National University of Medical Sciences

PhD(PMR) Thesis

A Comparative Review of Osteopathy and Standard Care in the Rehabilitation of Infants with Deformational Plagiocephaly:

Effects on Cranial Symmetry and Motor Development

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy (Ph.D.) in Physical Medicine and Rehabilitation.

Marc DEORA, DO.

NUMSS Student: S25-02-002

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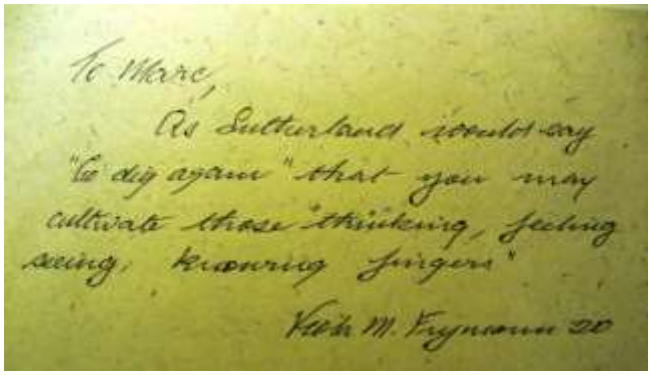

To Dr. Viola Frymann, DO., my respected mentor:

"My path was forever enriched by walking shoulder-to-shoulder with a Giant, whose extraordinary insight, inspiring spirit, wisdom and strength broadened my horizons and elevated everything I dared to dream."

Contents:

Introduction

The field of paediatric osteopathy offers a unique perspective on infant health and development, grounded in a holistic philosophy that emphasizes the body's inherent capacity for self-healing and the intricate relationship between structure and function.
This approach is increasingly recognized for its potential role in managing non-synostotic positional plagiocephaly (NSP), a common condition arising from various prenatal or perinatal factors. While often initially perceived as primarily a cosmetic issue, NSP presents multifaceted challenges. Emerging evidence appears to highlight that, if left unaddressed, significant plagiocephaly can be associated with a spectrum of functional difficulties including torticollis, feeding issues, and, crucially, potential delays in achieving key motor milestones.
Furthermore, significant cranial asymmetry, particularly involving the cranial base, raises concerns regarding potential impacts on longer-term neurodevelopmental pathways and even visual function due to effects on orbit symmetry and visual tracking. As a result, the timely and effective management strategies for NSP that consider the infant as a an integrated whole are crucial.

While cranial orthoses (helmet therapy) represent a common intervention, primarily focusing on passively redirecting growth to improve skull shape, Osteopathic Manipulative Treatment (OMT) approaches NSP through a distinct, fundamentally holistic lens. Rather than solely targeting the cranial deformation itself, OMT seeks to identify and gently address potential underlying biomechanical restrictions – such as cervical spine dysfunction, dural tension patterns, or cranial base strains – believed to contribute to both the cranial asymmetry and the associated functional deficits. Given these different therapeutic philosophies and overarching aims, evaluating their relative effectiveness, particularly concerning functional outcomes, is essential.

This thesis, therefore, aims to critically evaluate the role of OMT in managing positional plagiocephaly, specifically focusing on its potential benefits for addressing associated motor asymmetries and fostering positive developmental trajectories, considering the potential neurological (motor & sensory) and visual implications often overlooked in purely shape-focused interventions such as helmet therapy. This thesis argues that OMT represents a valuable, non-invasive intervention for positional plagiocephaly that specifically targets foundational musculoskeletal function, suggesting its potential as a primary or complementary therapy aimed at optimizing not only cranial shape but also crucial motor development trajectories often impacted by this condition.

History of Paediatric Osteopathy: Renowned Influencers

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Dr. Andrew Taylor Still, DO: The Founder of Osteopathy

Dr. Andrew Taylor Still (1828–1917) stands as a revolutionary figure in medical history, credited with the discovery and development of osteopathy. His transformative philosophy challenged the prevailing medical practices of his era by emphasizing the interconnectedness of the body, mind, and spirit. Through innovative thinking, persistence, and unwavering dedication, Still laid the foundation for a holistic medical discipline that continues to thrive today.

In 1874, A.T. Still formally introduced "Osteopathy" – a distinct medical philosophy rooted in the belief that the human body possesses an inherent capacity for self-healing. He viewed the body, mind, and spirit as an integrated unit governed by natural laws. Central to his theory was the necessity of unobstructed flow – of nerve energy, blood, and lymph – for maintaining health. He posited that structural misalignments, particularly in the spine, could impede these flows, disrupting the body's innate healing mechanisms and leading to disease. Consequently, Still championed gentle manual manipulation to restore structural integrity, thereby facilitating the body's natural return to health, positioning the osteopath as a facilitator rather than the sole agent of cure.

In terms of Dr. Still's contribution to paediatric care, his holistic philosophy found particular resonance in paediatric care. He recognized that children's developing bodies required a tailored approach, emphasizing early intervention to correct structural imbalances before they became chronic issues. His gentle, non-invasive manual techniques were especially suited for infants and children. Still specifically addressed the impact of birth trauma, understanding how the birthing process could stress a baby's delicate cranial and musculoskeletal systems. His pioneering work in this area laid the groundwork for modern cranial osteopathy and continues to inform the treatment of conditions related to birth stress, developmental delays, and structural asymmetries in young patients.

Throughout his later years, Dr. Still remained deeply engaged with studying nature and fostering intellectual exploration, continually seeking to deepen his understanding of health and the human body. While tensions sometimes arose with faculty who embraced more conventional medical tools like

medication, Still remained steadfast in his core philosophy emphasizing the unity of body, mind, and spirit – his concept of the "triune man". [1]

Dr. William Garner Sutherland, DO: Pioneering the Cranial Concept

A student of Dr. A.T. Still, Dr. William Garner Sutherland (1873–1954) became a pivotal figure in osteopathic medicine, pioneering the revolutionary field of cranial osteopathy. This specialized branch focuses on the subtle, inherent movements within the skull and their profound impact on overall health. Through meticulous research, innovative thinking, and lifelong dedication, Sutherland fundamentally expanded the scope of osteopathy, leaving a legacy that continues to influence practitioners worldwide, particularly within the realm of paediatric care.

Towards the end of his osteopathic education, a profound moment of insight occurred while Sutherland examined a disarticulated skull. Observing the bevelled edges of the sphenoid bone where it met the temporal bones, he was struck by the thought: "Bevelled, like the gills of a fish, indicating articular mobility for a respiratory mechanism." This contradicted the firmly established medical doctrine of the time, which held that the cranial sutures fused in adulthood, rendering the skull immobile.

Intrigued and driven by his "Dig on!" philosophy, Sutherland embarked on decades of rigorous, often self-experimental, research to test his hypothesis. He designed ingenious mechanical devices to restrict specific cranial bone movements on himself, meticulously documenting the resulting physiological effects. His painstaking work confirmed the existence of a subtle, rhythmic, involuntary motion involving the cranial bones, the sacrum, the cerebrospinal fluid, the Dural membranes, and the central nervous system. He termed this inherent physiological motion the Primary Respiratory Mechanism (PRM), proposing it was essential for maintaining health and homeostasis throughout the body.

Crucially, the gentle, non-invasive nature of Sutherland's cranial techniques proved exceptionally well-suited for treating the delicate systems of infants and children. British osteopaths, and subsequently practitioners worldwide, recognized the profound potential of cranial osteopathy in paediatrics. The understanding of cranial bone mobility and the PRM provided a framework for assessing and addressing

issues potentially arising from the physical stresses of birth. Practitioners began applying Sutherland's principles to help infants experiencing difficulties related to birth trauma, such as cranial asymmetries, feeding problems, and excessive crying or irritability. The subtle evaluation and treatment methods allowed osteopaths to address restrictions and imbalances in the developing bodies of children in a way that supported their inherent growth and healing processes.

Dr. Sutherland’s contributions remain deeply embedded in modern osteopathy. His concept of the Primary Respiratory Mechanism provides a vital framework for understanding cranial dynamics and their relation to overall health.

His holistic perspective, merging anatomical precision with the body's self-healing capacity, resonates strongly today. Nowhere is this more evident than in the field of paediatric osteopathy. Sutherland's legacy provides the foundation for treating infants and children for a range of conditions, from addressing the impacts of birth interventions and resolving structural strains to supporting optimal development. His pioneering insights into the subtle mechanics of the cranium opened doors for generations of osteopaths to offer gentle, effective care, significantly improving the health and well-being of countless young patients. Sutherland's relentless pursuit of a challenging idea not only expanded osteopathy but also offered invaluable tools for nurturing the health of the next generation, securing his place as one of the discipline's most impactful pioneers. [2]

Dr. Viola Frymann: Championing Cranial Osteopathy for Children

Dr. Viola Frymann, DO, FAAO, FCA (1921–2016), stands as a preeminent figure in modern osteopathy, particularly renowned for championing the application of cranial osteopathy in the treatment of children. Building upon the foundational work of Dr. Sutherland, her dedication to paediatric care, rigorous research, and holistic philosophy profoundly shaped the field, establishing new standards for infant treatment and leaving an indelible legacy felt worldwide.

Crucially, after the tragic loss of her first baby to constant vomiting after a traumatic birth, exposure to Dr. Sutherland's cranial concepts (in particular the decompression of the occipital condylar parts) to

release the Vagus nerve (responsible for vomiting in infants) ignited a lifelong passion and set the course for her specialization in paediatric osteopathy.

Dr. Frymann became a trailblazer in applying cranial osteopathy to new-borns and infants, particularly those presenting with cranial asymmetries like plagiocephaly. She forcefully advocated for early intervention, recognizing the critical window in the first months of life when the infant skull is most malleable and timely treatment could significantly mitigate or prevent long-term developmental challenges, including potential impacts on neurological function, vision, and hearing.

Her hands-on techniques, deeply rooted in Sutherland's principles of the Primary Respiratory Mechanism, were exceptionally gentle and precise. They aimed not just at cosmetic correction but at restoring inherent motion, balance, and symmetry to the intricate cranial structures, thereby supporting optimal neurological and physiological development.
Furthermore, Dr.Frymann embraced a profoundly holistic philosophy. She looked beyond the physical mechanics, emphasizing the interconnectedness of the infant's physical, emotional, and neurological well-being. This comprehensive view was revolutionary for its time, urging practitioners to treat the whole child, not just the presenting condition, and setting a new, empathetic standard for paediatric osteopathic care.

A staunch advocate for evidence-based practice, Dr. Frymann dedicated significant effort to validating the effectiveness of cranial osteopathy through research. She conducted pioneering studies demonstrating measurable positive outcomes for infants treated for cranial issues, linking cranial imbalances not only to structural asymmetry but also to functional problems like feeding difficulties, colic, and sleep disturbances. As a result, her research was instrumental in bolstering the credibility of cranial osteopathy within the broader medical community

Her research was instrumental in bolstering the credibility of cranial osteopathy within the broader medical community. Through numerous seminars, lectures, publications, and dedicated mentorship, Dr. Frymann tirelessly educated fellow osteopaths, other healthcare professionals, and parents about the importance of early cranial assessment and the benefits of osteopathic intervention for children.

An Enduring Legacy in Paediatric Health.
Dr. Frymann's impact on osteopathy, particularly in the realm of child health, is immense and enduring.

