REVIEW ARTICLE

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Osteopathic treatment of non-synostotic plagiocephaly in infants – a systematic review

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Abstract

Introduction and Objective. Deformational (non-synostotic positional) plagiocephaly is a frequent craniofacial asymmetry in infants caused by prolonged external pressure on the neonatal skull. It may lead to motor delays, postural asymmetries and neurodevelopmental issues. Osteopathic manipulative treatment (OMT) is used as a gentle, non-invasive approach to improve cranial symmetry and support development. The aim of this systematic review is to evaluate the effectiveness and safety of OMT in infants under 12 months with non-synostotic positional plagiocephaly.

Review Methods. Six clinical studies (two RCTs, one large cohort, one outcome research, one chart review and one pilot study) assessing OMT with validated anthropometric measures (ODDI, CVAI, CVA) were included. Methodological quality was evaluated using the Downs and Black checklist.

Brief description of the state of knowledge. OMT was typically delivered in 3–6 sessions. Most studies showed significant or clinically relevant reductions in cranial asymmetry. Benefits were observed in both therapeutic and preventive settings. High parental satisfaction and excellent safety (no adverse events) were consistently reported.

Summary. Available evidence indicates that OMT is a safe and potentially effective complementary intervention for non-synostotic positional plagiocephaly in infants. Early application may improve cranial symmetry and support neurodevelopment. However, due to heterogeneity, small samples and limited long-term data, high-quality multicentre RCTs are required to confirm these findings.

Key words

non-synostotic plagiocephaly, osteopathic treatment, Infants, cranial asymmetry

INTRODUCTION

Deformational (non-synostotic or positional) plagiocephaly is an acquired craniofacial asymmetry resulting from prolonged extrinsic mechanical forces acting upon the highly compliant neonatal skull [1, 2]. The condition is characterised by unilateral flattening of the occipital or parieto-occipital region, frequently accompanied by ipsilateral anterior ear displacement and contralateral frontal bossing, resulting in a parallelogram-shaped cranium [3].

Since the implementation of the 'Back to Sleep' campaign by the American Academy of Pediatrics in 1992, the prevalence of positional plagiocephaly has increased markedly. Current epidemiological estimates indicate that this deformity affects 20–48% of healthy infants, with a peak incidence of 30–35% at approximately 4 months of age [4, 5]. Although initially regarded primarily as a cosmetic concern, contemporary evidence demonstrates that deformational plagiocephaly is associated with a spectrum of functional sequelae, including motor developmental delays, persistent postural asymmetries, visuomotor and auditory processing impairments, temporomandibular joint dysfunction, and potential long-term neurocognitive effects [1, 6].

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The etiopathogenesis is multifactorial, encompassing prenatal, perinatal and postnatal contributors. Intrauterine constraint, macrosomia, multiple gestation, oligohydramnios and maternal pelvic anomalies may initiate cranial moulding *in utero.* During parturition, prolonged labour, instrumental delivery and atypical foetal presentation are associated with the development of cranial base strains (CBS) and disturbances within the reciprocal tension membranes [7, 8]. Postnatally, habitual supine positioning and prolonged confinement in restrictive devices ('container syndrome') further promote unilateral occipital deformation [4, 5].

From an osteopathic perspective, deformational plagiocephaly represents a structure–function disorder. Persistent cranial base strains and membranous tension may compromise the primary respiratory mechanism, thereby influencing not only cranial morphology, but also global neuromotor organisation and developmental trajectories [1, 7]. McElwain and Schmidt have underscored the potential link between birth presentation, cranial base strains and the persistence of cranial asymmetry, emphasising the importance of early identification and correction of somatic dysfunctions [8]. Similarly, Filisetti et al. reported that 81% of infants with positional plagiocephaly presented with associated disorders affecting growth, behaviour and neurodevelopment, highlighting the need for a holistic therapeutic approach [1].

Current standard management strategies primarily include parental repositioning education, targeted physiotherapy

(particularly in the presence of congenital muscular torticollis) and cranial helmet therapy in moderate to severe cases [9, 10]. Although these interventions are widely recommended, their long-term efficacy in addressing functional impairments beyond cranial shape remains a subject of debate. Osteopathic manipulative treatment (OMT) offers a gentle, non-invasive and integrative modality aimed at restoring cranial symmetry, releasing restricted membranous and articular tensions, and supporting physiological development.

