



Massage with Herbal Oils as a Novel Therapeutic Approach for Cerebral Palsy: A Medical Hypothesis

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Abstract

Cerebral palsy (CP) is a condition resulting from injury to the developing brain. Treatment modalities vary based on symptomatology and may range from physiotherapy to pharmacologic intervention and surgical intervention. Despite the current therapeutic strategies, outcomes remain suboptimal. In light of limited data regarding the therapeutic effects of oil-based massages on neonates with CP, this study aimed to investigate the potential neurological benefits of incorporating herbal oils into massage treatments for these infants. In this investigation, we conducted a thorough exploration of the medicinal herbs described in the paralysis section of medical and pharmaceutical sources in Persian medicine. Subsequently, we conducted an extensive literature review on the neurological effects of oils or essential oils derived from these herbs. Our search was conducted up to 2023 using pertinent keywords such as *Pimpinella anisum* L., anise, aniseed, *Foeniculum vulgare* Miller, fennel, *Carum carvi* L., caraway, *Piper nigrum* L., pepper, *Cinnamomum zeylanicum*, cinnamon, *Nigella sativa* L., black seed, *Vitis vinifera* L., grape seed, *Olea europaea* L., olive, *Rosa x damascena* Herrm., and rose flower. We specifically focused on studies related to neuroprotection, neurology, massage, and cerebral palsy, and obtained relevant information from data sources such as PubMed, Scopus, and Google Scholar. Our investigation revealed that massage therapy has an impact on CP and that herbal oils possess neurological properties, such as anticonvulsant and neuroprotective effects, as well as enhancements in behavior, memory, learning, and cerebral function. Based on the advantageous mechanisms of action of herbal oils, we postulate that massage therapy utilizing herbal oils may offer a promising *complementary approach* in the management of newborns with CP. We recommend further experimental and clinical studies to establish their effectiveness.

Keywords: Cerebral palsy; Massage; Herbal oil; Persian medicine; Complementary medicine; *Vitis vinifera* L.; *Rosa x damascena* Herrm.; *Pimpinella anisum* L.

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Introduction

Cerebral palsy (CP) is a chronic neurological disorder resulting from brain damage that can occur before, during, or after birth, as the brain continues to grow during the first two years of life [1, 2]. The prevalence of CP varies globally, with estimates ranging from 1.5 to over four cases per thousand live births based on population-based studies [3-8]. While most children are born with healthy musculoskeletal systems, postural issues may develop over time [9,10]. CP is characterized by motor problems such as spasticity, which manifests as increased muscle tone, hyperkinetic disorders such as dystonia and choreoathetosis, which result in unwanted excessive movements, and less commonly, ataxia, which presents as uncoordinated movement. However, many children exhibit a mixed movement disorder [11]. Dystonia can have severe consequences on function, including impaired communication and swallowing, as well as difficulties in performing self-care activities and sitting comfortably in a wheelchair. Moreover, children may develop cycles of dystonia leading to musculoskeletal pain, which further exacerbates dystonia. The most severe manifestation of this cycle is the dystonic crisis, which may require muscle paralysis or sedation [11,12].

Children with CP commonly experience cognitive deficits, hearing and vision impairments, communication difficulties, and seizures [13,14]. These challenges, together with mental health issues, limit their ability to participate in physical and skill-based activities typically performed outdoors, leading to a negative impact on their daily routines, quality of life, occupational performance, and social functioning [15-17]. Since 1862, significant scientific and medical advancements have been made in the prevention and management of CP. There are various therapeutic modalities available, including physiotherapy, drug therapy, and surgical intervention, depending on the patient's symptoms. Although physical limitations in individuals with CP are incurable, physiotherapy has demonstrated remarkable success in improving muscle function and structure, joint range of motion, relieving pain, and reducing contractures [18,19].

