

Systemic and Local Ayurvedic Therapeutics in the Management of Spasticity in Cerebral Palsy: A Narrative Review

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ABSTRACT

Background: Spasticity is the most common motor impairment in children with cerebral palsy (CP), leading to muscle stiffness, contractures, pain, and progressive functional limitations. Although conventional therapies such as physiotherapy, oral antispastic agents, botulinum toxin, and surgery are effective, their long-term use is often limited by adverse effects, invasiveness, and high cost. Ayurveda offers a holistic approach through systemic and local therapeutic interventions aimed at correcting the underlying Dosha imbalance and improving neuromuscular function.

Objective: To review the role of systemic and local Ayurvedic therapeutics in the management of spasticity in cerebral palsy and discuss their probable mechanisms and clinical relevance.

Methods: A narrative review was conducted using published literature indexed in PubMed, Scopus, and Web of Science, together with classical Ayurvedic texts including Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya. Studies describing the pathophysiology of spasticity, modern management, Ayurvedic concepts, Panchakarma procedures, and related pharmacological evidence were reviewed.

Results: From an Ayurvedic perspective, the clinical manifestations of spastic cerebral palsy resemble Vatavyadhi, particularly Sthambha, Sankocha, and Snayugata Vata. Management primarily focuses on pacifying aggravated Vata through Basti, Shamana Aushadhi, Abhyanga, Swedana, Nasya, Shirodhara, and other Panchakarma procedures. Experimental and clinical evidence suggests that these interventions may improve muscle flexibility, reduce stiffness, enhance circulation, support neuromuscular function, and facilitate rehabilitation.

Conclusion: Ayurvedic systemic and local therapeutics provide a rational complementary approach for the management of spasticity in cerebral palsy. Integration of these interventions with conventional rehabilitation may improve functional outcomes; however, further high-quality clinical studies are required to strengthen the evidence base...

Keywords: Cerebral palsy, Spasticity, Ayurveda, Vatavyadhi, Panchakarma, Abhyanga, Basti..

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INTRODUCTION

Cerebral palsy (CP) is the most common cause of permanent physical disability in childhood, with a global prevalence of approximately 2–3 per 1,000 live births.^{1,2} It comprises a group of non-progressive neurodevelopmental disorders affecting movement and posture due to injury to the developing brain. Among the various clinical subtypes, spastic cerebral palsy accounts for nearly 70–80% of cases and is characterized by velocity-dependent hypertonia, exaggerated stretch reflexes, muscle stiffness, contractures,

and impaired voluntary movement.³ These manifestations significantly restrict mobility, functional independence, and quality of life while increasing caregiver burden.

Current management of spasticity is multidisciplinary and includes physiotherapy, occupational therapy, orthotic devices, oral antispastic medications, botulinum toxin injections, intrathecal baclofen, and selected surgical procedures.⁴ Although these interventions reduce muscle tone and prevent deformities, they are often associated with adverse effects, repeated interventions, high cost, or limited long-term functional improvement.^{5,6} Consequently, there

is growing interest in complementary therapeutic approaches that can safely enhance rehabilitation and improve functional outcomes.

Ayurveda does not describe cerebral palsy as a distinct disease entity; however, its clinical manifestations closely resemble Vatavyadhi, particularly Sthambha, Sankocha, and Snayugata Vata.⁸⁻¹⁰ The management of these conditions emphasizes restoration of normal Vata function through Snehana, Swedana, Basti, Nasya, and appropriate Shamana Aushadhi. These interventions are believed to reduce stiffness, improve joint mobility, nourish tissues, and enhance neuromuscular function. Emerging experimental and clinical evidence further supports their potential role as adjunctive therapies in children with spastic cerebral palsy.¹²⁻¹⁵

This review summarizes the current understanding of spasticity in cerebral palsy while primarily focusing on the principles, therapeutic modalities, and probable mechanisms of systemic and local Ayurvedic interventions, highlighting their relevance in integrative rehabilitation.

2. Overview of Cerebral Palsy and Spasticity

Spasticity is the predominant motor abnormality in cerebral palsy and results from damage to the upper motor neuron pathways, leading to loss of inhibitory control over spinal reflexes.^{2,7} Clinically, it presents with increased muscle tone, exaggerated tendon reflexes, clonus, impaired selective motor control, muscle weakness, and progressive contractures. Persistent spasticity contributes to musculoskeletal deformities, gait abnormalities, pain, and limitations in activities of daily living.