Her insistence on early diagnosis and treatment, her holistic approach, and her commitment to research fundamentally transformed the care available to infants and children with cranial issues. She inspired generations of practitioners to develop expertise in paediatric cranial techniques, dramatically improving the lives of countless young patients and their families.

Today, the principles she championed are integral to paediatric osteopathy globally.
Cranial osteopathy is widely recognized as a valuable approach for addressing structural imbalances and supporting optimal development in infants and children.
Dr. Frymann’s legacy lives on through the OCC, San Diego, the practitioners she trained who now use or teach her method to the next generations of osteopaths, and the continued application and refinement of the gentle, effective methods she pioneered, ensuring her position as a cornerstone of modern paediatric osteopathic care [3].

Dr. Rollin E. Becker, DO: Deepening the Perception of Inherent Health

> *"It is as if the whole body, functioning as a unit, is responding to a force that is similar to that moving the tides of the ocean!" Dr. Becker.*

While a dedicated student of Sutherland, Dr. Becker (1910-1996) didn't just replicate the mechanical understanding of the cranial concept. He delved profoundly into the *nature* of the forces Sutherland described, particularly the Primary Respiratory Mechanism (PRM). He shifted the focus from simply identifying and correcting "lesions" towards perceiving and cooperating with the body's inherent "Intelligence" or "physiologic knowing."

Becker emphasized that the body possesses an innate capacity not just for healing, but for *self-correction*. He taught osteopaths to develop a palpatory awareness that could sense the patient's system actively working towards balance. The practitioner's role, in his view, was less about applying an external corrective force and more about becoming a supportive fulcrum or witness, allowing the patient's inherent health mechanisms to express themselves more fully.

His approach was characterized by incredibly refined, subtle palpation. He advocated for using the minimum intervention necessary, often finding that simply being present with attentive hands and acknowledging the body's efforts was profoundly therapeutic. He explored concepts of "stillness" where the practitioner's quiet presence allows the patient's system to reorient and find its own way back to balance.

Becker's philosophy and approach have been deeply influential in paediatrics. Treating infants, especially those who are fragile or have experienced birth trauma, requires immense gentleness and respect for their delicate systems. His emphasis on listening to the body's inherent wisdom, using minimal force, and supporting the infant's own self-correcting capacity provides a powerful framework for paediatric osteopathic care. It validated the efficacy of very subtle, non-invasive interactions, which are often essential when working with new-borns and young children. His work laid much of the philosophical groundwork for the biodynamic models that followed. [4,4b]

[Dr. James Jealous, DO: Formalizing the “Biodynamic” Model]

Dr. Jealous built significantly upon the foundations laid by Sutherland and Becker. He synthesized their insights, particularly Becker's focus on inherent forces, into a distinct and comprehensive model known as the "Biodynamics of Osteopathy in the Cranial Field."

Dr. Jealous placed the palpable manifestation of the Primary Respiratory Mechanism, which he often referred to using Sutherland's term "The Breath of Life," at the very centre of his model. He taught practitioners to perceive different expressions or "tides" of this mechanism (like the Cranial Rhythmic Impulse, Mid-Tide, and Long Tide), viewing them as indicators of the depth of the patient's inherent health expression and physiological functioning.

Central to his teaching was the concept of the patient's "inherent treatment plan." He believed the body has its own diagnostic and therapeutic priorities, which can be palpably sensed by the practitioner. The goal is to synchronize with this plan rather than imposing an external one. He further developed the concept of "therapeutic stillness," viewing it not just as a passive state but as a potent moment where the patient's system accesses deep reorganizing forces.

The Biodynamic model developed by Jealous is arguably one of the most influential forces in contemporary paediatric osteopathy worldwide.
Its profound emphasis on gentleness, non-invasiveness, and perceptual skill makes it exceptionally well-suited for the unique needs of infants and children. It offers a way to work effectively with new-borns (including premature infants), children with complex neurological conditions, or those highly sensitive due to trauma, where standard biomechanical manipulations might be inappropriate or overwhelming.

In paediatric osteopathy, particularly within Dr. Jealous' biodynamic model, the focus transitions from directly treating a lesion to supporting the child's inherent capacity for health and vitality. This profoundly holistic and respectful method manages conditions like plagiocephaly by considering the entire interconnectedness of the child's system. The legacy of Dr. Jealous is carried forward by the extensive network of practitioners worldwide who implement his model. [5]

[Dr. Philippe Druelle, DO: Advancing Cranial Osteopathy for Infants through Education and Innovation]

Dr. Philippe Druelle, DO, is a highly influential contemporary figure in osteopathy, particularly renowned for advancing the application of cranial techniques in the treatment of infants.

His work, characterized by gentle precision, a commitment to rigorous education, and the integration of traditional principles with modern research, has significantly shaped the field, especially within Canada and increasingly on a global scale.

Early in his career, Dr. Druelle developed a deep dedication to understanding the intricate mechanics of the cranium and their critical impact on health, particularly during early development. This focus naturally led him to specialize in addressing cranial issues in newborns, seeking compassionate, precise, and innovative approaches to conditions often overlooked or undertreated.

Central to his methodology is the skilled palpation and interpretation of the cranial rhythmic impulse (CRI) – the subtle, inherent motion described by Sutherland. His techniques focus on identifying and gently resolving imbalances within the cranial system, thereby addressing structural issues like plagiocephaly and, crucially, supporting optimal neurological and physiological development.

Complementing his technical expertise is a deeply holistic perspective. Dr. Druelle emphasizes considering the interconnectedness of the infant's physical, emotional, and neurological state, tailoring interventions specifically to each child's needs. This comprehensive philosophy ensures that treatment addresses the whole person, aligning with osteopathic tradition while integrating contemporary understanding of infant development.

Dr. Druelle has consistently championed the importance of evidence-based practice. Recognizing the need to validate osteopathic methods within the broader healthcare landscape just as Dr Frymann did, he has supported and contributed to research efforts. This dedication helps bolster the credibility of cranial techniques, particularly demonstrating their efficacy and safety in paediatric care, reinforcing osteopathy's role as a valuable component of integrative health.

Also like Dr. Frymann, with whom he reportedly collaborated, he shares a profound emphasis on early intervention and holistic care for infants, moving beyond mere physical correction. His methods remain firmly rooted in the foundational principles of Dr. Sutherland, representing a direct lineage, yet they are informed by ongoing clinical experience and modern research. While related to the work of figures like Dr. John Upledger, DO whose Craniosacral Therapy evolved from Sutherland's concepts but developed distinct theoretical frameworks, Dr. Druelle's approach is often seen as remaining more closely aligned with traditional osteopathic principles and practice. [6]

Stuart Korth, DO: A Leading Figure in UK Paediatric Osteopathy

Stuart Korth, DO. stands as a prominent and highly regarded figure within UK osteopathy, particularly distinguished for his extensive work with infants and the treatment of cranial deformities often resulting from birth trauma. His significant legacy encompasses pioneering clinical contributions, influential institutional leadership, and dedicated educational efforts.

Renowned as one of the leading paediatric osteopaths globally, Korth brings decades of specialized experience to his practice. He possesses particular expertise in addressing severe cranial moulding patterns, including plagiocephaly, utilizing gentle and precise osteopathic techniques tailored for infants. Central to his clinical philosophy is the principle of early intervention; Korth strongly advocates for treating infants within the first few weeks of life to effectively leverage the natural plasticity of the developing cranium. His treatment approach is characterized by light-touch cranial osteopathy aimed at mitigating the effects of birth trauma, coupled with a holistic assessment that emphasizes accurate diagnosis and the crucial understanding of when osteopathic treatment is indicated versus when referral to other specialists may be necessary.

Demonstrating clinical pragmatism, Korth also recognizes the value of integrating conventional methods, recommending cranial orthoses (baby helmets) as a complementary approach for managing severe cases of plagiocephaly.

Stuart Korth's enduring influence is underscored by professional accolades, including recognition from the Institute of Classical Osteopathy for his substantial contributions to the field. His practice, with roots dating back to 1938, maintains a distinguished reputation for treating patients across all age groups, with a notable focus on infants experiencing cranial issues. While perhaps not directly conducting large-scale published research himself, his pioneering clinical work and teachings have undoubtedly inspired further investigation into the efficacy of cranial osteopathy for infants.

In summary, Stuart Korth's legacy is defined by his expert, gentle, and holistic approach to treating infants with cranial deformities related to birth trauma, his foundational leadership at the OCC, and his extensive global educational initiatives.
His multifaceted contributions have profoundly shaped and advanced the field of paediatric osteopathy within the United Kingdom and internationally. [7]

[Bruno Ducoux and Roselyne Lalauze-Pol: Influential Figures in French Paediatric Osteopathy]

Within the rich landscape of French osteopathy, Bruno Ducoux, DO, and Roselyne Lalauze-Pol, DO, are recognized as highly influential figures, particularly noted for their profound impact on the specialized field of paediatric osteopathy. While perhaps less known globally, their contributions through dedicated clinical practice and extensive teaching have significantly shaped a generation of osteopaths, emphasizing a subtle, precise, and deeply respectful approach to treating infants and children.

Bruno Ducoux is often associated with a particular quality of osteopathic listening and presence. His approach, often described as minimally invasive and deeply perceptive, focuses on engaging with the inherent health mechanisms and subtle physiological movements within the patient's system, including the cranium. In the context of paediatrics, this translates into exceptionally gentle techniques aimed at facilitating the infant's own self-corrective capacities rather than imposing external force. Ducoux's influence has largely spread through his postgraduate courses and mentorship, where he emphasizes the development of refined palpatory skills and a deep understanding of the living anatomy and physiology as expressed in the individual child. His work encourages practitioners to address the impacts of birth and early life by supporting the underlying vitality and fluid dynamics of the infant's body.[8]

Similarly, Roselyne Lalauze-Pol has dedicated much of her career to the specific needs of infants and the perinatal period. Her work often focuses intensely on understanding and addressing the consequences of the birthing process on the newborn’s structure and function. Lalauze-Pol is known for teaching specific diagnostic approaches and gentle techniques tailored to common infant presentations, such as feeding difficulties, digestive discomfort, sleep disturbances, and cranial asymmetries potentially stemming from birth strains. Her influence is characterized by a pragmatic yet profoundly gentle application of osteopathic principles, emphasizing the unique vulnerability and rapid developmental changes occurring in infancy.[9]