Complementary and alternative medicine (CAM) encompasses a broad range of therapeutic approaches that are used in conjunction with or instead of conventional medical care and treatment. CAM therapies include the use of vitamins, herbs, and minerals, as well as mind-body activities such as chiropractic, yoga, acupuncture, exercise therapies, massage therapy, and osteopathy. Other forms of complementary treatments include traditional Chinese medicine, folk medicine, naturopathy, and homeopathy [20].

Study conducted by Astin showed that 40% of individuals use CAM, often in association with chronic health conditions [21]. CAM use is typically sought to

enhance overall well-being and health [22,23] or to alleviate symptoms related to chronic or life-threatening illnesses, or the adverse effects of conventional therapies [24-26]. Children, particularly those with disabilities, frequently use CAM. Children with chronic medical conditions are three times more likely to use CAM compared to their healthy peers. Furthermore, children with CP exhibit an even higher prevalence of CAM use [1].

Badr et al. [27] and Lu et al. [28] conducted updated meta-analyses that demonstrated significant daily weight gain in medically stable preterm newborns who received massage compared to controls. Badr also reported that newborns who received massage in the Neonatal Intensive Care Units (NICU) exhibited higher neurodevelopmental scores, as measured by structured developmental assessments, compared to those who received conventional care [29]. This approach is now widely utilized in NICUs [30,31] as it is considered a valid environmental enrichment model due to its beneficial effects on neonatal stress and parent-infant attachment [31,32]. Newborn massage involves the systematic tactile stimulation of a newborn by human hands [33]. Massage is a therapeutic option for several musculoskeletal pathological disorders [34-36] and is known to stimulate blood circulation in the tissues, which promotes new tissue formation and wound healing [36-38]. Massage therapy may also facilitate the elimination of lactic acid from muscles, the release of endorphins, and the inhibition of serotonin reuptake [39-41]. Furthermore, massage therapy may lengthen muscle fibers and reduce the production of fibrotic tissue, potentially preventing contractures [42-44], enhancing growth [45,46], increasing weight gain [47-50], improving gastrointestinal function [45,46], boosting the immune system [51], promoting body fat deposition [52], and mitigating neurobehavioral effects [53-56] and pain [57,58]. Massage therapy has also been demonstrated to increase heart rate variability [59], reduce stress-related factors and infant stress [58,60], alleviate jaundice [61], prevent late-onset sepsis [62], and lower maternal anxiety and depression [63]. According to studies, newborn massage therapy increases vagal activity, serum insulin, and stomach activity and has beneficial effects on the development of visual function and brain electrical activity [31,64,65]. Another study of 20 infants with CP demonstrated that massage therapy was associated with reduced stiffness, increased muscular tone, range of cognition, motion, gross and fine motor abilities, and social functioning [66,67]. However, the effects of massaging preterm newborns with or without oils on their development are currently unknown [68].

Herbal oils are derived from herbs and possess therapeutic properties [69]. The therapeutic effects of herbal oils are attributed to the combination of anti-

oxidants, nutrients, and biostimulants extracted from herbs [70]. While studies have shown that oils can serve as a source of heat and nutrients, it remains unclear what impact oil alone has on the development of premature newborns [68]. The use of oil during massage therapy makes the process frictionless, enabling prolonged rubbing with appropriate and consistent pressure. Additionally, the oil softens the skin and eliminates skin dryness. The use of oils for skin massage is gaining popularity, particularly in the Mediterranean region and India, where natural oils have been used in newborn massage therapy for over a century [71]. This may be due to their lower skin irritancy compared to synthetic oils [72].

Traditional Chinese Medicine (TCM) has been identified as an alternative therapy for individuals with CP disabilities [73]. Similarly, Persian Medicine (PM), a form of CAM, is a system of medical practices and principles documented in well-known texts [74]. The section on paralytic (falej) diseases in Persian medical literature recommends the oral ingestion of suitable medicinal herbs in individuals with CP, as well as the application of herbal oils topically for body rubbing [75].

There is currently limited data available on the efficacy of herbal oils in massage therapy and their impact on newborns with CP. Therefore, the aim of this study is to investigate the incorporation of herbal oils into massage therapy for infants with CP, particularly in relation to their neurological effects.

