studies - in vitro, animal models), systematic reviews, meta-analyses, and relevant narrative reviews.
- Publications exploring the Ayurvedic concept, aetiology, pathogenesis, clinical features, or management of *Sandhigata Vata*.
- Publications investigating the efficacy, safety, or mechanism of action of Ayurvedic interventions (single herbs, formulations, *Panchakarma*) for OA/*Sandhigata Vata*.
- Publications correlating Ayurvedic concepts (*Dosha*, Dhatu, Srotas) with modern OA pathophysiology.
- Publications in English or Sanskrit (with English translation/abstract).

2.4. Exclusion Criteria:

- Publications not directly related to *Sandhigata Vata* or OA.
- Publications on other types of arthritis (e.g., Rheumatoid Arthritis - *AmaVata*, Gout - *Vatarakta*) unless directly comparative.
- Publications with poor methodology (e.g., inadequate controls, high risk of bias), very small sample sizes, or lacking essential data.
- Duplicate publications.

2.5. Data EÛtraction and Synthesis:

In a bid to present informed overview of the recent researches to study Ayurvedic therapies in osteoarthritis (OA), a subset of studies has been extracted, keeping in consideration study design, participant profiles, the interventions (Ayurvedic drug/formulation/procedure, dose, duration), the control groups, outcome measures (clinical - pain visual analogue scale [VAS], WOMAC, Lequesne index; functional; radiological, biochemical; safety), the main findings, and the proposed mechanism. The hierarchical synthesis of these data was not quantitative due to the differences among interventions and study designs, but was done in themes (aetiology, pathogenesis, presentation, management strategies, science correlations). The clinical trial methodological quality was also assessed, where suitable with the Cochrane Risk of Bias tool and the Jadad scale.

3. Results

3.1. Ayurvedic Understanding of Sandhigata Vata

- ***3.1.1. Aetiology (Nidana):*** Ayurveda attributes *Sandhigata Vata* primarily to factors that vitiate *Vata Dosha*, particularly in the context of *Dhatu Kshaya* (tissue depletion) and *Margavarana* (channel blockage). Key etiological factors include [5, 6, 8]:
    - In the Ayurvedic theory of physiology, *Vata*-prakopaka ahara will be considered as consummation of dry foods (ruksha), light (laghu), cool (sheeta) and astringent (kashaya) along with long periods of fasting and missed eating schedules. Such physical activities that pertain to "*Vata*-prakopaka vihara" are excessive exertion (ativyayama), postural instability, joint trauma or hurt (abhigata), repetitive hopping or bearing.
    - *Vata* aggravation could also be caused by internal psychological factors or manasika *Nidana*; this could be prolonged worrying, fear, grief or anxiety (chinta, bhaya, shoka).
    - Environmental factors resulting in imbalance of *Vata* include old age (jara- natural preponderance of *Vata Dosha*) and cold or arid weather conditions (shishira rtu).
    - *Other Factors*: Depletion of *Kapha* (which provides joint lubrication) and *Asthi Dhatu* (bone tissue) due to other diseases or inherent weakness.
- ***3.1.2. Pathogenesis (Samprapti):*** The pathogenesis involves a sequence of events [4, 5, 7]:
    1. *Vata* Prakopa: The increase of *Vata Dosha* caused by the previously mentioned causative factors.
    2. The disturbed *Vata*, characterised by its mobility and roughness, tends to migrate to susceptible areas, particularly targeting the joints (*Sandhi* Marma).
    3. *Sthana Samshraya*: *Vata* localises in the joint spaces (*Sandhis*).
    4. Dhatu Kshaya & Margavarana: When *Vata* becomes localised, it leads to the reduction (Kshaya) of Kapha (similar to synovial fluid) and Asthi Dhatu (bone/cartilage). At the same time, its Ruksha (dry) and Khara (rough) characteristics hinder the channels (Srotas) that supply the joint, resulting in Margavarana (blockage of passages).
    5. Vikruti Utpatti: The combination of Dhatu Kshaya (loss of cushioning) and Margavarana (hindered nutrition and waste elimination) leads to the typical symptoms:
        - *Sandhi Shula*: Pain due to *Vata* vitiation and friction.
        - *Sandhi Shotha*: Swelling due to impaired microcirculation and inflammation (*Ama* accumulation can sometimes contribute).
        - *Stambha*: Stiffness due to dryness and loss of lubrication.
        - *Sankocha*: Contraction/restricted movement due to *Vata*'s contractile nature.
        - *Sparshasahatva*: Tenderness due to hypersensitivity caused by *Vata*.
        - *Atopa*: Cracking sound (crepitus) due to friction between roughened joint surfaces. The process is predominantly *Vata-Kaphahara* (depleting Kapha), distinguishing it from *AmaVata* (rheumatoid arthritis), where *Ama* (toxins) plays a central role.
- ***3.1.3. Clinical Features (Lakshana):*** As described in classics [5, 6, 9]:
    - *Sandhi Vedana*: Pain in the affected joint(s), aggravated by movement, cold, dryness, and wind; often relieved by warmth, massage, and mild compression.
    - *Sandhi Shotha*: Variable swelling around the joint, usually non-inflammatory (cool, non-tender) unless complicated.