Management aims not only to reduce muscle tone but also to preserve joint mobility, prevent secondary deformities, improve functional independence, and enhance quality of life. While modern interventions primarily target neural hyperexcitability, Ayurvedic therapeutics adopt a holistic approach by addressing the underlying Dosha imbalance, improving tissue nourishment, and supporting functional rehabilitation.

3. Ayurvedic Perspective

Although cerebral palsy is not explicitly described as a separate disease entity in the Ayurvedic classics, its clinical manifestations can be interpreted through the principles of Vatavyadhi. The predominant features of spastic cerebral palsy, including muscle stiffness, contractures, restricted joint mobility, abnormal posture, impaired voluntary movements, and gait disturbances, closely resemble the manifestations of Sthambha, Sankocha, and Snayugata Vata.⁸⁻¹⁰ These conditions arise due to derangement of Vata Dosha, particularly when its normal functions governing voluntary movement, neuromuscular coordination, and motor control are compromised.

From an Ayurvedic perspective, Vata is the principal Dosha responsible for all voluntary and involuntary movements of the body. Disturbance of its normal Gati affects the functional integrity of Snayu (ligaments and tendons), Kandara (musculotendinous structures), Sandhi (joints), Asthi (bones), and Majja (nervous tissue), resulting in

stiffness, contracture, restricted movements, and impaired motor coordination.^{8,9} In many children, prolonged disease progression may also lead to Dhatu Kshaya, further aggravating Vata and perpetuating musculoskeletal dysfunction.

Unlike modern medicine, which primarily focuses on suppressing hyperactive stretch reflexes, Ayurveda approaches spasticity as a consequence of disturbed Dosha–Dhatu–Srotas homeostasis. Therefore, management extends beyond symptomatic reduction of muscle tone and aims at Samprapti Vighatana by restoring the normal physiological functions of Vata, improving tissue nourishment (Dhatu Poshana), enhancing flexibility of muscles and joints, and facilitating functional rehabilitation. This holistic approach addresses both the neurological and musculoskeletal components of the disorder.

The classical management of Vatavyadhi emphasizes therapies possessing Snigdha (unctuous), Ushna (warm), Mridu (gentle), Brimhana (nourishing), and Vatahara properties.⁸⁻¹⁰ Among these, Snehana, Swedana, Basti, and Nasya constitute the principal therapeutic modalities. These interventions are often complemented with Shamana Aushadhi, Rasayana therapy, and individualized rehabilitation strategies. Rather than functioning as isolated procedures, they act synergistically to reduce stiffness, improve joint mobility, nourish neuromuscular tissues, and enhance motor performance. This integrative therapeutic philosophy forms the basis of Ayurvedic management of spasticity in children with cerebral palsy.

4. Principles of Ayurvedic Management

The management of spasticity in Ayurveda is guided by the fundamental principle of Vata Shamana, as Vata is the primary Dosha responsible for motor activity.⁸ Treatment is individualized according to the patient's strength (Bala), age, associated Dosha involvement, disease chronicity, and degree of functional impairment. Since cerebral palsy is a lifelong condition requiring prolonged rehabilitation, the therapeutic objective extends beyond reducing muscle stiffness to improving functional capacity, preventing secondary deformities, and enhancing quality of life.

Classical texts recommend a combination of Bahya Chikitsa (external therapies) and Abhyantara Chikitsa (internal therapies) for disorders dominated by Vata.⁸⁻¹⁰ External therapies primarily alleviate muscle stiffness, improve flexibility, and prepare the child for physiotherapy and functional training. Internal therapies, particularly Basti, aim to restore systemic Vata balance, improve tissue nourishment, and support long-term neuromuscular recovery. When administered in a planned sequence, these interventions complement each other and provide a comprehensive therapeutic approach.