Materials and Methods

In this review, we aimed to investigate the potential beneficial effects of massage and herbal oils for newborns with CP. Initially, we searched for medicinal herbs mentioned in the section on paralysis in medical and pharmaceutical sources of Persian medicine. We then searched for relevant information in the literature regarding the neurological effects of oils or essential oils extracted from these herbs. The search was conducted using databases such as PubMed, Scopus, and Google Scholar, with a time frame up to 2023, using keywords such as *Pimpinella anisum* L., anise, aniseed, *Foeniculum vulgare* Mill., fennel, *Carum carvi* L., caraway, *Piper nigrum* L., pepper, *Cinnamomum zeylanicum*, cinnamon, *Nigella sativa* L., black seed, *Vitis vinifera* L., grape seed, *Olea europaea* L., olive, *Rosa x damascena* Herrm., and rose flower, in combination with terms such as neuroprotective, neurological, massage, and cerebral palsy.

Results

Pimpinella anisum L.

Pimpinella anisum L., commonly known as anise, belongs to the Apiaceae family and has a long history of

medicinal use in PM due to its beneficial effects on epilepsy [76]. Anise contains essential oil, which makes up 1.5 to 5% of its weight. The primary constituents of anise essential oil are trans-anethole, estragole, methyl chavicol, and para-anisaldehyde [77]. Anise possesses an array of properties, including analgesic, anticonvulsant, muscle relaxant, antioxidant, antiviral, and antifungal effects [78]. A study has demonstrated the anticonvulsant effects of anise essential oil [79], while another study showed the ameliorative effect of anise essential oil on emotional reactivity disruption due to developmental exposure to lead [80]. Table 1 summarizes the neurological effects of *Pimpinella anisum* L. according to the literature.

Foeniculum vulgare Mill.

Foeniculum vulgare Mill. (fennel) is a member of the Apiaceae family. Studies have shown that fennel contains essential oil, phenolic components, fatty acids, and hydrocarbons. Fennel is a commonly used medicinal herb in traditional medicine for various disorders, including endocrine, digestive, and respiratory conditions [81]. One study has demonstrated the potential efficacy of fennel essential oil on animal models of Parkinson's disease [82]. Table 1 summarizes the neurological effects of *Foeniculum vulgare* Mill. according to the literature.

Carum carvi L.

Carum carvi L., commonly known as caraway, is a member of the Apiaceae family [83]. Caraway contains various secondary metabolites, including carvone, which is the primary component of its essential oil, as well as limonene, phenols, and flavonoids [84]. These components contribute to the antioxidant, anticancer, antimicrobial, analgesic, hypolipidemic, antidiabetic, bronchial, gastrointestinal, relaxant [83], and anticonvulsant [85] effects of caraway. One study conducted on rats illustrated that caraway oil can reduce behaviors associated with injury-related pain [86]. The neurological effects of *Carum carvi* L. are summarized in table 1.

Piper nigrum L.

Piper nigrum L. (black pepper) belongs to the Piperaceae family [87]. Black pepper contains several secondary metabolites, including phenol compounds, steroids, alkaloids, tannins, flavonoids, fatty acids, and resins [88]. The primary bioactive constituent in black pepper is piperine, which has various therapeutic effects, including antioxidant, analgesic, antihypertensive, antiplatelet, antidepressant, and anticancer effects [89-91]. One study has demonstrated that the essential oil of black pepper can improve memory impairment in rats [92]. Table 1 summarizes the studies on the neurological effects of *Piper nigrum* L.

Matricaria chamomilla L.