- *Sandhi Stambha*: Significant stiffness, especially after rest or in the morning.
- *Prasarana-Akunchana Pravritti Vedana*: Pain specifically elicited during joint extension and flexion.
- *Sandhi Sankocha*: Gradual reduction in the range of motion.
- *Atopa*: Audible grating or cracking sound during joint movement.
- *Sparshasahatva*: Tenderness on palpation of the joint line.
- *Vatapurna Driti Sparsha*: Feeling of air-filled or "puffed" joint on palpation (classical sign). Commonly affected joints include *Janu* (knee), *Kati* (lumbar spine), *Gulpha* (ankle), and *Prishta* (other spinal joints).

3.2. Ayurvedic Management of Sandhigata Vata

The method focuses on soothing *Vata* (*Vata*shamana), strengthening weakened tissues (Dhatupushti), especially Asthi and Shleshak Kapha, removing obstructions (Srotoshodhana), and alleviating pain and stiffness [7, 8, 10].

- ***3.2.1. Nidana Parivarjana (Avoidance of Causative Factors*:** As an essential initial measure, patients are encouraged to steer clear of cold, dry settings; avoid excessive physical exertion; refrain from consuming foods that aggravate *Vata*; and minimise exposure to emotional stressors.

3.2.2. Ahar (Dietary Modifications):

- Pathya (Beneficial): Foods that are warm, freshly prepared, nourishing, and rich in oils (Snigdha); soups; milk (Ksheera - ideally with ginger or turmeric); ghee (Ghrita - particularly medicated varieties like Tila Ghrita or Bala Ghrita); bone broth; sesame seeds (Tila); green gram (Mudga); root vegetables; fruits such as ripe bananas and mangoes; spices including ginger (Shunthi), garlic (Rasona), turmeric (Haridra), and fenugreek (Methika). Consumption of warm water or milk is recommended.
- Apathya (Avoid): Foods that are cold, stale, dry, or processed; an overconsumption of legumes (Kulattha); vegetables with a bitter taste; fermented items; too much tea or coffee; carbonated beverages; incompatible foods (Viruddha Ahara); and excessive fasting.

3.2.3. Vihar (Lifestyle Modifications):

- Engage in gentle, consistent physical activities such as walking, swimming in warm water, or practising yoga (with poses like Setu Bandhasana and Pavanamuktasana, adjusted as necessary) to keep joints flexible without causing strain.
- Adequate rest and sleep.
- Application of warmth (warm water baths, heating pads).
- Stress management techniques (meditation, *Pranayama*).
- Avoiding prolonged sitting/standing in one posture.