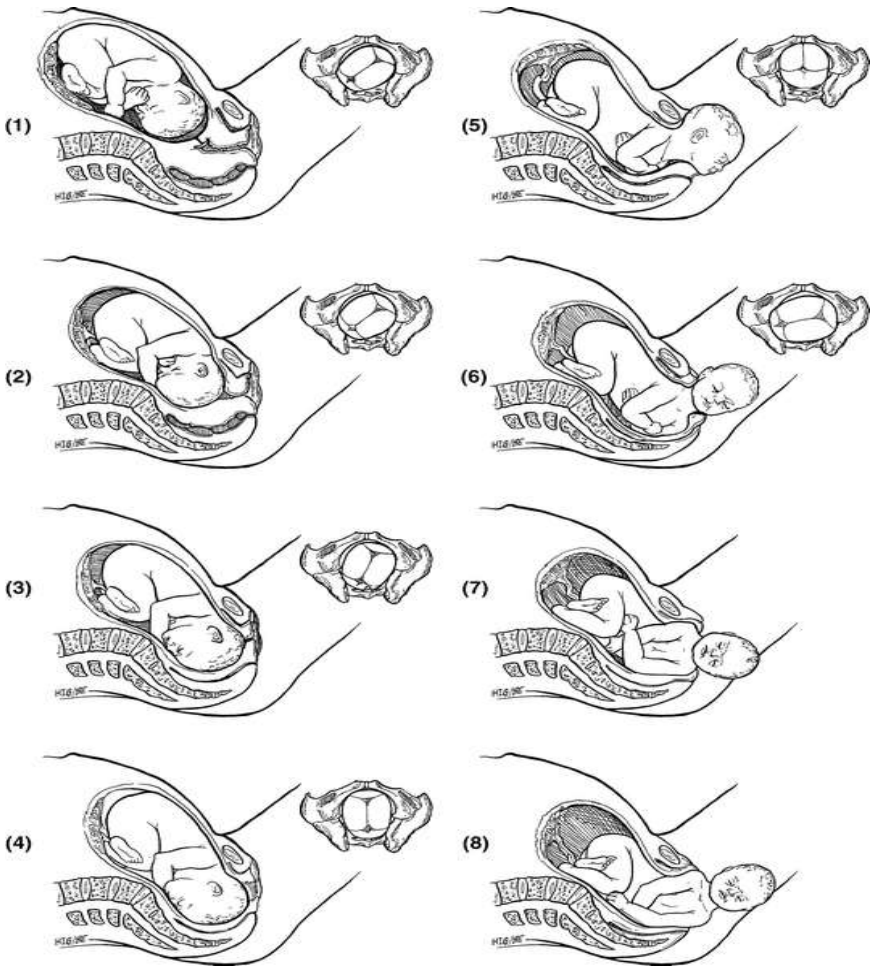
Collectively, Ducoux and Lalauze-Pol represent a stream of French osteopathy that prioritizes perceptual skill, gentle application, and a holistic understanding that integrates the physical, physiological, and even emotional aspects of the infant's experience. Their shared emphasis on the importance of the birth process and early developmental influences has reinforced the critical role of osteopathy in early life. They have contributed significantly to a clinical culture that values deep listening, minimal intervention, and fostering the inherent health expression within the child…Bruno Ducoux and Roselyne Lalauze-Pol have exerted a considerable and lasting influence on paediatric osteopathy.

During Pregnancy: What is the latest research on foetal positioning effects?

Recent research highlights that a foetus's position in the womb significantly impacts its development and long-term postnatal health. Prolonged abnormal positioning, or malposition, is increasingly linked to various developmental challenges.
The continuous pressure from constrained positioning can alter the growth of the spine, skull base, and face. This may lead to physical changes such as cranial asymmetries, altered jaw development, and a narrower palate. These structural changes are associated with difficulties later in life, including problems with feeding (sucking/swallowing), breathing (nasal obstruction, sleep-disordered breathing), and overall postural stability.
Related research on maternal positioning during childbirth further suggests that the intrauterine environment is dynamic and influenced by external factors, potentially impacting foetal well-being and heart rate patterns. This reinforces the idea that optimizing positioning could affect both immediate neonatal outcomes and long-term musculoskeletal and neurodevelopmental health.
Consequently, early detection of adverse foetal positioning, integrative approaches, such as osteopathy, OMT, physiotherapy, exercises, and nutritional support, are being investigated as potential ways to lessen the long-term consequences of foetal malposition.[10]

The Birth Process

A) What is a normal birth, and when / where can it go "wrong"?



Childbirth is a significant event, and while a smooth, natural process is desired, understanding normal birth and potential deviations is crucial for informed decision-making to mitigate risks. This chapter outlines normal physiological childbirth, its stages, potential complications, birth settings, risk factors, interventions, the immediate postpartum period, and available resources.

Normal physiological birth is defined by global midwifery organisations as powered by the innate capacity of the birthing person and foetus, proceeding without interventions that disrupt natural mechanisms. Supporting this process, when appropriate, improves outcomes, potentially reducing Caesarean sections, enhancing breastfeeding success, fostering positive birth experiences, and lowering care costs. For babies, benefits include better bonding, reduced intervention risks, and fewer breastfeeding disruptions.

Key characteristics include spontaneous onset and progression of labour, supported by conditions like continuous companionship, dedicated provider care, immediate skin-to-skin contact, and delayed cord clamping. The birth centre model exemplifies an environment supporting physiological birth—a safe, respectful, and cost-effective approach within an integrated system.

Despite evidence that overuse of interventions can be detrimental, intervention rates have risen over the past three decades. Consequently, there's growing global recognition of physiological birth's value for community health and healthcare sustainability. The International Confederation of Midwives (ICM) emphasises birth as a normal life event, highlighting the midwife's crucial role in preserving this normality. Midwives optimise natural processes, provide holistic support (physical, psychological, social, cultural, spiritual), and work proactively to promote positive outcomes and prevent complications.

Normal childbirth is a dynamic interaction between foetal and maternal physiology within the individual's psychosocial context. It typically involves spontaneous labour onset and progression at term, culminating in a vaginal birth in the vertex position without surgical, medical, or pharmaceutical interventions. The World Health Organisation (WHO) called for eliminating unnecessary interventions in 1996, a goal still relevant today.[84] "Normal" signifies the standard, while "physiology" refers to functional processes; normal human physiology thus frames optimal childbirth. Birth encompasses labour, newborn transition, and the first postpartum hour.

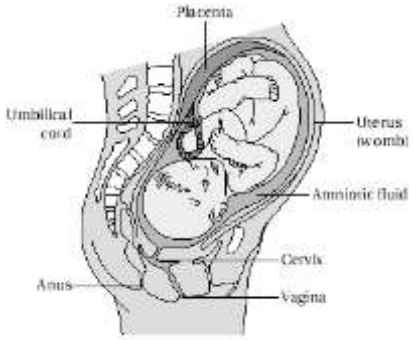
Even when complications arise requiring medical attention, supporting underlying physiological processes can enhance outcomes. Optimal neuroendocrine function (releasing endogenous oxytocin, catecholamines, endorphins) promotes effective labour, aids pain management, facilitates the baby's cardiorespiratory transition and thermoregulation, supports lactation, and enhances bonding. Physiologically progressing labour reduces the need for augmentation, foetal compromise risk, and instrumental/surgical delivery likelihood. Birthing individuals often emerge feeling physically and emotionally strong, while infants benefit from maternal responsiveness and lack of medication exposure. Long-term benefits may include improved maternal mental/physical health, enhanced infant development, and possibly reduced chronic disease incidence. This focus shifts the narrative from birth as an illness requiring external authority to a wellness event involving shared decision-making.

Physiological birth emphasises an unrushed, supported process trusting the body's innate ability, often facilitated by midwives or doulas. Preparation classes teach coping techniques (breathing, relaxation) and partner support measures. While often occurring in hospitals where medical options are available if needed, the core principle remains minimising unnecessary intervention. [11]

The Typical Process and Stages of Normal Labour and Delivery:

Labour is typically divided into three stages:

First Stage: Begins with labour onset and ends with full cervical dilation (10 cm) and effacement. Often the longest stage (up to 20 hours, especially for first-time mothers).



The anatomical structures of pregnancy

- Latent Phase: Cervix dilates 0-6 centimetres. Mild contractions become more frequent (from every 5-15 min to < 5 min). Bloody show may occur. Rest, relaxation, and position changes are encouraged.
- Active Phase: Cervix dilates 6-8 centimetres. Contractions become stronger, longer, more frequent (approx. every 3 min, lasting 45 sec). Back pressure and cramping may increase. Amniotic sac might rupture.
- Transition Phase: Cervix dilates 8-10 centimetres. Most intense phase, though often shortest (15 min-1 hour). Contractions are very strong (every 2-3 min, lasting 60-90 sec). Strong urge to bear down; rectal pressure.

Second Stage: Begins with full dilation (10 cm) and ends with the baby's birth. Can last 20 minutes to hours (longer with first births or epidurals).

- Contractions may slow slightly (every 2-5 min, lasting 60-90 sec). Strong urge to push. Baby moves through the birth canal. Various pushing positions can be used.
- Crowning (baby's head visible) occurs before birth. Provider guides the baby out; umbilical cord is cut.

Third Stage: Begins after baby's birth and ends with placental delivery ("afterbirth"). Usually the shortest stage (under 20 minutes).

- Continued, less painful contractions help the placenta detach (typically 5-30 min post-birth). Medication may be given to aid contractions and prevent bleeding.
- Midwife checks uterus; repairs episiotomy if needed. Cord blood collected if arranged. Chills/shakiness is common. [11]

Potential Foetal Complications during Labour and Delivery:

Childbirth represents a critical transition for the foetus. Although usually a straightforward physiological process, labour and delivery carry potential risks requiring careful monitoring and appropriate management.

A primary concern involves disruptions to the foetal oxygen supply. 'Foetal distress', often identified by abnormal heart rate patterns on the CTG trace, can indicate hypoxia due to issues like umbilical cord compression or placental problems. Severe oxygen deprivation ('birth asphyxia') poses significant risks to vital organs, particularly the brain. Umbilical cord complications, such as prolapse (a critical emergency where the cord descends before the baby) or tight nuchal cords (around the neck), can seriously compromise oxygenation.

Mechanical difficulties during passage through the birth canal present further challenges. Foetal 'malpresentation' (e.g., breech or transverse lie) can obstruct labour. 'Shoulder dystocia', where the baby's shoulder becomes stuck after the head delivers, is an obstetric emergency risking asphyxia and injury, such as brachial plexus nerve damage or fractures.

More generally, 'birth trauma' can result from a difficult labour, large babies (macrosomia), or instrumental deliveries (forceps or ventouse). This spectrum ranges from minor bruising or scalp swelling (caput succedaneum, cephalohematoma) to fractures (commonly the clavicle) and nerve palsies. Importantly, the forces involved can contribute to cranial moulding and deformities like plagiocephaly.

Additionally, both preterm birth (due to foetal fragility) and post-term birth (carrying risks of placental decline or larger foetal size) present specific challenges during delivery.

In summary, labour and delivery can involve various complications affecting the foetus, from oxygen deprivation and mechanical trauma to infection. These potential events underscore the need for vigilant obstetric and midwifery care, as they can have significant short-term and long-term health implications for the new-born.[12]

B) Birth Trauma

Birth is one of life's most natural processes, yet it can also be the first instance of trauma a new-born experiences. While many births proceed without complications, the forces exerted during delivery can still have lasting effects, even in cases that appear uneventful. The pressure applied to the baby's cranium during passage through the birth canal may result in structural compression, potentially causing long-term issues. In some cases, these effects can manifest as physical challenges, while in others, the trauma may lead to subtle emotional or developmental difficulties that only emerge later in life.

Despite these challenges, the infant's body demonstrates remarkable resilience. The process of birth involves immense pressures, which the new-born must endure as they transition from the safety of the womb to the outside world. Their first breath marks a crucial moment, as it expands their compressed body and infuses their tissues with oxygen, preparing them for life outside the womb. The infant's skull plays a pivotal role in facilitating this process. It is a key component in opening the birth canal, with cranial bones overlapping due to the pressures applied. Meanwhile, the brain is cushioned by cerebrospinal fluid and the protective membranes (meninges), which act as shock absorbers. The infant's nervous system works continuously to maintain stability, protecting the brain from trauma while allowing it to function optimally.