Matricaria chamomilla L., commonly known as chamomile, is a member of the Asteraceae family [93]. The most important group of bioactive constituents in chamomile essential oil are terpenoids, including bisabolol oxide A, bisabolol oxide B, bisabolone oxide A, chamazulene, and β -farnesene [94,95]. Chamomile essential oils and extracts exhibit antifungal, antibacterial, antioxidant, anti-inflammatory, antiparasitic, analgesic, antidepressant, antidiabetic, anticancer, anti-allergic, and antipyretic activities [93]. One study has demonstrated that hydroalcoholic extracts of chamomile can increase the time of onset, and decrease the duration and intensity of convulsions [96]. Table 1 summarizes the neurological effects of *Matricaria chamomilla* L.

Cinnamomum verum J.Presl (Synonym: *Cinnamomum zeylanicum* Blume)

Cinnamomum verum (cinnamon) is a member of the Lauraceae family [97]. The bioactive components of cinnamon include cinnamaldehyde, carvacrol, cinnamyl acetate, eugenol, cinnamyl alcohol, and benzyl benzoate [98]. The secondary metabolites in cinnamon have been associated with various pharmacological activities, including neuroprotective [99], antibacterial, anti-allergic, antioxidative, hypoglycemic, and anticarcinogenic effects [100]. One study has demonstrated that the essential oil of cinnamon has a neuroprotective effect against ischemic stroke [99]. Table 1 summarizes the studies on the neurological impacts of *Cinnamomum verum*.

Nigella sativa L.

Nigella sativa L., commonly known as black seed, is a member of the Ranunculaceae family [101,102]. The primary active compounds identified from black seeds include thymoquinone, thymol, alkaloids such as nigellidine, nigellimine, and nigellicine, as well as vitamins, minerals, and proteins [103]. Black seed and its oil have therapeutic effects on inflammatory disorders, digestive diseases, and diabetes [104]. Thymoquinone and black seed are known as neuroprotective substances [105]. Although there are few studies on black seeds' ability to protect the brain, in vitro studies have shown that pretreatment with black seed oil significantly increased the vitality of neuronal cells [106]. Moreover, black seed methanolic extract has significant central nervous system (CNS) and analgesic activities. It also regulates the neuronal release of amino acid neurotransmitters such as gamma-aminobutyric acid (GABA), glycine, aspartate, and glutamate in cultured cortical neurons [107,108]. Table 1 summarizes the studies on the neurological impacts of *Nigella sativa* L.

Vitis vinifera L.

Vitis vinifera L., commonly known as grape seed, is a member of the Vitaceae (grape) family. Grape seeds contain various compounds, including vitamin E, polyphenols such as catechins, gallic acid, resveratrol, tannins, proanthocyanidins, polyunsaturated fatty acids such as oleic, alpha-linolenic acids, and linoleic, carbohydrates, and protein. Grape seed oil also contains quercetin, tocopherol, carotenoids, procyanidins, and phytosterols [109]. Grape seed extracts have been shown to improve neuropathy and cognitive disorders in Alzheimer's disease mouse models [110]. In studies, grape seed powder (2.5 g/kg) had a prophylactic impact against brain ischemia/reperfusion (I/R) damage and protected against the harmful effects of I/R-induced oxidative stress [111]. Table-1 summarizes the studies on the neurological impacts of *Vitis vinifera* L.

Olea europaea L.

Olea europaea L., commonly known as the olive tree, belongs to the Oleaceae family. This plant produces phenols [112]. Natural phenols have been shown to exhibit a variety of biological functions, including the ability to alter cell redox status [113] through direct action on proteins, enzymes, receptors, and other signaling mechanisms [114,115], and the potential to disrupt biochemical homeostasis [116,117]. Olive oil has been found to have antioxidant and cytoprotective effects in rats with brain hypoxia-reoxygenation, reducing lipid peroxide levels, brain cell death, counteracting glutathione depletion, and suppressing prostaglandin E2 overproduction in brain tissues [118]. Virgin olive oil has also been found to reduce brain prostaglandin E2, lipid peroxidation, and nitric oxide production, while increasing glutathione levels and preventing cell death [119]. Table 1 summarizes the studies on the neurological impacts of *Olea europaea*.

Rosa x damascena Herrm.