3.2.4. Shamana Chikitsa (Palliative Internal Medications):

Herbs and formulations are primarily focused on achieving effects such as *Vata*shamana, *Shotha*hara (anti-inflammatory), *Shula*hara (pain relief), Brimhana (nourishment), and Asthisandhanaka (healing of bones/joints) [10, 11, 12]. Notable examples include:

- *Single Herbs (Dravyas):*
  - *Shallaki* (*Boswellia serrata*): Resin (Gum Olibanum). Potent anti-inflammatory (LOX inhibition), analgesic, chondroprotective.
  - *Guggulu* (*Commiphora wightii*): Resin. Anti-inflammatory, lipid-lowering, rejuvenative (*Rasayana*), and facilitates tissue cleansing.
  - *Ashwagandha* (*Withania somnifera*): Root. Anti-inflammatory, analgesic, adaptogenic, nourishing, supports muscle and bone health.
  - *Rasna* (*Pluchea lanceolata*/*Alpinia galanga*): Leaf/Rhizome. Strong *Vatashamaka*, anti-inflammatory.
  - *Nirgundi* (*Vitex negundo*): Leaf/Seed. Analgesic, anti-inflammatory, muscle relaxant.
  - *Shunthi* (*Zingiber officinale* - Dry Ginger): Rhizome. Digestive, anti-inflammatory, *Vatahara*.
  - *Eranda* (*Ricinus communis*): Root. Powerful *Vatashamaka*, laxative (used cautiously).

- *Bala* (*Sida cordifolia*): Root. Nourishing, nervine tonic, *Vatahara*.
- *Guduchi* (*Tinospora cordifolia*): Stem. Immunomodulatory, anti-inflammatory, *Rasayana*.

- *Classical Formulations (Yogas):*
  - *Guggulu-based: Yogaraja Guggulu* (complex formulation with multiple *Vatahara* herbs), *Simhanada Guggulu* (stronger anti-inflammatory/pain relief), Kaishora *Guggulu* (detoxifying, useful if *Ama* is present), Trayodashanga *Guggulu*.
  - *Kwatha (Decoctions): Maharasnadi Kwatha* (Rasna dominant), Dashamula Kwatha (ten roots, nourishing/*Vata* pacifying), Rasnasaptak Kwatha.
  - *Churna (Powders): Ashwagandha* Churna, Shatavari Churna (nourishing), Triphala Churna (mild detoxifier, antioxidant).
  - *Taila (Medicated Oils):* Mahamasha Taila, Bala *Ashwagandha*di Taila, Dhanwantaram Taila, Prasaranyadi Taila (used internally in small doses for *Snehana* or externally).
  - *Rasayana (Rejuvenatives):* Chyawanprash (general immunomodulator), Praval Pishti (coral calcium, bone health).

- ***3.2.5. Shodhana Chikitsa (Bio-purification / Panchakarma):*** Considered highly effective, especially in chronic/severe cases [7, 13, 14]. Conducted under expert supervision after proper preparation (*Purvakarma*).
  - Snehana (Oleation): Internal (Snehapana) - The process involves administering medicated ghee or oil, such as Tila Taila, Bala Taila, or Mahatikta Ghrita, in progressively larger amounts to lubricate body tissues and facilitate the removal of toxins. External (Abhyanga) - This refers to a full-body or targeted massage using warm *Vata*shamaka oils, including Mahanarayana Taila, Dhanwantaram Taila, Bala*Ashwagandha*di Taila, and Ksheerabala Taila.
  - Swedana (Sudation/Fomentation): After Snehana, this process is used to induce perspiration, help release toxins, and alleviate stiffness. Techniques include Bashpa Sweda (steam chamber), Nadi Sweda (targeted steam application), and Pinda Sweda (bolus fomentation, such as Shashtika Shali Pinda Sweda using a rice bolus cooked in milk or herbal decoction, and Patra Pinda Sweda with medicinal leaves).
  - *Basti (Medicated Enema):* The cornerstone therapy for *Vata* disorders. *Matra Basti* (nutritive enemas with oils/milk) or *Kashaya Basti* (decoction enemas) are used systemically to pacify *Vata* profoundly. Common formulations: Dashamula Ksheera Basti, Ksheerabala Taila Basti, Erandamuladi Basti.
  - Localised Basti treatments, such as Agnikarma and Snehika Basti, include *Janu Basti* for the knees and *Kati Basti* for the lower back, which are essential practices. In these treatments, warm medicated oils like Mahanarayana Taila, Ksheerabala Taila, and Dhanwantaram Taila are collected over the affected joint using a dough barrier and kept in place for 30 to 45 minutes. This process offers profound Snehana and Swedana, enhancing blood flow, decreasing inflammation, and nourishing the joint structures. Numerous studies confirm its effectiveness (see 3.4).
  - *Other Procedures: Pichu* (oil-soaked cotton pad application), *Lepa* (herbal paste application - e.g., with Shigru, Rasna, Dashanga Lepa), *Upanaha* (medicated poultice).