Despite growing clinical interest in OMT for infants with plagiocephaly, high-quality systematic syntheses of its effectiveness and safety remain limited. Therefore, the objective of this systematic review was to evaluate the effectiveness and safety of osteopathic manipulative treatment in reducing cranial asymmetries and improving clinical outcomes in infants with nonsynostotic plagiocephaly

OBJECTIVE

Therefore, the aim of this systematic review was to evaluate the effectiveness and safety of osteopathic manipulative treatment in reducing cranial asymmetries, and improving clinical outcomes in infants with nonsynostotic plagiocephaly.

The primary aim of this review was to summarize the aims and outcomes of 6 clinical studies investigating the role of osteopathic manipulative treatment (OMT) in the management or prevention of nonsynostotic positional plagiocephaly in infants. The selected studies focused on both therapeutic effects on existing cranial asymmetries and the potential preventive role of early osteopathic intervention.

MATERIALS AND METHOD

Inclusion criteria:

- Original clinical studies (randomized controlled trials, prospective or retrospective cohort studies, case series.
- Studies involving infants younger than 12 months old.
- Diagnosis of non-synostotic (deformational/positional) plagiocephaly or brachycephaly.
- Intervention consisting of osteopathic manipulative treatment (OMT), with or without repositioning advice.
- Quantitative assessment of cranial asymmetry using validated anthropometric or plagiocephalometric measures.

Exclusion criteria:

- Studies on synostotic (craniosynostotic) plagiocephaly.
- Systematic reviews, narrative reviews, editorials, commentaries, or conference abstracts without full-text data.
- Studies without objective quantitative outcome measures of cranial shape.

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Fig. 1) PRISMA 2020 statement [10].

Quality assessment: the methodological quality of included studies was assessed independently by the Downs and Black checklist [11] (Tab. 1).

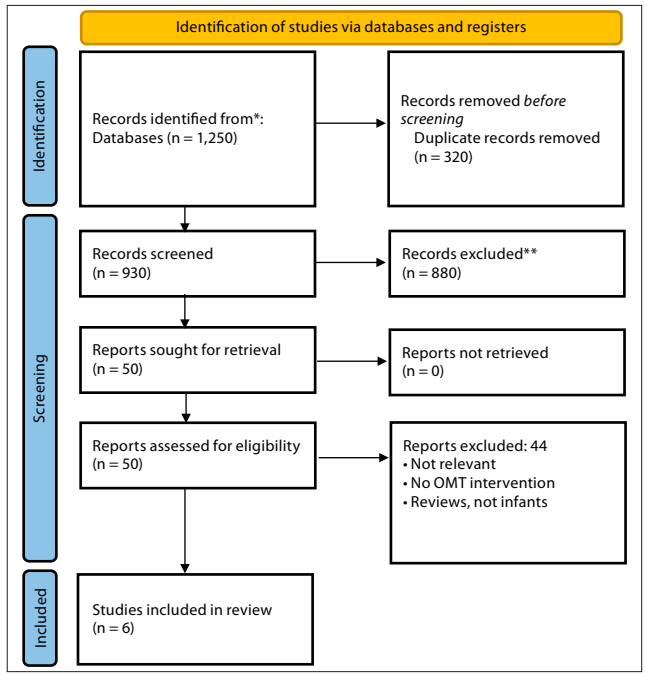

Figure 1. PRISMA 2020 flow diagram for the systematic review of osteopathic treatment in plagiocephaly

RESULTS

Studies conducted in Italy, France, the United States and Canada, investigated the effectiveness of osteopathic interventions – applied either alone or in combination with repositioning recommendations – on cranial asymmetry in infants during the first months of life. Characteristics and aims of the studies are presented in Table 2, and detailed characteristics included in Table 3.

The reviewed studies collectively indicate that osteopathic manipulative treatment (OMT) is associated with improvement in cranial symmetry in infants with nonsynostotic positional plagiocephaly [1–3]. When applied in the first months of life, either alone or in combination with repositioning recommendations, OMT consistently showed positive effects on the reduction of cranial asymmetries [1, 3, 4]. Overall, the available evidence from the included studies supports the potential effectiveness of osteopathic interventions in improving cranial symmetry, and suggests that early application of OMT may positively influence the clinical course of positional plagiocephaly and brachycephaly in young infants [1–7].

Six clinical studies evaluating osteopathic manipulative treatment (OMT) in infants with non-synostotic positional plagiocephaly were included. The main outcomes are summarized in Table 4.