Considering the multifactorial nature of spasticity, Ayurvedic management should not be viewed as a single therapeutic procedure but as an integrated rehabilitation strategy incorporating Panchakarma procedures, oral medications, dietary modifications, physiotherapy, and caregiver participation. Such a multimodal approach aligns

with the contemporary understanding that optimal management of cerebral palsy requires coordinated interventions addressing multiple aspects of motor dysfunction.⁵

5. Systemic Ayurvedic Therapeutics

The management of spasticity in cerebral palsy extends beyond the reduction of muscle hypertonia and requires interventions that address the underlying neuromuscular dysfunction, prevent progressive musculoskeletal deformities, and improve functional performance. In Ayurveda, this objective is achieved through systemic therapies, which primarily aim to restore the physiological functions of Vata Dosha, nourish depleted tissues, and enhance neuromuscular coordination. Unlike local procedures that predominantly target the affected muscles and joints, systemic interventions exert a broader therapeutic influence by correcting internal Doshic imbalance and promoting overall functional recovery. Consequently, they constitute the cornerstone of Ayurvedic management of chronic Vatavyadhi.

Among the various therapeutic modalities described in the classics, Basti is regarded as the principal treatment for Vata disorders and occupies a central position in the management of conditions characterized by stiffness, contractures, and impaired movement.⁸ Oral medications possessing Vatahara, Brimhana, Balya, and Rasayana properties further complement Basti by supporting tissue nourishment and improving long-term functional outcomes. The combined administration of these therapies forms the systemic foundation upon which local therapeutic procedures are subsequently integrated.

5.1 Basti: The Principal Systemic Therapy for Vata Disorders

Among all Panchakarma procedures, Basti has been accorded the highest therapeutic importance in the management of Vatavyadhi, leading Acharya Charaka to describe it as the foremost treatment for disorders dominated by aggravated Vata.⁸ Since Vata governs all motor, sensory, and neuromuscular activities, therapies capable of restoring its physiological function are considered fundamental in conditions presenting with rigidity, restricted movements, and contractures.

The rationale for employing Basti in spastic cerebral palsy extends beyond its local action on the gastrointestinal tract. According to Ayurvedic principles, the Pakwashaya is the principal seat of Vata; therefore, administration of medicated decoctions and oils through this route facilitates systemic regulation of Vata and promotes restoration of normal neuromuscular activity.^{8,9} Classical formulations containing Sneha, Kashaya, and Brimhana drugs are believed to nourish depleted tissues, improve muscle flexibility, reduce stiffness, and support functional recovery. In children with chronic neuromuscular disorders, Matra Basti and Yapana Basti are particularly preferred because of their nourishing nature, better tolerability, and suitability for repeated administration.

From a contemporary perspective, the therapeutic effects of Basti are likely to be multifactorial. The rectal mucosa

permits efficient absorption of bioactive phytoconstituents while avoiding extensive first-pass hepatic metabolism, thereby facilitating systemic bioavailability. In recent years, the potential role of the gut-brain axis has attracted considerable attention, raising the possibility that Basti may influence neurological function through modulation of intestinal microbiota, immune signaling, and neuroendocrine pathways.^{12,13} Although these mechanisms remain hypothetical in the context of cerebral palsy, they provide a plausible scientific basis for the systemic effects traditionally attributed to Basti.

Clinical studies evaluating Ayurvedic management of children with cerebral palsy consistently include Basti as a major therapeutic component and have reported improvements in muscle stiffness, range of motion, gross motor function, and activities of daily living when combined with rehabilitation therapies.^{12,14,15} However, most available studies are limited by small sample sizes, methodological heterogeneity, and short follow-up periods. Well-designed randomized controlled trials are therefore required to establish its long-term efficacy and optimize treatment protocols.

5.2 Shamana Aushadhi and Rasayana Therapy

Systemic management of spasticity is further supported by the administration of Shamana Aushadhi, which aims to maintain Doshic equilibrium, nourish affected tissues, and sustain the benefits achieved through Panchakarma procedures. Ayurvedic formulations possessing Vatahara, Brimhana, Balya, Medhya, and Rasayana properties are selected according to the child's constitution, disease severity, and associated clinical manifestations.

Several medicinal plants commonly employed in the management of Vatavyadhi, including Ashwagandha (*Withania somnifera*), Bala (*Sida cordifolia*), Guduchi (*Tinospora cordifolia*), Kapikacchu (*Mucuna pruriens*), and Shatavari (*Asparagus racemosus*), have demonstrated antioxidant, anti-inflammatory, adaptogenic, and neuroprotective properties in experimental studies.^{26,27} These pharmacological actions may contribute to improved muscle function, reduction of oxidative stress, enhancement of neuronal survival, and better tolerance to rehabilitation. Rasayana therapy may further support tissue regeneration, improve strength and endurance, and enhance overall quality of life in children requiring long-term multidisciplinary care.