However, these protective measures are not fool-proof. The significant forces experienced during labour and delivery can sometimes overwhelm the infant's body. It can lead to common early-life issues, such as respiratory challenges. Conditions like bronchitis may develop as a result of birth trauma, with some infants showing a higher susceptibility due to the pressures endured during delivery. Recognizing these connections is critical for timely treatment and support to promote recovery and long-term health. Addressing these challenges early can help ensure better infant outcomes and mitigate potential developmental delays or structural imbalances.

Forces of Birth:

The forces exerted on a new-born during birth can have profound and lasting effects. If these compressive forces become too intense, they may overwhelm the infant's nervous system, preventing the cranial bones from fully re-expanding to their natural position after delivery. Even when labour appears straightforward, significant pressure can still cause cranial compression.

Interestingly, unusually quick and prolonged labours can pose unique challenges to the new-born. In cases of rapid labour, the sudden transition may leave the nervous system unable to adapt smoothly, resulting in lingering effects such as structural imbalances. Similarly, extended labours can subject the infant to prolonged pressure, leaving lasting imprints that manifest in various ways, ranging from irritability to more serious complications. Fortunately, early intervention—such as osteopathic treatments—can address these issues by promoting structural balance and supporting the nervous system. This holistic approach helps alleviate symptoms and supports the infant's overall development.

Caesarean Section:

A Caesarean section may become necessary under specific circumstances, such as when the infant's life is at risk or prolonged labour places excessive pressure on the baby's head. While C-section deliveries can bypass some of the compressive forces associated with vaginal births, they are not entirely free from complications. For instance, many infants born via C-section still experience significant cranial pressure

during the initial stages of labour, especially if their head becomes lodged in the maternal pelvis. In such cases, the delivering obstetrician may need to apply considerable force to free the baby, which can result in trauma to the head (including plagiocephaly) and surrounding tissues.

On the other hand, some C-section deliveries involve minimal physical trauma, leading many to believe that this method is inherently less stressful for the new-born. However, this is not always the case. The absence of compressive forces during a C-section can impact the baby's adaptation to life outside the womb. The squeezing that occurs during a vaginal birth plays a crucial role in stimulating the baby's systems.

The Birth Canal:

Passing through the birth canal is a vital trigger for several biological and hormonal processes that prepare the baby for life outside the womb. This process helps expel fluid from the lungs, creates the pressure needed for the baby to take their first breath, and stimulates the central nervous system to begin organizing itself (& the hormonal system to kick start). Moreover, the passage through the birth canal initiates significant changes in the circulatory system, including:

- The closure of the umbilical vessels signals the end of the placental blood supply.
- The closure of the foramen ovale in the heart directs blood flow to the lungs.
  The closure of the ductus arteriosus aids the infiltration and oxygenation of blood by the lungs.
  The activation of the liver for metabolism (ductus venosus closure).
  The kidneys take over blood filtration.
  The gastrointestinal tract starts absorbing nutrients independently.

These changes must occur precisely and systematically to ensure the new-born's survival.

However, when the transition to life outside the womb happens too quickly, these processes can become disorganized, leading to what paediatric osteopaths describe as a form of "shock."
This state of nervous system irritability can manifest as symptoms such as excessive crying, weakness, or increased susceptibility to infections.

Even in the absence of obvious physical trauma, these subtle disruptions may indicate the need for early osteopathic intervention to support the infant's recovery and development [13].

C) Clinical Implications of Birth: Non-Synostotic Plagiocephaly (NSP)

Anatomy of a normal female pelvis:

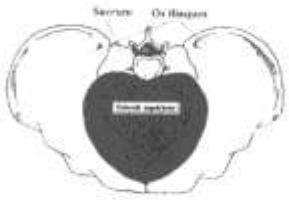
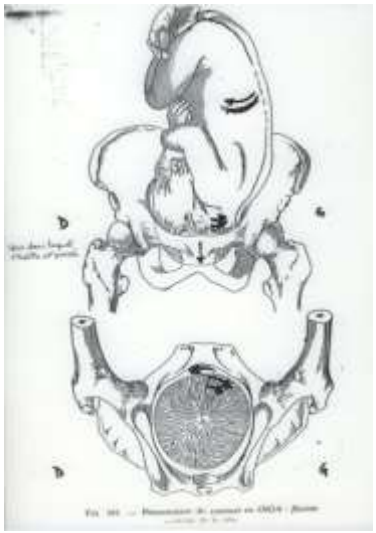


Figure 9 : Détroit de bassin maternel normal.

Anatomy of an abnormal scoliotic female pelvis which can cause considerable compression forces on the foetal skull!

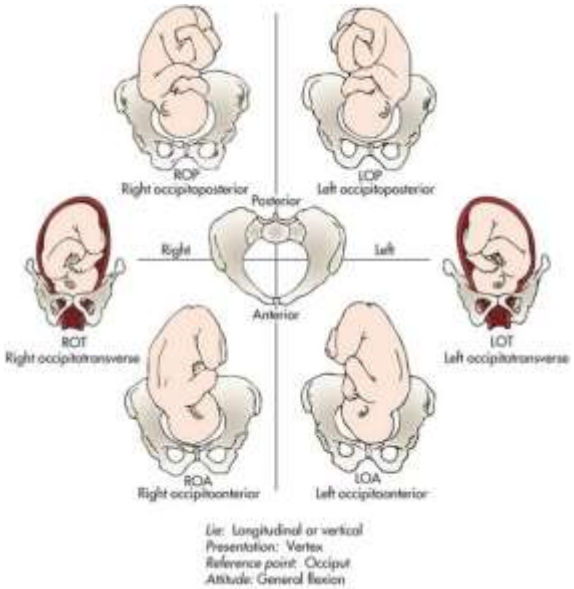
Figure 10 : Détroit de bassin scoliotique.

Best presentation of the foetus at term is as follows:

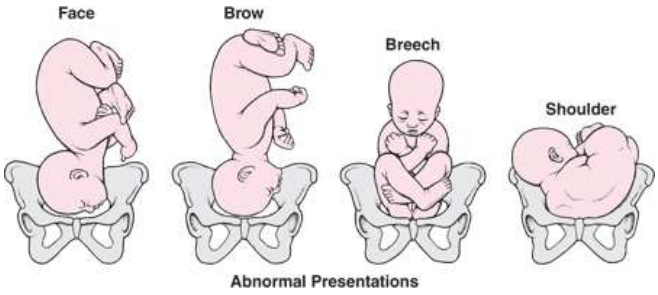


Note his position with full cervical flexion to present his smallest skull diameter to his mother's birth canal.

Other possible presentations:

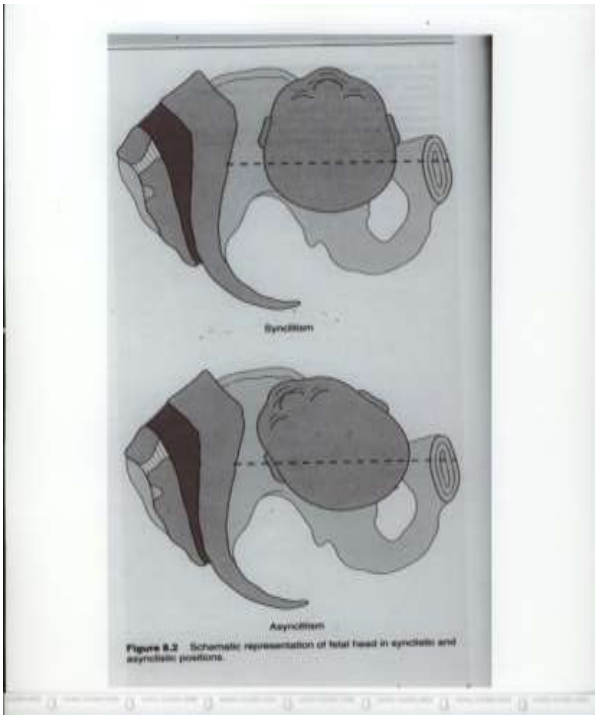


Abnormal presentations leading to long labour and foetal trauma:



Synclitism: refers to the state during labour where the sagittal suture of the foetal head is midway between the mother's pubic symphysis (front) and sacral promontory (back). This indicates that the transverse plane of the foetal head is parallel to the corresponding plane of the maternal pelvis (e.g., the pelvic inlet or outlet), facilitating optimal descent through the birth canal. Synclitism represents the ideal alignment for progress.

Asynclitism: refers to the state during labour where the sagittal suture of the foetal head is not midway between the mother's pubic symphysis and sacral promontory. Instead, the head is tilted, causing the parietal bones to come into contact with the front (anterior asynclitism) and the back (posterior asynclitism) of the maternal pelvis causing a shearing force to physically "compress" the parietals down to the centre of the foetus' skull (SBS). Persistent asynclitism can hinder descent, progress and may cause an osteopathic pattern on the foetus' SBS called a "Lateral Strain" lesion via this shearing force from the maternal pubis and sacrum on the foetus' parietal bones. That force is inevitably transmitted all the way to the SBS.



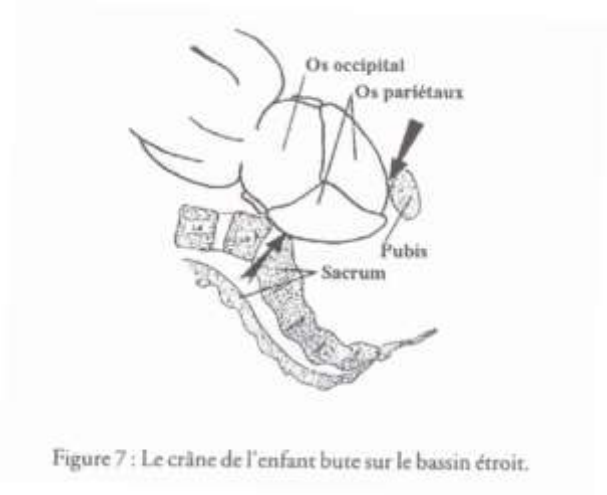


Figure 7 : Le crâne de l'enfant bute sur le bassin étroit.

Lateral Strain on palpation: Plagiocephaly

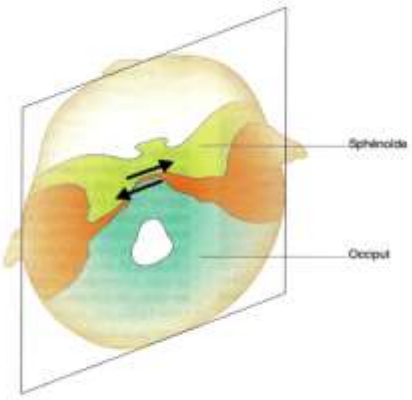


Figure 4.12. Plagiocéphalie postérieure : la tête vue de dessus a la forme d'un « parallélogramme ». Une dysfonction de strain latéral est associée aux plagiocéphalies.

As the birth process continues, the uterine contractions may cause the foetus to suffer a Vertex and a Cervical, or Atlanto/occipital compression.