Rosa x damascena Herrm., a member of the rose family, is a rich source of flavonoids such as quercetin, kaempferol, and their derivatives, which may have various therapeutic benefits for psychiatric diseases [120-122]. The flavonoids found in this plant also have several neuroprotective activities in the brain, such as protecting against neurotoxic damage, suppressing neuro-inflammation, and enhancing learning, memory, and cognitive function. Flavonoids that suppress apoptosis enhance synaptic plasticity and neuronal survival, which may be responsible for these benefits. They may also improve blood flow in the brain, neurogenesis, angiogenesis, and neuronal morphology [123]. There is substantial evidence that *Rosa x damascena* extracts strongly stimulate neurite outgrowth and prevent A- β deposition and fibrilization in the brain [124]. Additionally, *Rosa x damascena* essential oil can acquire

Table 1. Neurological effects of *Pimpinella anisum* L., *Foeniculum vulgare* Mill., *Carum carvi* L., *Piper nigrum* L., *Cinnamomum verum* J.Presl, *Matricaria chamomilla* L., *Nigella sativa* L., *Vitis vinifera* L., *Olea europaea* L., and *Rosa x damascena* Herrm.

First author	Country	Year	Scientific name	Types of study	Results	References
Fariba Karimzadeh	Iran	2012	<i>Pimpinella anisum</i> L.	<i>In vivo</i> and <i>in vitro</i> experimental models of rat	Neuroprotective and anticonvulsant effects of anise oil	[79]
Khaled Kahloula	Algeria	2013	<i>Pimpinella anisum</i> L.	<i>In vivo</i> study in Wistar rat pups	Amelioration of the disruption in emotional reactivity due to the developmental exposure to lead by treatment with anise essential oil	[80]
Wael M Al-Amoudi	Saudi Arabia	2017	<i>Foeniculum vulgare</i> Mill.	<i>In vivo</i> study of sodium valproate-induced hepatorenal damage in albino rats	Positive effects on the levels of ALT, AST, ALP, urea, creatinine, total proteins, and bilirubin, and the histological structure of the kidney and liver.	[135]
Mohammad Nemati	Iran	2018	<i>Foeniculum vulgare</i> Mill.	Animal study (rat)	Improvement of Parkinson's behavioral-motor disorders by essential oils of fennel	[82]
Alireza Showraki	Iran	2016	<i>Carum carvi</i> L.	Animal study (mice)	Anticonvulsant effects of the essential oil and aqueous extract of caraway	[85]
Faisal K. Alkholifi	India	2023	<i>Carum carvi</i> L.	Animal study (rat)	Reduction of behavior associated with injury-related pain by caraway oil	[86]
Nada M Mostafa	Saudi Arabia	2021	<i>Piper nigrum</i> L.	Animal study (rat)	Improvement of the rat memory by cold-pressed oil from black pepper	[92]
Walaa M S Ahmed	Egypt	2021	<i>Cinnamomum verum</i> J.Presl	Animal study (rat)	Improvement in rat behavior and brain antioxidant capacities by cinnamon oil	[136]
Yuh-Fung Chen	Taiwan	2016	<i>Cinnamomum verum</i> J.Presl	Animal study	Neuroprotective effect of essential oil in cinnamon powder against ischemic stroke	[99]
A Arzi	Iran	2014	<i>Matricaria chamomilla</i> L.	Animal study (rat)	Increase of the time of onset, decrease of the duration and intensity of convulsions by hydroalcoholic extracts of chamomile	[96]
M Kanter	Turkey	2006	<i>Nigella sativa</i> L.	Animal study (rat)	Neuroprotective effects in spinal cord injury	[137]
B.V.S. Lakshmi	India	2014	<i>Vitis vinifera</i> L.	Animal study (rat)	Improvement of the cognition, short-term memory, anxiety, muscle activity and locomotion in aluminum-induced oxidative stress in rat brain by <i>Vitis vinifera</i> extract.	[138]
Ibrahim H. Borai	Egypt	2017	<i>Vitis vinifera</i> L.	Animal study (rat)	Improvement in brain function	[139]
Deepthi Rapaka	India	2019	<i>Vitis vinifera</i> L.	Animal study (rat)	Improvement in memory and learning	[140]