Despite encouraging preclinical and preliminary clinical evidence, standardized treatment protocols and high-quality clinical trials remain limited. Future research integrating classical Ayurvedic principles with contemporary outcome measures will be essential to define the precise role of systemic Ayurvedic therapeutics in the comprehensive management of spastic cerebral palsy.

6. Local Ayurvedic Therapeutics: Targeting the Musculoskeletal Manifestations of Spasticity

While systemic therapies primarily address the underlying Vata Dushti, local therapeutic procedures are directed towards the peripheral manifestations of spasticity, including muscle stiffness, restricted joint mobility, soft

tissue shortening, pain, and impaired motor performance. These therapies form an integral component of Ayurvedic rehabilitation, as they prepare the musculoskeletal system for active physiotherapy and functional training.

Among these interventions, Abhyanga and Swedana are considered the primary therapeutic modalities for disorders dominated by Vata. Their actions are further complemented by specialized procedures such as Shashtika Shali Pinda Sweda, Patra Pinda Sweda, Nasya, Shirodhara, and Agnikarma, each contributing through distinct yet complementary mechanisms.

6.1 Abhyanga

Abhyanga is one of the most frequently employed external therapies in the management of Vata vyadhi and is particularly indicated in conditions characterized by Rukshata (dryness), Sthambha (rigidity), and Sankocha (contracture).⁸ Medicated oils possessing Snigdha, Ushna, Vatahara, and Brimhana properties are gently massaged over the affected muscles and joints with the objective of alleviating stiffness, improving flexibility, and promoting functional movement.

The therapeutic effects of Abhyanga extend beyond simple lubrication of tissues. Mechanical stimulation of the skin, fascia, and underlying musculature activates cutaneous mechanoreceptors and proprioceptive pathways, which may modulate abnormal muscle activity and improve sensorimotor integration.¹⁹ Massage has also been shown to enhance local circulation, reduce muscle guarding, improve connective tissue mobility, and promote relaxation, thereby facilitating passive stretching and functional exercises.^{18,19} Clinical studies evaluating Abhyanga in children with cerebral palsy have reported improvements in muscle flexibility, joint range of motion, Gross Motor Function Measure (GMFM) scores, and caregiver-reported functional performance when incorporated into multidisciplinary rehabilitation programs.^{12,32} Nevertheless, the available evidence is predominantly derived from small-scale studies, highlighting the need for larger randomized controlled trials with standardized treatment protocols.

6.2 Swedana

Following Snehana, Swedana is traditionally administered to relieve stiffness and facilitate mobility by inducing therapeutic sudation.⁸ Classical texts recommend Swedana for conditions associated with Stambha, Gaurava, and Sheeta, making it particularly relevant in the management of spasticity.

From a physiological perspective, therapeutic heat increases tissue extensibility, reduces passive muscle stiffness, and improves local blood flow, thereby creating favourable conditions for stretching and functional rehabilitation.^{20,21} Heat may also decrease muscle spindle sensitivity, resulting in temporary reduction of hypertonia and improved range of motion. These effects are especially valuable when Swedana is administered immediately before physiotherapy.

Ayurveda describes several forms of Swedana, among which Shashtika Shali Pinda Sweda, Patra Pinda Sweda, and Parisheka have been extensively utilized in children with neuromuscular disorders. Rather than functioning

merely as heat therapies, these procedures combine thermal stimulation with the pharmacological properties of medicated oils, herbal decoctions, or nourishing substances, thereby producing both local and systemic therapeutic effects.

6.3 Shashtika Shali Pinda Sweda

Among the different forms of Swedana, Shashtika Shali Pinda Sweda (SSPS) occupies a unique position because it combines Brimhana and Swedana within a single therapeutic procedure. Warm boluses prepared from Shashtika Shali rice cooked with medicated milk and herbal decoctions are rhythmically applied over the body after oil massage, making it particularly suitable for children with chronic neuromuscular disorders associated with weakness and muscle wasting.

The repeated application of warm medicated boluses improves tissue pliability, enhances local circulation, and facilitates muscle relaxation, while the nourishing properties of milk, rice, and medicated oils are traditionally believed to strengthen Mamsa Dhatu and improve functional capacity. Clinical observations suggest that SSPS may reduce stiffness, improve joint mobility, and enhance motor performance when administered as part of an integrated rehabilitation programme.^{8,14} However, robust clinical evidence remains limited, and further well-designed studies are necessary to establish standardized protocols and long-term efficacy.