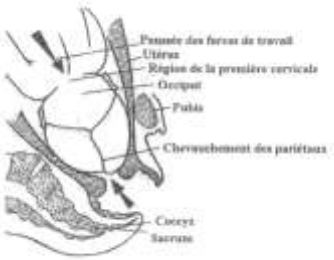
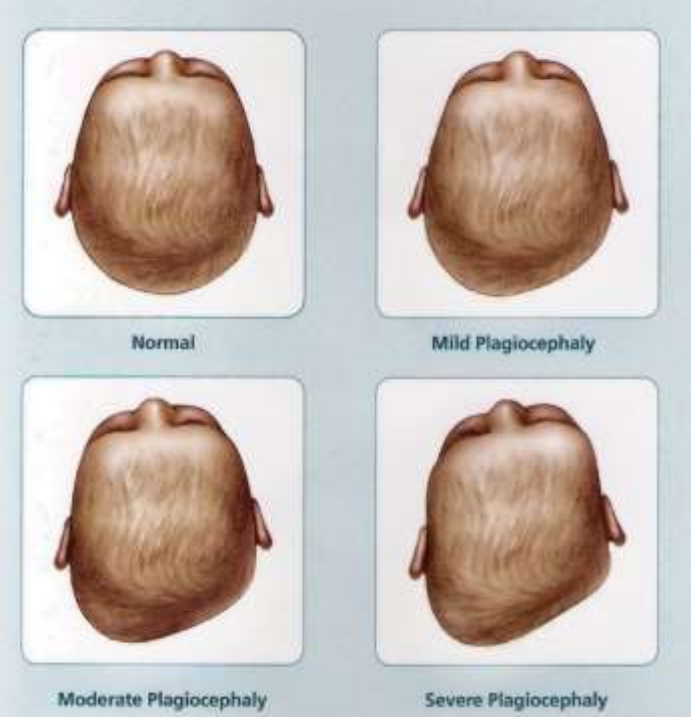


Figure 2 : Contraintes mécaniques à la naissance.

Then finally the cervix opens and the foetus has to turn again and for the first time fully extend his cervical spine. But if there is a delay or the foetus gets stuck, further occipital compression will occur:

Figure 6 : Naissance normale, période de dégagement.



NSP:

The incidence rate of plagiocephaly based on recent research varies:

- Positional (or deformational) plagiocephaly is common – some studies suggest it affects as many as **46.6%** of infants around 3 months of age, highlighting its widespread nature.[14,15]
- The incidence seems highest in the first few months of life when the skull is most malleable and tends to decrease as babies gain head control and mobility [16,17]:

6 weeks 16.0%
4 months 19.7%
8 months 9.2%
12 months 6.8%
24 months 3.3%.

Pathologies of Plagiocephaly: Epidemiology: Male > Female.

- Primary plagiocephaly: abnormal uterine lie or complication of labour
- Secondary plagiocephaly: abnormal forces on the vault or cervical region post-birth

Implications of Non-Synostotic Plagiocephaly

Although NSP often resolves naturally, it can lead to:

- Aesthetic concerns: Asymmetry of the head and face
- Musculoskeletal dysfunction: Imbalances in muscle tone and movement patterns
- Visual perception and ophthalmic dysfunction: Difficulties with eye tracking and coordination
- Temporomandibular joint (TMJ) problems: Issues with jaw movement and function
- Developmental delays: Challenges with motor skills and cognitive development.

Non-Synostotic Plagiocephaly Prevalence: Contributing Factors [18]

- Back to Sleep Campaign: While crucial for SIDS prevention, placing babies on their backs for prolonged periods has increased positional plagiocephaly by 600% since 1992. This is because prolonged time in this position can lead to external pressure on one side of the head of an infant's soft and malleable cranial bones. [19]

- Torticollis: This neck muscle condition, where a baby favours turning their head to one side, is a significant risk factor. It can be present at birth or develop later. Aetiology: Muscular spasm of SCM or/and scalenes.

- Premature Birth: Premature babies have softer skulls and often spend extended periods on their backs in hospitals, making them more susceptible. [20]

- Limited Tummy Time: Insufficient time spent on their stomachs can contribute to developing plagiocephaly as tummy time reduces pressure on the back of the head and strengthens neck muscles.

- Other Factors: Multiple births, restricted movement (e.g. in car seats or swings), increased foetal length (restricted space in the womb), challenging delivery, or certain birth interventions /assisted deliveries (forceps or vacuum delivery) can also play a role.

It is, however, important to recognise the spectrum of plagiocephaly, firstly regarding the types of plagiocephaly and consequently its severity. Generally speaking, many incidents of plagiocephaly are mild and resolve on their own with time and repositioning. Moreover, establishing exact figures regarding plagiocephaly remains difficult given the variations in how plagiocephaly is defined and the fact that it often improves naturally as forementioned. Finally the contributing factors mentioned above are only a general overview as scientists continue to study the causes and contributing factors to better understand and prevent plagiocephaly.[21]

Standard Care for Non-Synostotic Plagiocephaly

A) General Prevention Strategies

Parental Education regarding Positioning and Physical Therapy

For infants with mild cases of Non-Synostotic Plagiocephaly, standard care often revolves around promoting general motor development through, for example, physiotherapy intervention and parental education programs which emphasise proper positioning and handling.

In regards to physiotherapy, a randomised control trial found that infants receiving physiotherapy intervention had improved motor development outcomes compared to those receiving usual care. [22, 23] Also, manual techniques, such as those based on the Vojta principle[24], have been found to be more effective than other physiotherapy approaches in reducing cranial vault asymmetry index (CVAI) and ear shift.

As for parental education, preventing or mitigating plagiocephaly is about proactivity and creating a safe environment for the newborn to encourage movement. One effective strategy is to regularly change the baby's position during sleep and playtime. For instance, alternating the direction your baby faces in the crib – whether it is towards or away from the wall – can encourage the newborn to turn their head to both sides, promoting even skull growth. Furthermore, utilizing supportive devices like a well-fitted infant carrier can help maintain head control and support healthy development while allowing parents to be hands-free. [25] An example of an information leaflet educating parents regarding the home-based approaches to treating plagiocephaly can be seen below:

PLAGIOCEPHALY (FLATTENED HEAD) FACT SHEET AND AT-HOME EXERCISES

WHAT IS POSITIONAL OR DEFORMATIONAL PLAGIOCEPHALY (FLATTENED HEAD)?

Positional or deformational plagiocephaly (play-gee-o-SEF-uh-lee) is a flat area on the back or on the side of a baby's head. This may happen from laying on their back to sleep, long or difficult labors or sometimes how they were positioned when in the womb. It can be more commonly seen if the parent was pregnant with multiple children, the baby was premature, or if they have torticollis (tight muscle that limits neck motion). Some babies have this after birth or it can develop weeks later. Once plagiocephaly develops, it can worsen if not addressed. It has increased recently due to the American Academy of Pediatrics' sleep guidelines which include placing the infant on their back when sleeping. Even if your baby has plagiocephaly, it is recommended you continue to place your baby on their back for safe sleep. This brochure contains tips and tricks for exercises and activities to do at home to help with plagiocephaly.

WHAT CAN I DO AT HOME TO HELP MY CHILD?

There are several ways to help reshape your baby's head. You should start these positioning activities as soon as possible to help reshape your baby's head while it is still very flexible. As the baby gains more control of their body (including their head and neck), they will be able to move around more and look to both sides. Lying on the side of the head that is rounder will help re-shape the flatter part of the head. Some activities to start are:

TUMMY TIME

A baby needs supervised awake tummy time daily to help stretch and strengthen the back, neck, and arm muscles and help keep a round head shape. Start slowly for 1-2 minutes at a time, 4-5 times per day. The goal is to work towards 10-minute sessions several times a day. Give the baby something interesting to play with while on their tummy to encourage turning their head away from the flat spot.

SITTING UP AND CRAWLING

Plagiocephaly improves as a baby's motor skills, such as sitting and crawling, develop and they are spending less time lying flat on their back. Encouraging frequent & supervised tummy time is critical to help develop these skills which help your baby spend less time on their backs.

PLAY TIME ON THE FLOOR

When your baby is awake, limit the time they spend in devices such as swings or bouncers. As soon as your child is able to, have them sit up to play. Sitting takes the pressure off the back of your baby's head and builds strength in the neck and trunk. Infants should not be sitting all the time. They also need supervised play time on the floor to work on reaching, rolling, and pushing up on their arms while on their tummies.

SAFE SLEEP

Continue to place the baby on their back to sleep. When they're sleeping on their back, you can gently turn their head away from the flat spot. DO NOT use anything to hold the head in that position (pillows, stuffed animals or blankets) because these can block the face and make breathing difficult. You do not need to keep waking up at night to reposition their head. Once your child is able to roll over successfully, they are able to safely sleep on their tummies if they put themselves in that position (you do not need to roll them back over).

Prevention Strategies for Plagiocephaly

Preventing plagiocephaly is all about being proactive and creating a safe environment for the new-born. One effective strategy is to regularly change the baby's position during sleep and playtime. For instance, alternating the direction the baby faces in the crib—whether it's towards or away from the wall—can encourage them to turn their head to both sides, promoting even skull growth. Furthermore, utilizing supportive devices like a well-fitted infant carrier can help maintain head control and support healthy development while allowing you to be hands-free. By being mindful of these strategies, parents can effectively reduce the risk of developing plagiocephaly and contribute to baby's overall growth and comfort.[23]

Tummy Time

Tummy Time is more than just playtime; It has been shown to have a positive effect on infant development and head shape, it's a vital developmental activity for all infants, crucial for building neck, back, and shoulder strength.[26] For babies showing signs of plagiocephaly, Tummy Time transitions from being beneficial to arguably one of the best forms of exercise.

As plagiocephaly often develops from consistent pressure on one part of the skull when lying down, Tummy Time directly combats this by relieving pressure from the back and sides of the head. It involves placing the baby on their stomach in a safe, supervised area. This position encourages them to use their arms and legs, strengthening muscles essential for gross motor milestones such as rolling, sitting and eventually walking.
Furthermore, it actively encourages the baby to lift and turn their head freely, strengthening neck muscles. This improved strength and mobility helps prevent them from habitually resting on the flattened area, promoting more symmetrical head growth and actively working against the forces causing the flatness. Over time, they'll learn to push up, improving strength in their back, shoulders, and neck, which enhances head control and overall mobility. It's ultimately a simple, natural, and proactive way to address the core issue.
Finally, it provides a different sensory experience for the child rather than lying on their back.[26b]

Ways to ensure Tummy Time is a positive experience for the baby:

- Place engaging toys or a baby-safe mirror within view as a stimuli to encourage head lifting and reaching
- Ease into Tummy Time gently by trying it initially on the parent's chest or with a small rolled towel/pillow under the baby's chest for support
- Start with brief sessions (a few minutes) several times a day, gradually increasing duration.
- Incorporate it naturally, perhaps after naps or diaper changes, into the child's routine
- Ensure the parent offers encouragement and celebrates small efforts as interaction (including getting down on their level, talking, singing or pulling funny faces) can act as a motivating factor

Most importantly, it must be stressed to the parents to always supervise their baby during Tummy Time as a safety measure.

B) Helmet Therapy

Helmet therapy involves using a cranial orthosis in order to gently reshape an infant's head over a nine-month period and is often prescribed to children with conditions such as NSP or brachycephaly (a short and wide head). It requires a custom-fit to typically be worn for 23 hours a day for 6 to 9 months, only to be removed for bathing. Some helmets are periodically adjusted to accommodate the child's growth, yet not all have this feature.