In the randomized controlled trial by Bagagiolo et al. [3], 6 sessions of OMT combined with repositioning resulted in a significantly greater reduction in the Oblique Diameter Difference Index (ODDI), compared to light touch therapy, risk difference 0.41 at 3 months ($p < 0.001$), with the benefit maintained at 1-year follow-up. In the largest cohort (n = 424), Panza et al. [2] reported significant improvement in plagiocephaly severity score after a median of 3 osteopathic sessions. Higher severity scores were more common in preterm infants and males. Gasperini et al. [12] observed significant

Table 1. Methodological quality assessment using the downs and black checklist

Study	Reporting (max 11)	External validity (max 3)	Internal validity – bias (max 7)	Internal validity – confounding (max 6)	Power (max 1)	Total score (max 28)	Quality rating
Bagagiolo et al., 2022	10	2	6	5	1	24	Good
Genelot et al., 2025	9	2	6	4	0	21	Good
Panza et al., 2024	9	2	5	4	0	20	Good
Gasperini et al., 2021	8	2	5	4	0	19	Fair
King et al., 2024	7	1	4	3	0	15	Fair
Lessard et al., 2011	6	1	4	2	0	13	Poor

Table 2. Characteristics of studies included in the review.

No.	Authors and year	Study design	Aim of the study
1	Bagagiolo et al., 2022	Randomized controlled trial (RCT)	To compare the efficacy of osteopathic manipulative treatment (OMT) versus light touch therapy in reducing cranial asymmetries in infants with non-synostotic plagiocephaly.
2	Panza et al., 2024	Retrospective observational cohort study	To evaluate the effectiveness of osteopathic treatment in 424 infants with positional plagiocephaly and brachycephaly.
3	Gasperini et al., 2021	Prospective outcome research study	To assess the long-term effects of an osteopathic approach on deformational plagiocephaly in infants and to evaluate parental satisfaction.
4	Genelot et al., 2025	Randomized controlled trial (RCT)	To evaluate the effectiveness of early osteopathic manipulative treatment in preventing the development of cranial positional deformities in newborns with risk factors.
5	King et al., 2024	Retrospective chart review	To assess the effects of osteopathic manipulative treatment on cranial symmetry in children with plagiocephaly in routine paediatric practice.
6	Lessard et al., 2011	Pilot pre-post study	To evaluate the impact of four osteopathic treatment sessions on cranial asymmetries in infants with non-synostotic plagiocephaly and to assess the feasibility of a future larger RCT.

Table 3. Detailed characteristics of studies included in the review

Study	Year	Country	Study Design	Sample Size	Participants' Age at Inclusion	Intervention	Main Outcome Measures	Key Notes
Bagagiolo et al.	2022	Italy	Randomized controlled trial (RCT)	96 (48 OMT + 48 LTT)	1–6 months	OMT (6 sessions) + repositioning	Oblique Diameter Difference Index (ODDI)	Therapeutic RCT
Panza et al.	2024	Italy	Retrospective observational cohort study	424	First months of life	Osteopathic treatment (median 3 sessions)	Severity score of plagiocephaly and brachycephaly	Large real-world cohort
Gasperini et al.	2021	Italy	Outcome research study (prospective)	37	Mean 16.6 ± 5.7 weeks	Osteopathic approach (mean 6.5 sessions) + advice	Plagiocephalometry indices at 12 months + parental satisfaction	12-month follow-up
Genelot et al.	2025	France	Randomized controlled trial (RCT, preventive)	101 (65 completed)	3–10 days	Early OMT + prevention advice	Occurrence of plagiocephaly or brachycephaly at 4 months	Preventive RCT
King et al.	2024	USA	Retrospective chart review	26	≤10 months	OMT	Cranial Vault Asymmetry Index (CVAI)	Private practice setting
Lessard et al.	2011	Canada	Pilot pre-post study	12	<6.5 months	4 osteopathic treatments + positioning	CVA, SBA, TCVA	Feasibility study

OMT = Osteopathic Manipulative Treatment LTT = Light Touch Therapy ODDI = Oblique Diameter Difference Index CPI = Cranial Proportional Index CVAI = Cranial Vault Asymmetry Index