6.4 Patra Pinda Sweda

Patra Pinda Sweda (PPS) is a localized fomentation therapy in which freshly prepared boluses containing medicinal leaves processed with Vatahara drugs and medicated oils are applied over the affected muscles and joints after Abhyanga. Owing to its Snigdha, Ushna, and Vata-Kapha Shamaka properties, PPS is particularly useful in children presenting with marked muscle rigidity, joint stiffness, and restricted mobility.

The therapeutic benefits of PPS arise from the combined effects of heat, massage, and the pharmacological properties of herbal ingredients. Controlled heat improves collagen extensibility, reduces passive muscle stiffness, and facilitates stretching of contracted muscles, while rhythmic compression with herbal boluses provides continuous proprioceptive stimulation. Herbs such as Nirgundi (*Vitex negundo*), Eranda (*Ricinus communis*), and Arka (*Calotropis procera*), traditionally used in Patra Pinda Sweda, possess anti-inflammatory and analgesic properties that may further contribute to pain reduction and improved joint mobility.¹¹

Although clinical evidence specifically evaluating PPS in cerebral palsy remains limited, studies involving musculoskeletal and neurological disorders have demonstrated improvements in pain, flexibility, and functional movement. Its incorporation into multidisciplinary rehabilitation programmes may therefore enhance therapeutic outcomes, although high-quality randomized controlled trials are still required.

6.5 Nasya

Among the Panchakarma procedures, Nasya occupies a unique position because it is considered the principal

therapy for disorders affecting the region above the clavicle (Urdhvajatrugata Vikara). Classical texts describe the nose as the gateway to the head (Nasa Hi Shiraso Dwaram), providing the conceptual basis for administering medicated oils, ghee, or herbal formulations through the nasal route to influence neurological function.¹⁰

From the Ayurvedic perspective, Nasya helps normalize the functions of Prana Vata, Tarpaka Kapha, and higher neurological centres responsible for motor coordination, sensory perception, and cognitive function. Consequently, it has been traditionally employed in conditions characterized by impaired movement, neuromuscular dysfunction, and disorders of the head and neck.

Modern pharmacological research provides a plausible explanation for this classical concept. The intranasal route offers direct access to the central nervous system through the olfactory and trigeminal pathways, bypassing the blood-brain barrier.^{22,23} This “nose-to-brain” pathway has attracted increasing attention as a potential route for delivering neuroactive compounds to the brain. Clinical observations suggest that Nasya may improve muscle tone, coordination, attention, speech, and overall neurological function when administered as part of comprehensive Ayurvedic rehabilitation; however, these findings are primarily based on small observational studies, and well-designed clinical trials are required before definitive conclusions can be drawn.

6.6 Shirodhara

Shirodhara is a specialized external therapy involving the continuous pouring of warm medicated oil or other therapeutic liquids over the forehead in a rhythmic manner. Traditionally, it is indicated in disorders involving Prana Vata, mental stress, sleep disturbances, and neurological dysfunction. Although its direct role in reducing spasticity has not been extensively investigated, Shirodhara is increasingly incorporated into comprehensive Ayurvedic rehabilitation programmes for children with neurological disorders.

The therapeutic rationale of Shirodhara extends beyond relaxation alone. Continuous tactile and thermal stimulation over the forehead is believed to modulate autonomic

nervous system activity, reduce sympathetic overactivity, and promote parasympathetic dominance. Experimental studies have demonstrated reductions in heart rate, blood pressure, and stress-related biochemical markers following Shirodhara, suggesting a physiological relaxation response.^{24,25} Improved autonomic regulation may indirectly reduce muscle tension, facilitate voluntary motor activity, and enhance participation during rehabilitation sessions.

In children with cerebral palsy, anxiety, irritability, sleep disturbances, and poor cooperation frequently interfere with rehabilitation. By promoting relaxation and improving behavioural responsiveness, Shirodhara may enhance the child's ability to actively participate in physiotherapy and occupational therapy, thereby contributing to better overall functional outcomes. Nevertheless, direct evidence supporting its effect on spasticity remains limited, highlighting an important area for future clinical research.