Helmet therapy has been widely studied, with reviews indicating its effectiveness in achieving cranial symmetry through a significant reduction in cranial vault asymmetry, particularly when used in younger infants. [27] The effectiveness of cranial orthoses is further supported by improvements in both 2D and 3D metrics of cranial asymmetry.[28,29]

However, studies by Lee et al. (2020) [30] and Goldstein et al. (2021) [31] have underscored the importance of a comprehensive approach that combines repositioning strategies with other therapeutic modalities, suggesting that isolated helmet therapy may not be sufficient for optimal outcomes. [32,33]

Considerations and Risks

While helmet therapy can be effective, there are several other factors for parents to consider when faced with the option of helmet therapy going beyond its inconvenience and its expense. For example, despite promising evidence suggesting initial success with helmet therapy to correct cranial malformation, there is limited evidence as to the long-term effects and some studies have suggested that the skull may revert back to its original shape after helmet therapy is discontinued. [34]

Regarding motor skill development, it has also been suggested that prolonged helmet therapy can interfere with the development of fine motor skills (small movements such as picking up objects) and gross motor skills (more significant movements such as crawling and walking). A study using the Alberta Infant Motor Scale (AIMS) found that infants with plagiocephaly had lower motor performance scores than their peers without the condition, suggesting that early intervention is crucial to mitigate these effects.[35] Yet infants are in a critical period of growth and development, and their ability to move freely and explore their environment is crucial for achieving developmental milestones. By its nature, helmet therapy restricts certain movements and can hinder the development of neck and upper body strength. [36] This restriction can impact the infant's ability to lift their head, roll over, and eventually crawl, which are fundamental gross motor skills. Additionally, the limited sensory input from wearing a helmet might affect the child's coordination and balance, further contributing to delays in motor development.[37]

Behavioural changes are another concern for children undergoing helmet therapy. The prolonged use of a helmet can cause discomfort, skin irritation, and pressure sores, leading to increased irritability and fussiness in infants; this discomfort can result in behavioural changes such as excessive crying, difficulty sleeping, and resistance to wearing the helmet. [34] Moreover, the social and psychological impact of wearing a helmet should not be overlooked. As children grow older, they become more aware of their surroundings and their appearance – wearing a helmet may make them feel different from their peers, potentially leading to social stigma and reduced self-esteem. This sense of being different can affect their social interactions, leading to social withdrawal or difficulty forming peer relationships.
The stress and anxiety experienced by parents due to the need for helmet therapy can inadvertently affect the child's behaviour.[38] Children are highly perceptive and can pick up on their parent's emotions, leading to increased stress and anxiety in the child.[39]

Therefore, while helmet therapy effectively treats deformational plagiocephaly and reshapes an infant's skull, it is important to consider the potential long-term implications on motor skills and behavioural development.[40]

C) Comparing Standard Care Approaches: Helmet or no Helmet?

Increasing awareness of plagiocephaly prompts the question: is conservative management or cranial orthotic (helmet) therapy the better management technique?

The optimal strategy isn't universal, depending significantly on the infant's age, the deformation's severity, and associated factors like congenital muscular torticollis (CMT). In fact, for infants with moderate to severe plagiocephaly, cranial orthoses are often used as an adjunct to standard care.

Conservative management is typically the first step, combining repositioning techniques (like varied sleep positions and ample tummy time) with physiotherapy. Repositioning aims to relieve pressure on flattened areas, while physiotherapy addresses neck tightness and promotes symmetrical movement. This approach is non-invasive, low-cost, empowers parents, and treats underlying muscular issues. However, its success requires consistent adherence and is most effective in younger infants under 5 months with milder cases; it may be insufficient for moderate-to-severe or later-diagnosed asymmetry.

Conversely, helmet therapy is generally reserved for moderate-to-severe NSP or when conservative efforts fail, with an optimal start time between 4-8 months. Helmets effectively correct significant asymmetry passively but come with costs, require regular adjustments, pose a small risk of skin irritation, and notably, do not fix underlying torticollis, often necessitating concurrent physiotherapy.

Therefore, the "better" approach is highly individualized. Mild-to-moderate plagiocephaly diagnosed early could in theory respond well to diligent conservative management alone. However, moderate-to-severe cases, later diagnoses, or lack of improvement with conservative methods typically warrant consideration of helmet therapy, usually alongside physiotherapy if CMT is involved. [41]
Ultimately, the decision requires careful evaluation by multiple healthcare professionals (paediatricians, physiotherapists, or specialists) considering objective measurements, the infant's age, the presence of torticollis, and family circumstances.

Osteopathy and Non-Synostotic Plagiocephaly

A) Introduction

Osteopathy emphasises the interconnectedness between the body's structure and its ability to function correctly. Osteopaths utilize a range of gentle, hands-on techniques to diagnose and treat musculoskeletal imbalances, intending to restore proper movement and function throughout the body. This approach recognizes that the body has an innate ability to heal itself, and osteopathic treatment aims to facilitate this process by removing restrictions and promoting balance.

In the case of infants with NSP, osteopathic treatment focuses on:

- Cranial manipulation: Gentle techniques are used to address restrictions in the skull bones and the surrounding membranes. This may involve subtle pressure and mobilization to encourage proper movement and alignment of the cranial bones.
- Release of muscle tension: Osteopaths work to alleviate neck, shoulder, and back tightness that may contribute to the infant's head positioning and the development of plagiocephaly. The neck muscles in particular are highly important in the osteopathic treatment of NSP, especially when combined with torticollis. By gently easing these muscles, osteopathic treatment can lead to better head and neck alignment which helps position the head right and reduces pressure on the flat spots of the baby's skull.[42]
- Improving mobility: Treatment aims to enhance overall movement and flexibility in the infant, promote symmetrical development, and reduce the risk of long-term complications.

OMT comprises hands-on techniques osteopaths use to diagnose and treat traumatic patterns and injuries. It can complement or sometimes replace other medical interventions. Osteopathic Cranial Manipulative Medicine (OCMM) is a type of OMT that addresses issues in the head, including those that may contribute to plagiocephaly.[43]

Safety

When considering the safety profile of osteopathic treatment for newborns, it is essential to understand that paediatric osteopaths are trained to deliver gentle, effective care specifically suited for infants. Research indicates that when performed by an experienced paediatric osteopath, treatments can be both safe and beneficial, addressing issues such as plagiocephaly without the risk of adverse effects. The techniques utilized are designed to promote comfort and relaxation, ensuring that the delicate nature of a newborn's body is respected. Moreover, osteopathic treatments focus on enhancing the natural healing processes of the body, allowing for effective resolution of associated conditions while minimizing any potential discomfort.

Parents can feel assured that these approaches are supported by evidence, emphasizing the importance of clinical judgment and individualized care in optimizing the well-being of their new-borns. In fact, when it comes to the osteopathic treatment of NSP, parental satisfaction is high, with 94% reporting improvements in symmetry and functional outcomes.[44] Furthermore, osteopathy has a low complication rate (3.5% mild transient reactions) and no serious adverse events reported across 3,212 treatments.[45] However, being aware of the potential risks and side effects of paediatric osteopathy is important. These can include:

Potential Risk/ Side Effect	*Description*
Mild discomfort	Infants may experience temporary discomfort or tenderness in the areas being treated
Agitation	Some infants may become fussy or agitated during the treatment session.
Adverse Reactions	A study found that adverse reactions, such as increased fussiness or changes in sleep patterns, were reported in 3.5%, yet these reactions were described as generally mild and temporary[45]
Serious Complications	While rare, there has been some isolated case reports of reactions following treatment adverse events associated with osteopathic techniques in infants

Ethical Considerations towards choosing Osteopathic Treatment over Standard Care

When considering osteopathy as a treatment method for newborn plagiocephaly, it's essential to address the ethical considerations that come into play.

Parents are often faced with the important decision of how to approach their baby's treatment, and it's crucial for osteopathic practitioners to uphold the principles of informed consent and prioritizing the best interests of the child. This involves providing clear and comprehensive information about the benefits, risks, and limitations of osteopathic treatment. It's also imperative that osteopaths respect the values and preferences of families, tailoring treatment plans that align with their beliefs. Additionally, ensuring that treatments are evidence-based strengthens the trust between practitioners and parents. The ethical landscape also requires ongoing and open communication: osteopaths should encourage questions and discussions to dispel concerns and foster a cooperative relationship. By navigating these ethical

considerations thoughtfully, osteopathy can be delivered as a safe and supportive treatment option for families coping with plagiocephaly.[46]

Importance of Recording a Comprehensive Infant Case History [47]

A comprehensive osteopathic case history, followed by an infant examination is recommended first for all newborns receiving osteopathic treatment to assess for any musculoskeletal imbalances or restrictions that may affect their development. The exam can help identify potential issues early on and allow for timely intervention.

This case history plan aims to gather comprehensive information about an infant presenting with NSP to understand its onset, progression, potential contributing factors, and guide appropriate management:

I. Identifying Information:

- Infant's Name:
- Date of Birth:
- Age at Presentation:
- Gender:
- Informant(s) (Parent(s)/Guardian(s)):
- Relationship to Infant:
- Contact Information:
- Date of History Taking:
- Observer(s) during history taking:

II. Presenting Complaint (PC):

- Clearly document the parent(s)'s primary concern in their own words.
    - e.g., "My baby's head looks flat on one side."
    - e.g., "We've noticed their ears don't line up."
    - e.g., "The back of their head seems uneven."

III. History of the Presenting Complaint (HPC):

- Onset:
    - When did the parent(s) first notice the asymmetry of the head shape?
    - Was it present at birth? If so, describe its appearance then.
    - If not present at birth, when did it become noticeable and how quickly did it develop?
- Progression:
    - Has the asymmetry remained the same, improved, or worsened over time?
    - Are there periods where it seems more or less noticeable?
    -
- Location and Description of Asymmetry:
    - Which side of the head is flattened (right or left occiput)?
    - Describe the shape of the head:
        - Posterior flattening: Is it just a flat spot on the back?

        - Parallelogram shape: Is there also a bulging on the opposite side of the forehead?
        - Ear misalignment: Do the ears appear to be positioned differently?
        - Facial asymmetry: Is there any noticeable asymmetry in the face (e.g., one cheek appearing fuller)?
        -
- Associated Symptoms (Actively inquire about these, as they can provide clues):
    - Torticollis: Does the infant have a preference for turning their head to one side? Is there any tightness or resistance when turning the head to the other side?
    - Feeding Difficulties: Any preference for feeding on one breast or side of the bottle?
    - Developmental Milestones: Are they meeting age-appropriate motor milestones (e.g., rolling, sitting, crawling)? Any perceived delays or preferences in movement?
    - Irritability or Discomfort: Does the infant seem uncomfortable or fussy, particularly when lying in certain positions?
    - Sleep Habits: What is the infant's preferred sleeping position? Do they consistently lie on one side or their back?
    - Visual Preferences: Do they seem to favour looking in one direction more than the other?
- Alleviating/Aggravating Factors:
    - Does anything seem to make the asymmetry more or less noticeable (e.g., head position, time of day)?
- Parental Concerns: What are the parent(s)' specific concerns about the head shape? Are they worried about cosmetic appearance, developmental issues, or other potential problems?
- Previous Interventions: Have any measures been taken to address the head shape (e.g., repositioning, tummy time)? If so, what and what was the outcome?