Yisong Qian	China	2016	<i>Olea europaea</i> L.	Animal study (rat)	Improvement of glial function by maslinic acid (a natural product from <i>Olea europaea</i>)	[141]
F. Ashrafzadeh	Iran	2007	<i>Rosa x damascena</i> Herrm.	Clinical trial	Reduction in mean seizure frequency with <i>Rosa damascena</i> essential oil	[142]
Mansour Homayoun	Iran	2020	<i>Rosa x damascena</i> Herrm.	Animal study (rat)	Reduction in apoptotic neurons by <i>Rosa damascena</i> extract	[143]
Mansour Homayoun	Iran	2015	<i>Rosa x damascena</i> Herrm.	Animal study (rat)	Prolongation the latency, reduction the frequency, and inhibition of production of dark neurons in the hippocampus by hydro-alcoholic extract of <i>Rosa damascena</i>	[144]

contract kindling and has been shown to reduce the development of behavioral seizures in amygdale electrical kindling [125]. Table 1 summarizes the studies on the neurological effects of *Rosa x damascena*.

Discussion

Massage therapy has been used since ancient times to treat muscular tightness and promote overall health in both newborns and adults, and it is often used as CAM [126, 127]. Various studies have demonstrated the benefits of massage therapy in improving spasticity and motor skills in children with CP. For instance, Rasool et al. showed that deep cross-friction massage improved spasticity in children with CP [128]. Silva et al. demonstrated that Qigong massage improved motor skills and sensory responses in young children with CP [129]. Elbasan et al. showed that reflexology improved constipation and motor functions in children with CP [130]. Malila et al. showed that Thai massage decreased muscle spasticity in young people with CP [131]. Mahmood et al. indicated that traditional massage reduced spasticity in children with CP [126]. Özkan et al. found that reflexology with physiotherapy improved gross motor functions, reduced spasticity in legs, and decreased dependency in children with CP [132]. Wang et al. showed that massage improved gross motor function in children with spastic CP [133]. In conclusion, these findings suggest that massage therapy is an effective complementary therapeutic method for reducing muscle spasticity and improving motor functions in patients with CP.

Recent studies have shown that baby massage is more effective when used in combination with oil [71]. Essential oils and their constituents are known to be quickly absorbed by the skin. For instance, linalyl acetate and linalool can be rapidly detected in plasma after topical application with massage, with peak levels occurring after approximately 19 minutes [134]. Furthermore, based on the findings of our study, medicinal herbs have neuroprotective effects.

Limitations

A limitation of this study was the insufficient number of studies on the efficacy of massage therapy in conjunction with medicinal oils in individuals with cerebral palsy. Although existing studies suggest that herbal oils may have potential as a complementary therapy for cerebral palsy, further studies are necessary to establish the safety and efficacy of this approach. Additionally, more studies are required to determine the optimal massage therapy type and the most effective herbal oils for this population. Further studies in this area could help to broaden the range of treatment options available to individuals with cerebral palsy and enhance their quality of life.

Conclusion

Based on our findings, herbal oils such as *Pimpinella anisum*, *Foeniculum vulgare*, *Carum carvi*, *Piper nigrum*, *Matricaria chamomilla*, *Cinnamomum verum*, *Nigella sativa*, *Vitis vinifera*, *Olea europaea*, and *Rosa x damascena* have potential effects on the nervous system due to their neuroprotective, cytoprotective, and antioxidant activity. Given the beneficial mechanisms of action of these herbal oils, we suggest that massage therapy with herbal oils may be used as a complementary therapy in newborns with cerebral palsy. However, more experimental and clinical studies are needed to confirm the effects of this approach.

Declaration of competing interest

There is no conflict of interests to be disclosed.

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None.

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