6.7 Agnikarma

Agnikarma is a para-surgical procedure described in Ayurveda for conditions associated with severe pain, stiffness, and disorders involving Snayu, Sandhi, and Mamsa.¹¹ Although traditionally employed in chronic musculoskeletal disorders, its application in spastic cerebral palsy has recently attracted attention because of its potential to reduce localized muscle tightness and improve joint mobility.

The therapeutic effect of Agnikarma is attributed to controlled therapeutic heat, which may reduce muscle stiffness, improve local circulation, enhance tissue extensibility, and alleviate pain. Unlike generalized heat therapies, Agnikarma provides targeted intervention over selected anatomical sites exhibiting persistent muscle tightness or early contracture formation. Evidence supporting its use in cerebral palsy is currently limited to preliminary clinical observations and isolated reports; therefore, its safety, efficacy, and standardized treatment protocols require further evaluation through well-designed clinical studies.

Tables

Table 1. Classical Correlation of Spastic Cerebral Palsy in Ayurveda

Modern Clinical Feature	Ayurvedic Correlate	Key Reference
Muscle stiffness / hypertonia	Sthambha, Snayugata Vata	8
Contractures, restricted joint mobility	Sankocha	8,9
Impaired voluntary movement	Vata Vaishamya affecting Chesta	10
Gait disturbance, abnormal posture	Snayu-Kandara-Sandhigata Vata	8
Progressive tissue wasting (chronic cases)	Dhatu Kshaya aggravating Vata	8

Table 2. Summary of Systemic and Local Ayurvedic Therapeutics

Therapy	Type	Probable Mechanism	Key Reference
Basti	Systemic	Vata pacification; rectal absorption; possible gut–brain modulation	8,12,13
Shamana Aushadhi Rasayana	Systemic	Antioxidant, adaptogenic, neuroprotective actions	26,27

Therapy	Type	Probable Mechanism	Key Reference
Abhyanga	Local	Mechanoreceptor stimulation, circulation, muscle relaxation	18,19
Swedana	Local	Increases tissue extensibility, reduces stiffness	20,21
Shashtika Shali Pinda Sweda	Local	Nourishing warmth; Mamsa Dhatu strengthening	8,14
Patra Pinda Sweda	Local	Heat combined with herbal anti-inflammatory action	11
Nasya	Local (nose-to-brain)	Olfactory/trigeminal access to CNS	10,22,23
Shirodhara	Local	Autonomic modulation; relaxation response	24,25
Agnikarma	Local (para-surgical)	Targeted thermal stimulation of Snayu/Sandhi	11

Table 3. Future Research Priorities

Priority Area	Rationale
Standardized treatment protocols	Reduce heterogeneity across existing studies ⁵
Validated outcome measures (GMFM, GMFCS, MAS, PedsQL)	Enable objective, comparable assessment of efficacy ³⁰⁻³³
Mechanistic and translational studies	Clarify gut–brain and nose-to-brain pathways underlying Basti and Nasya ^{12,13,22,23}
Multicentre RCTs with long-term follow-up	Strengthen the evidence base for clinical efficacy ^{5,6}
Integration with conventional rehabilitation	Support patient-centred, multidisciplinary care models ^{35,36}

7. Discussion

Spasticity in cerebral palsy is a multifactorial disorder involving altered neural control, muscle stiffness, soft tissue shortening, and progressive musculoskeletal deformities. Consequently, effective management requires interventions that not only reduce muscle tone but also improve joint mobility, facilitate functional movement, prevent contractures, and enhance participation in rehabilitation.⁴⁻⁶ This therapeutic gap has encouraged increasing interest in complementary approaches capable of addressing multiple aspects of the disorder simultaneously.

Ayurveda approaches spasticity from a fundamentally different perspective by considering it a manifestation of Vata Dushti affecting the neuromuscular system.⁸⁻¹⁰ Rather than focusing solely on muscle hypertonia, Ayurvedic management aims to restore functional balance through correction of Dosha imbalance, nourishment of Dhatus, maintenance of joint mobility, and improvement of overall physical function. This holistic concept aligns with the contemporary understanding that cerebral palsy requires comprehensive rehabilitation rather than isolated symptomatic treatment.