IV. Past Medical History (PMH):

- Prenatal History:
    - Maternal health during pregnancy (e.g., oligohydramnios, multiple gestation, breech presentation, prolonged labour).
    - Foetal positioning in utero (if known).
- Neonatal History:
    - Birth weight and Apgar scores.
    - Mode of delivery (vaginal, Caesarean section - was forceps or vacuum used?).
    - Any neonatal complications (e.g., jaundice, hypotonia).
    - Length of hospital stay.
- Infancy:
    - Feeding history (breastfeeding or formula, frequency, amount).
    - Growth and development (milestones achieved).
    - Immunization history (up-to-date?).
    - Previous illnesses, hospitalizations, or surgeries.
    - Any known musculoskeletal or neurological conditions.

V. Family History (FH):

- Family history of any congenital abnormalities, particularly craniofacial conditions or torticollis.
- Family history of developmental delays.

VI. Social History (SH):

- Family structure and support system.
- Home environment (e.g., type of sleeping surface, amount of time spent in carriers or swings).
- Caregiving routines and typical positioning of the infant.
- Parental understanding of plagiocephaly and repositioning techniques.

VII. Review of Systems (ROS):

A brief system-by-system inquiry to identify any other potential symptoms:

- General: Overall well-being, any signs of distress.
- Neurological: Irritability, lethargy, seizures (unlikely to be directly related to positional plagiocephaly but important to rule out other conditions).
- Musculoskeletal: Any other noted asymmetries or limitations in movement.

VIII. Physical Examination (To be documented separately, but informed by the history):

- General Observation: Overall appearance, alertness, and interaction.
- Head Shape Assessment:
    - Visual Inspection: Observe the head from all angles (top, front, back, sides). Note the location and degree of flattening, any bulging on the opposite side, and ear alignment.
    - Palpation: Gently palpate the skull to assess for any ridging or unusual contours (important to differentiate positional plagiocephaly from craniosynostosis).
    - Measurements (if appropriate and trained):
        - Cranial Vault Asymmetry Index (CVAI): Measures the diagonal difference of the skull.
        - Oblique Cranial Length Ratio (OCLR): Ratio of the two diagonal lengths.
        - Document these measurements and the method used.
- Neurological Examination: Assess tone, reflexes, and developmental milestones.
- Musculoskeletal Examination:
    - Cervical Range of Motion: Assess for torticollis (passive and active range of motion of the neck). Note any preference for head turning or tilting. Palpate the sternocleidomastoid muscle for tightness or a mass.
    - Gross Motor Skills: Observe spontaneous movements and assess developmental milestones (e.g., head control, rolling).
- Other Systems: Brief examination of other systems as indicated.

IX. Red Flags (Crucial to identify potential serious underlying conditions that mimic plagiocephaly):

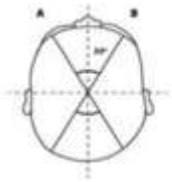
Actively inquire about and carefully assess for the presence of any of the following red flags that would warrant further investigation and specialist referral (neurosurgeon, craniofacial specialist):

- Progressive worsening of asymmetry after 6 months of age despite repositioning.
- Palpable bony ridge along the suture lines of the skull (suggestive of craniosynostosis).
- Restricted head growth or abnormal head circumference percentile.
- Associated neurological symptoms (e.g., developmental delay, seizures, increased intracranial pressure).
- Facial asymmetry that is severe or rapidly progressive.
- Signs of increased intracranial pressure (e.g., bulging fontanelle, persistent vomiting, irritability).
- Concerns about non-accidental injury.

X. Provisional Diagnosis:

- Based on the history and physical examination, The osteopath formulates a provisional diagnosis (e.g., positional plagiocephaly, deformational plagiocephaly).
- Or Considers differential diagnoses (e.g., craniosynostosis, congenital muscular torticollis).

The Cranial Vault asymmetry index: Measuring improvement before, during and following a course of OMT

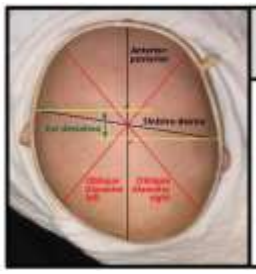


The cranial vault asymmetry index (CVAI) is the difference between the lengths of two diagonals measured 30 degrees from midline, divided by the larger of the two diagonals. Multiplication by 100 results in a percentage.

$$CVAI = \frac{A - B}{A} \times 100$$

Severity of DP based on CVAI: Grade 1 (Normal) <3.5; Grade 2 (Mild) 3.5 – 6.25; Grade 3 (Moderate) 6.25 – 8.75; Grade 4 (Severe) 8.75 – 11.0; Grade 5 (Very Severe) >11.0.

Figure: CVAI calculation depending on Diagonal A and Diagonal B measurements



	ODDI (%)		CPI (%)
Normal Shape	<104	and	<90
Mild Deformation	104–107	or	90–94
Moderate Deformation	108–111	or	95–99
Severe Deformation	≥112	or	≥100

Figure: Illustration of plagiocephalometry and cut-off points for severity of skull deformation. The photograph of left occipital flattening shows the thermoplastic measuring ring and digitally drawn lines used in plagiocephalometry. CPI cranial proportional index (calculated by dividing the sinistra-dextra value by the anterior-posterior value and multiplying by 100%), ODDI_oblique diameter difference index (calculated by dividing the longest oblique diameter by the shortest oblique diameter and multiplying by 100%).

In order to complete these calculations, I use a tool such as the MIMOS Craniometer [48] as an objective measurement of an infant's head shape:

Observing an infant's developing head shape should be a common practice for all paediatric osteopaths. Yet when concerns arise about a potential plagiocephaly, subjective visual assessment can be

challenging. The Mimos Craniometer provides a valuable tool to move beyond observation, offering a standardized and objective method for measuring cranial dimensions. Its use involves careful technique, followed by thoughtful analysis to understand the clinical significance of the measurements.

The process of using the craniometer begins with ensuring the infant is calm and positioned comfortably, often sitting upright on a parent's lap or lying supine if needed. Precision starts with correct placement: the fixed reference point of the calliper typically rests gently on the glabella, the spot between the eyebrows. The main bar of the craniometer should align roughly along the midline of the head, crucially kept level and parallel to the horizontal plane (a line from the lower eye socket to the top of the ear canal) – avoiding any upward or downward tilt.

With the tool positioned, the key measurements can be taken. To assess asymmetry, two diagonal measurements are captured. The calliper arms reach from one side's frontal prominence (about 30 degrees off the glabella) to the opposite posterior prominence at the back of the head (Diagonal A in above Figure), followed by the measurement of the mirrored diagonal (Diagonal B). Gentle, consistent contact without compressing the soft tissues is key. Next, the maximum head width is measured, typically across the parietal bones above the ears.
Finally, the maximum head length is recorded, measured along the midline from the glabella to the most prominent point on the back of the skull (opisthion). For reliability, repeating each measurement a couple of times and averaging the results is recommended.

Once these raw measurements (in millimetres) are obtained, the analysis phase translates numbers into meaningful clinical information. The primary calculation for asymmetry is the Cranial Vault Asymmetry Index (CVAI) which is found by taking the absolute difference between Diagonal A and Diagonal B, dividing it by the larger of the two diagonals, and multiplying by 100 to get a percentage.
The CVAI provides a quantitative measure of plagiocephaly severity.

To understand the overall head proportion, the Cephalic Index (CI), sometimes called the Cranial Ratio (CR), is calculated. This is simply the head width divided by the head length, multiplied by 100.

A higher CI suggests a relatively wide head for its length (brachycephaly), while a lower CI indicates a relatively long, narrow head (scaphocephaly).

However, these calculated indices (CVAI and CI) do not exist in a vacuum. Their true value comes from comparing them against established, age-specific normative data or severity scales (often categorized as mild, moderate, or severe). This comparison helps determine if the infant's head shape falls within the typical range or deviates significantly.

Crucially, craniometer measurements form just one part of a comprehensive assessment.
The numerical data must always be correlated with a thorough clinical evaluation.
This includes visually inspecting the head shape from multiple angles, checking for facial asymmetry, observing ear alignment, noting any forehead bossing, and assessing for underlying conditions like torticollis (neck muscle tightness) which often contributes to positional head flattening.

In essence, the Mimos Craniometer is a powerful adjunct to clinical assessment, transforming subjective concerns into objective data. When used correctly and interpreted within the broader clinical picture by a trained professional, it aids significantly in diagnosing the type and severity of cranial deformation, tracking the effectiveness of interventions like repositioning or physiotherapy, and guiding decisions regarding further management, such as the potential need for helmet therapy. It provides a common language of measurement in the journey of monitoring and managing an infant's head shape.[48]

B) Dr. Frymann and Dr Sutherland's Osteopathic Protocol for Plagiocephaly

OMT's key principles include the body's inherent capacity for self-healing and the crucial interrelationship between anatomical structure and physiological function.[49]
In the paediatric population and infants, OMT involves the application of gentle, non-invasive manual techniques aimed at diagnosing and treating somatic dysfunction – impaired or altered function of related components of the somatic system (skeletal, arthrodial, and myofascial structures, and related vascular, lymphatic, and neural elements)

Techniques commonly employed for infants include, but are not limited to, cranial osteopathy, balanced ligamentous tension (BLT), myofascial release (MFR), and soft tissue mobilization.[50]

The application is specifically adapted to the infant's delicate physiology, emphasizing gentle pressures and subtle movements to restore symmetry, improve mobility, and optimize overall physiological function.[51]

The proposed mechanisms by which OMT may influence motor and developmental outcomes in infants with NSP extend beyond simply addressing the cranial asymmetry itself.
The primary theoretical pathways include:

- **Addressing Concurrent Torticollis:** NSP frequently co-occurs with congenital muscular torticollis (CMT) or functional torticollis, characterized by restricted cervical range of motion (ROM) and head tilt/rotation preference.[52] Torticollis directly hinders symmetrical motor development, impacting visual tracking, midline orientation, rolling, and precursor skills for sitting and crawling . OMT techniques target restrictions in the cervical spine, fascial tension in the neck (particularly the sternocleidomastoid muscle), and associated restrictions in the shoulder girdle and upper thoracic spine. By improving cervical mobility and reducing muscular imbalances, OMT aims to resolve the torticollis, thereby removing a significant barrier to symmetrical motor milestone achievement. [53,54]

- **Resolving Cranial Base and Sutural Strains:** From an osteopathic perspective, the forces contributing to plagiocephaly (intrauterine constraint, birth trauma, postnatal positioning) can also induce strains within the cranial bones, membranes (dura mater), and particularly at the cranial base (SBS).[55]
  While direct proof is challenging, the theory posits that these strains can potentially affect cranial nerve function (especially those exiting near the cranial base, like CN IX, X, XI, XII, which influence feeding, head, and neck control), Dural tension patterns throughout the spine, and overall neuromuscular integration. [56] Addressing these strains is theorized to optimize neurological function and reduce asymmetries that may manifest in motor patterns.

- **Improving Global Musculoskeletal Symmetry and Function:** OMT takes a whole-body approach. Restrictions or asymmetries identified not just in the head and neck, but also in the spine, pelvis, sacrum, or extremities, are addressed. The rationale is that these distant restrictions can contribute to postural preferences, movement limitations, and compensatory patterns that affect overall motor development [57]. By improving overall musculoskeletal balance, OMT may facilitate more efficient and symmetrical movement patterns.