Table 4. Summary of main outcomes of the included studies

Authors (year)	Interventions	Results in intervention group	Results in control group
Bagagiolo et al., 2022	OMT (6 sessions) + repositioning	Significant reduction of ODDI <104% (risk difference 0.41; $p < 0.001$)	Light touch therapy + repositioning: smaller reduction
Panza et al., 2024	Osteopathic treatment (median 3 sessions)	Significant improvement in severity score	No control group
Gasperini et al., 2021	Osteopathic approach (mean 6.5 sessions) + advice	Significant and sustained improvement at 12 months	No control group
Genelot et al., 2025	Early OMT + prevention advice	Trend toward lower occurrence of plagiocephaly/brachycephaly	Prevention advice alone: higher occurrence
King et al., 2024	Osteopathic manipulative treatment	CVAI reduced from 6.81 to 3.83 ($p \leq 0.001$)	No control group
Lessard et al., 2011	4 osteopathic treatments + positioning	Significant reduction in CVA, SBA and TCVA	No control group

OMT = Osteopathic Manipulative Treatment; ODDI = Oblique Diameter Difference Index; CVAI = Cranial Vault Asymmetry Index; CVA = Cranial Vault Asymmetry; SBA = Skull Base Asymmetry; TCVA = Trans-Cranial Vault Asymmetry

and sustained improvement in plagiocephalometric indices at 12-month follow-up after a mean of 6.5 osteopathic sessions, accompanied by high parental satisfaction. In the preventive randomized trial by Genelot et al. [6], early OMT initiated between 3–10 days of life, showed a trend towards a lower occurrence of plagiocephaly and brachycephaly at 4 months, compared to advice alone, although the difference did not reach statistical significance. King et al. [5] found a clinically meaningful reduction in Cranial Vault Asymmetry Index (CVAI) from 6.81 (±3.34) to 3.83 (±2.84) ($p \leq 0.001$) following OMT in a private practice setting. Lessard et al. [4], in a pilot pre-post study, demonstrated statistically significant reductions in Cranial Vault Asymmetry (CVA; $p = 0.02$), Skull Base Asymmetry (SBA; $p = 0.01$), and Trans-Cranial Vault Asymmetry (TCVA; $p < 0.003$) after 4 osteopathic treatments. Overall, OMT was typically delivered in a small number of sessions (median 3–6) and was well tolerated. No adverse events were reported in any study. High parental satisfaction was consistently documented where assessed [3, 12].

The primary clinical benefit reported is a significant improvement in cranial symmetry. Studies have shown notable reductions in cranial asymmetries when osteopathic treatment was initiated in the first months of life, frequently achieved with a relatively small number of sessions [1, 4, 5]. This indicates that OMT can be an efficient therapeutic option in clinical practice.

Beyond morphological changes, osteopathic interventions appear to support broader neurodevelopmental outcomes. By addressing restrictions in cranial mobility and associated musculoskeletal tensions, OMT may help reduce compensatory postural patterns, improve head control, and promote more symmetrical motor development [2, 5]. High levels of parental satisfaction were also documented, reflecting good treatment acceptance and perceived benefits by caregivers [3].

Importantly, osteopathy demonstrated an excellent safety profile across all reviewed studies, with no adverse events reported [1, 3, 5, 7]. Due to its non-invasive nature and high safety, OMT can be safely integrated as a complementary approach in the routine care of infants with positional plagiocephaly.

Furthermore, early osteopathic intervention in newborns with identified risk factors has been associated with a lower occurrence of moderate to severe cranial deformities, potentially reducing the future need for helmet therapy [7].

In summary, the clinical benefits of osteopathy in the treatment of plagiocephaly go beyond aesthetic correction of head shape. It offers a holistic, safe, and well-tolerated intervention that addresses both structural asymmetries and functional aspects of infant development, supporting more balanced growth during a critical period of rapid cranial and neurological maturation.

DISCUSSION

The collective evidence from the 6 included studies indicates that osteopathic manipulative treatment (OMT) constitutes a promising non-invasive approach in both the therapeutic management and prevention of non-synostotic positional plagiocephaly in infants [1–6]. When introduced during the critical window of the first months of life, osteopathic interventions appear to support the natural process of cranial remodelling and may facilitate more symmetrical head growth, either as a stand-alone therapy or as an adjunct to repositioning strategies [1, 2, 6].

A notable strength of the above-cited literature is its methodological diversity – randomized controlled trials evaluating both therapeutic [3] and preventive applications [6], complemented by a large-scale retrospective cohort reflecting real-world clinical practice [2], an outcome research study with long-term parental follow-up [12], a retrospective chart review from private practice [5], and an early pilot standardization project [4], provide a multifaceted perspective. This variety allows for a broader understanding of efficacy under controlled conditions as well as effectiveness in everyday paediatric settings across Italy, France, the United States and Canada.