One of the distinctive strengths of Ayurveda is the integration of systemic and local therapeutics within a single treatment protocol. Systemic interventions such as Basti and Shamana Aushadhi primarily target internal Vata imbalance and support tissue nourishment, whereas local

procedures including Abhyanga, Swedana, Shashtika Shali Pinda Sweda, Patra Pinda Sweda, Nasya, Shirodhara, and Agnikarma directly address muscle stiffness, restricted mobility, and soft tissue dysfunction. Such an integrative strategy closely parallels modern multidisciplinary rehabilitation, where optimal functional recovery depends upon combining multiple therapeutic modalities rather than relying on a single intervention.

Emerging experimental evidence provides plausible biological mechanisms supporting several classical Ayurvedic concepts. Massage-based therapies may enhance proprioceptive input, improve connective tissue extensibility, and reduce muscle guarding, while thermal procedures improve tissue elasticity and facilitate stretching.¹⁸⁻²¹ Similarly, the growing interest in the gut–brain axis and intranasal drug delivery offers potential scientific explanations for the systemic effects attributed to Basti and Nasya, respectively.^{12,13,22,23} However, these mechanisms remain largely hypothetical in the context of cerebral palsy and should not be considered definitive explanations for their clinical effects.

Despite encouraging findings, the current evidence supporting Ayurvedic interventions in cerebral palsy remains limited. Most published studies involve small sample sizes, heterogeneous treatment protocols, short follow-up periods, and variable outcome measures, making direct comparison difficult.^{5,6} High-quality multicentre randomized controlled trials employing standardized

treatment protocols and validated functional outcome measures are therefore essential to strengthen the evidence base.

Nevertheless, the available literature consistently suggests that Ayurvedic therapies are generally well tolerated and may improve muscle flexibility, joint mobility, gross motor function, and overall quality of life when integrated with conventional rehabilitation.^{28,29} Therefore, Ayurveda should not be viewed as an alternative to established neurorehabilitation but rather as a complementary therapeutic system capable of enhancing functional outcomes through a holistic, patient-centred approach.

8. Conclusion

Spasticity remains one of the most disabling manifestations of cerebral palsy and requires a comprehensive, multidisciplinary approach to optimize functional outcomes. Ayurveda provides a unique therapeutic framework that emphasizes correction of Vata Dushti through the coordinated use of systemic and local interventions.⁸⁻¹⁰ Among these, Basti serves as the principal systemic therapy, while Abhyanga, Swedana, Shashtika Shali Pinda Sweda, Patra Pinda Sweda, Nasya, Shirodhara, and Agnikarma complement rehabilitation by improving muscle flexibility, reducing stiffness, enhancing joint mobility, and facilitating motor performance.

Although the current scientific evidence remains limited, the available experimental and clinical studies indicate that these interventions may serve as valuable adjuncts to conventional rehabilitation rather than replacements for established medical care. Future well-designed clinical trials, mechanistic studies, and standardized treatment protocols are essential to further define the role of Ayurveda in the integrative management of spastic cerebral palsy.

Overall, the integration of systemic and local Ayurvedic therapeutics with evidence-based rehabilitation offers a promising and holistic strategy for improving functional ability and quality of life in children with cerebral palsy.

9. Future Perspectives and Research Gaps

Despite the increasing utilization of Ayurvedic therapies in the management of children with cerebral palsy, the current body of scientific evidence remains limited. Most published studies are characterized by small sample sizes, single-centre designs, heterogeneous intervention protocols, and short follow-up periods, making it difficult to draw definitive conclusions regarding long-term efficacy.^{5,6} Furthermore, many clinical trials evaluate combined Panchakarma regimens rather than individual therapeutic procedures, thereby limiting the ability to identify the specific contribution of each intervention.

Another major challenge is the lack of standardized treatment protocols. Variations in medicated oils, duration of therapy, frequency of treatment, and selection of Panchakarma procedures often hinder comparison among studies. Establishing standardized, reproducible protocols based on classical principles while maintaining flexibility for individualized treatment remains an important priority for future research.

Future clinical studies should incorporate validated neurological and functional outcome measures such as the Modified Ashworth Scale (MAS), Gross Motor Function Measure (GMFM), Gross Motor Function Classification System (GMFCS), Pediatric Quality of Life Inventory (PedsQL), and gait analysis to objectively evaluate therapeutic efficacy.³⁰⁻³³ Long-term follow-up studies are equally essential to determine whether Ayurvedic interventions merely provide temporary symptomatic relief or contribute to sustained functional improvement and prevention of secondary musculoskeletal complications.