3.3. Correlation of Sandhigata Vata with Contemporary OA Pathophysiology

The Ayurvedic concepts of *Vata* vitiation, *Kapha/Asthi Dhatu Kshaya*, and *Margavarana* find compelling correlations in modern OA science:

- ***Vata Dosha* Vitiation:** It is associated with neurological dysregulation, such as pain perception (*SandhiShula*), instability (Chala), changes in joint biomechanics, and the disruption of normal cellular processes, including catabolic and anabolic imbalances [15]. The sensitivity to cold and dryness corresponds with vasoconstriction and decreased viscosity of synovial fluid in cold conditions.
- **Kapha Kshaya (Synovial Fluid Depletion):** The decrease in both the amount and quality of synovial fluid (hyaluronan depletion) in OA is directly linked to heightened friction (Atopa), compromised lubrication (*Stambha*), and a diminished supply of nutrients to the avascular cartilage [16].
- **Asthi Dhatu Kshaya (Bone/Cartilage Depletion):** Mirrors the hallmark features of OA: progressive degradation of articular cartilage due to imbalanced extracellular matrix (ECM) metabolism (collagen type II degradation by MMPs, aggrecan loss by ADAMTS), chondrocyte apoptosis, and subchondral bone remodelling (sclerosis, cysts, osteophytes) [17]. *Asthi Kshaya* conceptually encompasses both cartilage loss and bone changes.
- **Margavarana (Channel Blockage):** Indicates compromised microcirculation within the synovium and subchondral bone, resulting in hypoxia, diminished nutrient and waste exchange, and the buildup of inflammatory mediators such as cytokines, chemokines, and DAMPs,

which eventually cause tissue damage [18]. Synovitis, frequently observed in OA, illustrates how inflammation can lead to "blockage" and further harm.

- **Inflammation (Ama/Sopha):** Although *Vata* is considered primary, modern science emphasises that low-grade, chronic inflammation plays a crucial role in the progression of OA. Synovitis, which is driven by activated macrophages and fibroblasts releasing pro-inflammatory cytokines such as TNF-α, IL-1β, and IL-6, contributes to cartilage degradation by increasing the activity of MMPs (1, 3, 13) and ADAMTS (4, 5). This process also hinders the synthesis of collagen and proteoglycans and heightens nerve sensitivity, leading to pain [19]. This concept is consistent with the Ayurvedic idea of Ama, or toxic byproducts, which may exacerbate *Vata*-related issues, resulting in swelling (*Shotha*) and tenderness.
- **Oxidative Stress:** Elevated levels of reactive oxygen species (ROS) in osteoarthritis (OA) joints lead to the deterioration of cartilage macromolecules such as collagen and proteoglycans, trigger pro-inflammatory pathways like NF-κB, and cause chondrocyte ageing and cell death [20]. This is linked to the Ayurvedic notion of Dhatwagnimandya, which refers to impaired tissue metabolism resulting in Ama.