From a clinical standpoint, the reviewed studies suggest that OMT offers benefits that extend beyond morphological correction. By addressing cranial mobility restrictions and associated musculoskeletal imbalances, osteopathic treatment may contribute to improved postural symmetry, head control, and overall motor development during a period of rapid neurodevelopmental maturation [5, 12]. The consistently high parental satisfaction and the absence of reported adverse events further support the acceptability and safety of this gentle manual approach, making it a potentially valuable addition to standard conservative care [2, 12].

These observations align with broader literature on conservative management of positional plagiocephaly. Systematic reviews of non-surgical interventions have highlighted that manual therapies, including osteopathy and physiotherapy-led stretching, can serve as low-risk and potentially helpful options, particularly when combined with parental education on repositioning and tummy time [8, 9]. Earlier clinical experience also emphasized that an integrated osteopathic approach, considering the infant as a whole rather than focusing solely on cranial shape, may positively influence associated functional disorders such as feeding difficulties, torticollis, or developmental delays [1].

Limitations of the study. Several important limitations must be acknowledged. First, the majority of the primary studies originate from European centres [2, 3, 6, 12], which may limit the generalizability of the results to populations with differing healthcare systems, cultural infant-care practices, or ethnic variations in cranial growth patterns. Second, although one study included a substantial sample [2], several others were limited by relatively small sample sizes, or early termination due to recruitment challenges [6], thereby reducing statistical power. Third, heterogeneity in treatment protocols, including the number, frequency, and specific techniques of osteopathic sessions, as well as differences in outcome measures (e.g., ODDI, CVAI) and follow-up duration, complicates direct comparisons across studies. Finally, long-term data beyond 12 months remain scarce, leaving uncertainty regarding the durability of observed improvements into later childhood [12, 4].

These limitations are consistent with the wider evidence base in paediatric manual therapy, where many studies on plagiocephaly suffer from small samples, lack of blinding, and variable methodological quality [8, 9, 13].

Future research should address these gaps through well-designed, multicentre randomized controlled trials involving

larger and more diverse populations, with standardized anthropometric protocols and longer follow-up periods (ideally up to 24–36 months). Comparative effectiveness and cost-effectiveness studies examining OMT alone or in combination with helmet therapy or targeted physiotherapy would be particularly valuable for informing evidence-based guidelines [8, 14]. Additionally, investigations into underlying mechanisms — such as the influence of OMT on cranial base strains, sutural mobility, and cerebral haemodynamics — could strengthen the theoretical foundation of this intervention. Exploring neurodevelopmental outcomes, parental adherence, and the potential synergistic role of OMT within multidisciplinary programs also represents an important direction [1, 9].

CONCLUSIONS

This systematic review suggests that osteopathic manipulative treatment (OMT) is a safe, well-tolerated, and potentially effective complementary intervention for infants with nonsynostotic positional plagiocephaly. The included studies consistently indicate that OMT, when applied in the first months of life, is associated with clinically relevant improvements in cranial symmetry, both in therapeutic and preventive settings. Benefits appear to extend beyond morphological correction, potentially supporting better postural control and neurodevelopmental outcomes.

Osteopathic treatment was typically delivered in a small number of sessions and demonstrated an excellent safety profile, with no adverse events reported across all studies. High parental satisfaction further supports its acceptability in clinical practice.

However, the current evidence is limited by methodological heterogeneity, relatively small sample sizes in several studies, and a predominance of research from European centers. Only two randomized controlled trials were identified, and long-term outcomes beyond 12 months remain insufficiently explored.

In conclusion, while the available data are encouraging, higher-quality, large-scale, multicenter randomized controlled trials with standardized outcome measures and longer follow-up periods are needed to establish the definitive role of osteopathic manipulative treatment in the management and prevention of positional plagiocephaly. Until then, OMT may be considered as a gentle and safe adjunct to conventional repositioning therapy and parental education in the early care of infants with deformational cranial asymmetries.

In conclusion, the current literature, including the six studies analyzed here and supporting evidence from broader reviews, provides encouraging support for the integration of osteopathic manipulative treatment into the care of infants with positional plagiocephaly. While methodological limitations preclude definitive recommendations at present, the consistency of positive findings across diverse study designs justifies further high-quality research to clarify the precise role, optimal timing, and long-term value of OMT in this common pediatric condition.

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