In addition to clinical research, mechanistic studies exploring the biological basis of Ayurvedic therapies are warranted. Emerging concepts such as mechanotransduction following Abhyanga, thermal modulation of muscle stiffness during Swedana, gut-brain interactions associated with Basti, and intranasal drug delivery through Nasya provide promising avenues for interdisciplinary research.^{12,13,18-23} Integration of Ayurveda with contemporary neuroscience, rehabilitation medicine, biomedical engineering, and molecular biology may facilitate a deeper understanding of these traditional therapies and strengthen their scientific acceptance.

10. Clinical Implications

The holistic philosophy of Ayurveda offers several practical advantages in the rehabilitation of children with spastic cerebral palsy. Rather than focusing exclusively on muscle tone reduction, Ayurvedic management addresses the broader objectives of improving flexibility, enhancing motor function, preventing secondary deformities, promoting tissue nourishment, and improving overall quality of life. This multidimensional approach complements the goals of contemporary rehabilitation and supports the concept of patient-centered care.^{35,36}

Importantly, Ayurvedic interventions should not be regarded as substitutes for established rehabilitation strategies but as complementary therapies integrated with physiotherapy, occupational therapy, speech therapy, and nutritional support. Such an integrative rehabilitation model may optimize functional outcomes while minimizing dependence on repeated pharmacological interventions or invasive procedures in appropriately selected patients.

Given the chronic nature of cerebral palsy, individualized treatment planning involving pediatricians, physiotherapists, rehabilitation specialists, and Ayurvedic physicians may provide a more comprehensive and sustainable management strategy. This collaborative approach aligns with current trends in integrative medicine and emphasizes functional improvement rather than isolated symptom control.^{28,29}

11. Key Take-Home Messages

Spasticity is the predominant motor manifestation of cerebral palsy and contributes significantly to functional disability, contracture formation, and reduced quality of life.³

Effective management requires a multidisciplinary rehabilitation approach that addresses both the neurological and musculoskeletal components of the disorder.^{4,6}

From an Ayurvedic perspective, the clinical features of spastic cerebral palsy can be interpreted under the broad framework of Vatavyadhi, particularly Snayugata Vata, characterized by Sthambha, Sankocha, and impaired motor function.⁸⁻¹⁰

Systemic therapies, especially Basti, play a central role in correcting Vata Dushti, improving tissue nourishment (Dhatu Poshana), and supporting neuromuscular recovery.^{8,12,13}

Local therapeutic procedures, including Abhyanga, Swedana, Shashtika Shali Pinda Sweda, Patra Pinda Sweda, Nasya, Shirodhara, and Agnikarma, primarily improve muscle flexibility, reduce stiffness, enhance joint mobility, and facilitate rehabilitation.¹⁸⁻²⁵

The integration of systemic and local Ayurvedic interventions provides a holistic treatment strategy that complements physiotherapy, occupational therapy, and other conventional rehabilitation modalities.

Current evidence suggests encouraging improvements in muscle tone, motor function, and quality of life; however, the scientific evidence remains limited by methodological heterogeneity and the lack of large-scale randomized controlled trials.^{5,6}

Future research should focus on standardized treatment protocols, objective outcome measures, mechanistic studies, and long-term follow-up to strengthen the evidence base for Ayurvedic rehabilitation in children with cerebral palsy.³⁰⁻³³

12. Practical Recommendations for Clinicians

Based on the currently available literature, the following practical recommendations may be considered while integrating Ayurveda into the management of spastic cerebral palsy:

Adopt an individualized treatment approach based on the child's age, functional status, associated comorbidities, and severity of spasticity.

Prioritize Basti as the principal systemic intervention in accordance with classical principles of Vatavyadhi Chikitsa, whenever clinically appropriate.⁸

Combine local therapies such as Abhyanga and Swedana with structured physiotherapy sessions to maximize muscle relaxation and facilitate active rehabilitation.¹⁸⁻²¹

Use nourishing therapies like Shashtika Shali Pinda Sweda in children with significant muscle wasting and weakness. Integrate Ayurvedic management with multidisciplinary rehabilitation rather than employing it as an isolated therapeutic modality.

Monitor functional outcomes using validated assessment tools such as the Modified Ashworth Scale (MAS), Gross Motor Function Measure (GMFM), Gross Motor Function Classification System (GMFCS), and quality-of-life scales to objectively evaluate treatment response.³⁰⁻³⁴

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