3.4. Scientific Evidence Supporting Ayurvedic Interventions

Numerous preclinical and clinical studies validate the efficacy and elucidate the mechanisms of Ayurvedic interventions for OA:

- ***Boswellia serrata* (*Shallaki*):**
  - *Mechanism:* Inhibits 5-lipoxygenase (5-LOX), reducing leukotriene synthesis. Downregulates TNF-α, IL-1β, IL-6, MMP-3, MMP-9, and MMP-13. Inhibits NF-κB activation. Exhibits antioxidant activity. Promotes glycosaminoglycan synthesis [21, 22].
  - Clinical Evidence: Numerous RCTs and meta-analyses indicate a notable decrease in pain (VAS), stiffness, functional disability (WOMAC), and NSAID usage when compared to placebo or glucosamine, with favourable tolerability [23, 24]. Kimmatkar et al. (2003) reported a significant enhancement in pain and function scores ($p<0.001$) along with a reduction in knee swelling [25].
- ***Commiphora wightii*/mukul (*Guggulu*) & Formulations:**
  - Mechanism: Guggulsterones (Z & E) suppress NF-κB activation, leading to a decrease in TNF-α, IL-1β, COX-2, iNOS, and MMP-9. They also demonstrate antioxidant properties and help lower lipid levels, while promoting tissue repair [26]. Formulations such as *Yogaraja Guggulu* combine these benefits with other herbs like Bala, *Ashwagandha*, and Shunthi, known for their *Vata*shamaka and *Shula*hara effects.
  - *Clinical Evidence:* RCTs show formulations like *Yogaraja Guggulu*, *Simhanada Guggulu*, and Trayodashanga *Guggulu* significantly improve pain, stiffness, physical function, and radiological scores compared to baseline and often outperform conventional NSAIDs (like diclofenac) with fewer side effects [27, 28]. Singh et al. (2003) reported that *Yogaraja Guggulu* significantly reduced WOMAC scores ($p<0.01$) [27].
- ***Withania somnifera* (*Ashwagandha*):**
  - Mechanism: Withanolides, such as Withaferin A, suppress NF-κB, STAT3, COX-2, iNOS, and MMPs. They demonstrate strong anti-inflammatory, antioxidant, anti-stress, and immunomodulatory properties. They also safeguard chondrocytes [29].
  - Clinical Evidence: Research indicates that it is effective in alleviating pain and enhancing function in OA, frequently as a component of formulations [30]. Its adaptogenic properties aid in managing stress-induced *Vata* aggravation.
- **Medicated Oils (Taila) & External Applications:**
  - *Mechanism:* Oils like Mahanarayana Taila (containing Bala, Rasna, Eranda, etc.) penetrate tissues (*Sukshma Guna*), providing local *Snehana*, reducing friction and inflammation, improving blood flow, and delivering active phytoconstituents transdermally. Counteract *Rukshata* (dryness) [31].
- ***Janu Basti:***
  - Mechanism: Offers prolonged, targeted Snehana and Swedana. Enhances local microcirculation, diminishes inflammation and swelling, aids in the elimination of inflammatory mediators, eases muscles and ligaments, decreases nerve sensitivity, and might support cartilage nourishment [14, 32].
  - Clinical Evidence: Numerous randomised controlled trials (RCTs) have shown that *Janu Basti*, utilising oils such as Mahanarayana Taila and Ksheerabala Taila, is significantly more effective than control treatments like sham Basti or a hot water bag, and even oral NSAIDs, in alleviating pain (VAS), reducing stiffness, enhancing functional ability (WOMAC, Lequesne index), and expanding range of motion [33, 34, 35]. In a study by Rathi et al. (2011), *Janu Basti* led to a highly significant ($p<0.001$) improvement in WOMAC scores when compared to a control group treated with diclofenac gel [33].
- ***Panchakarma* (Systemic - Basti):**

- *Evidence:* Studies suggest systemic *Basti* therapy (e.g., Ksheerabala Taila Matra Basti, Dashamula Ksheera Basti) combined with local therapies provides superior and more sustained relief in *Sandhigata Vata* compared to Shamana therapy alone, potentially by addressing systemic *Vata* imbalance [36].

4. Discussion

This review brings together the significant parallels between Ayurveda's *Sandhigata Vata* and modern osteoarthritis (OA), affirming ancient wisdom through the lens of current pathophysiology. The fundamental Ayurvedic principles—*Vata* imbalance leading to instability, dryness, and pain; Kapha Kshaya indicating synovial fluid issues; Asthi Dhatu Kshaya representing cartilage wear and bone alterations; and Margavarana associated with disrupted microcirculation and inflammation—offer a comprehensive framework that surpasses the purely structural perspective of traditional OA models.

Ayurvedic treatment employs a comprehensive, patient-focused strategy that differs from conventional care, which often centres on symptom relief and pharmacological interventions. *Nidana* Parivarjana and *Pathya-Apathya* focus on lifestyle-related risk factors that are frequently neglected. Shamana Chikitsa, which uses polyherbal formulations, offers a pharmacotherapy approach that targets multiple aspects. Herbs such as *Shallaki* and *Guggulu* demonstrate mechanisms like LOX/COX inhibition, cytokine/MMP suppression, and chondroprotection, which are similar to or enhance the effects of synthetic drugs, often with better safety profiles, especially concerning gastrointestinal and renal issues [23, 27]. Shodhana Chikitsa, particularly through procedures like *Janu Basti*/*Kati Basti*, provides a distinctive non-invasive, localised treatment method that has shown effectiveness and is well-received by patients. The warmth, oiliness, and medicinal qualities directly counteract the Ruksha, Sheeta, and Khara attributes of aggravated *Vata* at the site of the disorder.

Although the body of scientific evidence is expanding, it still has its limitations. Numerous clinical trials exhibit methodological flaws, such as small participant numbers, brief study periods, absence of blinding (which is challenging with treatments like Basti), and variability in interventions (including dosage, formulation, type of oil, and duration of Basti), as well as inconsistent outcome measures. It is essential to conduct high-quality, large-scale, long-term randomised controlled trials (RCTs) that compare standardised Ayurvedic protocols—whether they involve single drugs, formulations, procedures, or comprehensive system approaches—against placebos and standard medical care. Preclinical studies should further investigate the synergistic effects of polyherbal formulations, a distinctive feature of Ayurveda, and explore the specific mechanisms of procedures like Basti beyond mere heat and massage effects, such as gene expression profiling and proteomic changes in synovial fluid or tissue. Ensuring the standardisation of raw materials (herbs, oils) and manufacturing processes is crucial for achieving reproducibility and ensuring safety.

Integrating Ayurveda into mainstream OA management holds immense promise. Potential models include:

1. **Complementary Use:** Adding Ayurvedic herbs (e.g., Boswellia) or topical oils to conventional care, potentially allowing NSAID dose reduction.
2. **Sequential Therapy:** Using *Panchakarma* (especially Basti) during flare-ups or as intensive rehabilitation, followed by maintenance Shamana therapy and lifestyle management.
3. **Preventive/Regenerative Focus:** Utilising *Rasayana* therapies to potentially slow degeneration and promote tissue health, especially in early OA. Safety monitoring, particularly for herb-drug interactions (e.g., *Guggulu* with anticoagulants, thyroid medication) and ensuring the quality of Ayurvedic products, is essential for successful integration.

5. Conclusion

Sandhigata Vata, which corresponds to osteoarthritis in Ayurveda, is a clearly defined condition characterised by the deterioration of joints due to the imbalance of *Vata*. Ayurveda offers a thorough and holistic approach to managing this condition, which includes changes in diet and lifestyle, a diverse range of herbs and formulations known for their anti-inflammatory, pain-relieving, and cartilage-protecting effects, as well as specific treatments like *Janu Basti* that provide notable relief from symptoms and enhance functionality. Modern scientific studies strongly support the pathophysiological connections and the effectiveness of major Ayurvedic treatments, revealing mechanisms such as cytokine modulation, inhibition of MMPs, antioxidant actions, and enhancement of the joint microenvironment.

Although the current evidence is encouraging, future studies must maintain methodological rigour by conducting larger, longer, and well-structured RCTs, exploring the mechanisms of polyherbal synergy and *Panchakarma* actions in depth, and using standardised protocols. By conducting thorough research and thoughtfully integrating traditional knowledge with modern science, there is a significant opportunity to address the global challenge of OA. Ayurveda, with its comprehensive, multi-faceted, and generally safe approach, offers a valuable complementary and alternative framework for reducing suffering and enhancing the quality of life for the millions affected by *Sandhigata Vata*/Osteoarthritis.

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