- **Enhancing Neuromuscular Regulation:** By reducing physical restrictions and improving structural alignment, OMT is proposed to enhance proprioceptive feedback, reduce nociceptive

input, and potentially influence autonomic nervous system balance, creating a more optimal physiological environment for neuromuscular development and coordination.[58]

The four main osteopathic techniques recommended by Dr Sutherland and Dr Frymann are listed below:

1) **The Venous Sinuses Drainage Technique** (VSD)

Dr. Sutherland developed the Venous Sinus Drainage technique and its third stage represents, in Dr. Frymann's opinion, the key to releasing the possible anterior compression of one of (or both) the occipital condylar parts.

The VSD technique is used to enhance blood flow through the venous sinuses and is commonly employed in osteopathic cranial manipulative medicine and craniosacral therapy. By optimizing the circulation of venous blood within the cranium, this technique aims to improve the drainage of venous blood flow, facilitate the reabsorption of cerebrospinal fluid (CSF), and prevent accumulation.[59]

Anatomy:

The venous vascularization of the skull does not overlap with the arterial one. These veins cross the subarachnoid spaces to join the venous sinuses, which are contained within a double fold of the dura mater.

The intracranial membranes, such as the falx or the tentorium, insert onto the bones on each side of a groove, forming the cranial venous sinuses. The cranial veins and sinuses are valveless, inelastic,

inextensible, and non-contractile. Their drainage thus highlights the presence of a pumping mechanism, and the relaxation of the intracranial membranes has a direct impact on the venous sinuses.

There is also a suction mechanism due to pressure differences during the inspiratory phase. During thoracic inspiration, the pressure in the superior vena cava decreases, causing a suction effect that draws blood from the jugular veins to the right atrium of the heart. This implies that people, who have an inefficient thoracic breathing, or those with thoracic overpressure, potentially lose the benefit of this suction. For this reason, the work of the thoracic diaphragm, and more generally that of the three diaphragms, will have a positive impact on cranial venous drainage.

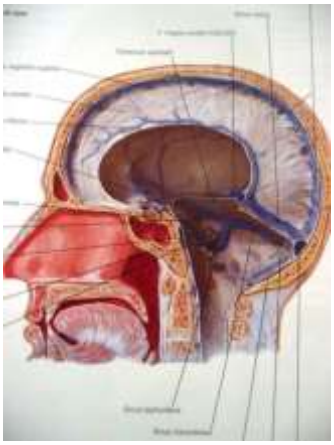
The role of these sinuses is not only to transport deoxygenated blood but also to serve as a reserve function in case of emergency, especially through the deep venous system.

The venous sinuses also play a crucial role in fluid balance and also have a role in the fluctuation of CSF. CSF circulates in the subarachnoid space which is located between the pia mater (which lines the convolutions of the brain) and the arachnoid. It is formed by filtering blood plasma at the level of the choroid plexuses located in the ventricles.

CSF allows the elimination of harmful metabolites in the body, lymphatic drainage, hormonal transmission, maintenance of homeostasis, as well as the protection of brain matter. The pressure of the CSF is controlled by the secretion/absorption mechanism. CSF is distributed during inspiration whilst, during expiration, arachnoid villi known as the Pacchionian Granulations, located on the walls of the superior longitudinal venous sinuses, allow the unidirectional passage of CSF to the veins by osmosis or active transport. The venous sinuses thus contribute to maintaining the balance of the intracranial pressure gradient.

These sinuses drain 95% of the cranial venous blood which exits the skull through the posterior Jugular foramen emptying into the internal jugular veins. The dural venous sinuses, located between the periosteal and meningeal layers of the dura mater, are part of the central nervous system's venous drainage system.
According to Dr.Sutherland, the VST involves a gentle manual, cranial osteopathic manipulation in

7 distinct stages to open the sinus tracts, thereby promoting enhanced venous blood flow and optimizing the physiological processes associated with CSF reabsorption.[59]



(Netter Atlas of Human Anatomy)

(Netter Atlas of Human Anatomy)

They are:

1. **Confluence of Sinuses Drainage**: Two fingers are positioned (end to end, perpendicular and close to the midline) at the inion (the external occipital protuberance) and gentle lateral pressure is applied to facilitate drainage. The tissues will "unwind" under the fingers until they find a point of "balance". At that point, waiting is important until, eventually, a softening occurs. When this release is palpated, move your fingers to the next stage.

2. **Occipital Sinus Drainage**: The practitioner places their fingers again along the midline of the occiput, now closer to the foramen magnum, and applies again a gentle lateral pressure in a similar manner as previously done to encourage drainage.

3. **Decompression of both occipital condylar parts:** The practitioner places the fingers still along the midline of the occiput, in a "chevron" manner, now creating a gentle posterior traction whilst approximating his wrists. This is the *most important part of the VSD* and the key is to wait until both condyles release (as the anterior condyle will often release last !).

4. **Transverse Sinus Drainage**: The practitioner places their fingers along the superior nuchal line (the base of the skull) and applies gentle pressure until a softening or warmth is felt.

5. **Straight Sinus Drainage**: The practitioner places their fingers at the bregma and applies gentle fluid drive from the patient's bregma towards his inion to facilitate drainage along the straight sinus.

6. **Superior Sagittal Sinus Drainage**: The osteopath's thumbs are crossed and placed along the midline of the skull, starting from the inion and moving in distinct steps towards the bregma, applying gentle pressure, again until a softening or warmth is felt.

7. **Metopic Suture Drainage**: The fingers are positioned along the metopic suture (the midline of the forehead) and gentle pressure is applied to encourage drainage.

Each stage is performed in sequence, with the practitioner maintaining pressure until a softening or warmth is felt under their fingers.

2) Dr. Sutherland's Approach to the Intraosseous Occipital Strain [59]

Sutherland recognised that significant compressive forces, during birth, could create strains *within the substance* of an occipital bone itself, not just at the sutures between bones.
This is termed intraosseous strain. For the occiput, which develops from multiple parts (squamous, two lateral/condylar, basilar) that fuse after birth, these internal strains were considered particularly relevant with plagiocephaly.

Diagnosis: Through refined palpation, Sutherland aimed to perceive areas of density, compression, lack of inherent plasticity, or distorted internal motion within the occipital bone structure itself. He might assess the quality of the bone's participation in the Primary Respiratory Mechanism.

Therapeutic Goal: The primary goal was to restore the inherent resilience, plasticity, and physiological motion within the bone tissue. This involves encouraging the release of the internal compression or "memory" of the traumatic force.

Mechanism: By restoring normal intraosseous mobility, the aim was also to potentially alleviate related issues, such as compromised function of structures passing near or through the occiput (e.g., cranial nerves at the jugular foramen, dural membranes attaching to the occiput, venous sinuses).

General Technique Principles from Sutherland's Philosophy:

- Gentle Engagement: Sutherland's approach involved very gentle, specific hand contacts designed to engage the bone tissue itself, often cradling the occiput or focusing on its specific developmental parts.
- Working *with* the Tissues: Rather than applying external force *against* the restriction, Sutherland emphasised following the tissues' inherent tendencies via:
    - Direct Action: Gently guiding the tissues *towards* the direction of ease or normal physiological motion, following the inherent corrective drive (PRM).
    - Balanced Tension: Finding a point of balance within the strained tissues and holding gently until a release (softening, warmth, and restored motion) is palpated.

In essence: Sutherland's approach to intraosseous occipital lesions wasn't a single, named manoeuvre but an application of his core cranial principles. It involved skilled palpation to identify internal bone restrictions and the use of extremely gentle, non-invasive techniques guided by the body's inherent motion to encourage the release of compression and restore the bone's natural plasticity and physiological function.[59]

3) The CV4 Technique [60]

The practitioner is positioned at the head of the table. The patient is lying supine (on their back).

Best Method "the Occipital Hold":

To begin the CV4 technique using the occipital hold, first cup one hand within the other, aligning the thenar eminences to form parallel ridges which create the highest point of contact. Gently slide this hand cradle beneath the patient's head, positioning it so the lateral angles of the occiput's squamous portion (just inside the occipitomastoid sutures) comfortably rest upon the thenar eminences. Ensure your fingers remain relaxed, avoiding pressure on the neck, allowing the head's weight to provide a gentle compressive contact on the occiput's lateral angles.

Now, bring your awareness to the subtle, rhythmic motion of the occiput – the Cranial Rhythmic Impulse (CRI). Gently follow this rhythm into its extension phase, feeling your hands rock slightly towards you. As the occiput moves towards flexion (away from you), subtly discourage this phase without forcing. Continue this gentle guidance; you will perceive the amplitude of the motion gradually diminishing until a physiological 'still point' is reached.

During or following this still point, you may palpate a softening or warmth releasing from the occiput. As the inherent motion gently resumes, it often feels like a quiet rocking, similar to a boat on calm water. Observe also if the patient's breathing slows and becomes more diaphragmatic, potentially synchronising with the CRI. Once the cranial field feels calm and integrated after the still point resolves, a sensation of softening and release of heat should follow, along with the subtle movement resembling a small boat on calm water. Then, very gently withdraw your hands.

Alternatively, a similar physiological effect can be pursued via the temporal bones. For this hold, gently cradle the occiput with palms crossed and fingers interlaced, placing your thumbs along the mastoid processes. Palpate the rhythmic external and internal rotation of both temporals. Follow the movement into the internal rotation phase while gently discouraging the external rotation phase, again anticipating a decrease in amplitude leading towards a still point and subsequent resolution.[60]

4) The Base-Spread Technique

Occipital deformity in infants, cervical or membranous tension at the craniocervical junction, or a rigid base, can be helped greatly with Dr. Frymann's "base spread" technique:
Method: The osteopath holds the infants' temporal bones gently in external rotation with the tip of his thumbs, his little fingers placed on the occipital squama, taking it whatever membranous tensions suggest, the ring fingers placed bilaterally beneath the inion, and the middle fingers guide the posterior masses of the second cervical vertebra gently caudally, thus creating a gentle craniocervical decompression.
A subtle "unwinding" process may occur at that level until the tissues find their point of "balanced membranous tension" (where all movement stops). The Osteopath should maintain the gentle decompression until a deep sensation of release within the tissues occurs.[61]

Research Methodology

A multifaceted research approach was undertaken to gather comprehensive information on the benefits of osteopathy for babies and infants with non-synostotic plagiocephaly.

The research methodology included the following steps:

1. Literature Review: Using PubMed, Google Scholar, and other academic databases, I conducted a thorough search of peer-reviewed articles. This search focused on identifying studies that investigated the effectiveness of osteopathic treatment for NSP.

2. Clinical Trial Identification: Reputable sources, such as the National Institutes of Health (NIH) and ClinicalTrials.gov, were consulted to identify ongoing or completed clinical trials related to osteopathic treatment for NSP.

3. Case Study Exploration: I searched for case studies and anecdotal evidence to gather real-world examples of how osteopathy has been used to address NSP in infants.

4. Online Resource Evaluation: Reputable websites and online resources, including those of professional organizations and associations, were reviewed to gather further information on osteopathy and its application in paediatric care.

This comprehensive methodology ensures that the information presented is accurate, up-to-date, and reflects current understanding.

Literature Review

Does Osteopathy Restore Cranial Symmetry to Infants Born with Cranial Deformities like Plagiocephaly?

This literature review examined the effectiveness of osteopathic treatment in restoring cranial symmetry to infants with cranial deformities, particularly Plagiocephaly.

A number of published research papers were reviewed to evaluate the current evidence on this topic:

- Dr. Viola Frymann (1966) conducted a seminal study examining the relationship between craniosacral mechanisms and symptomatology in 1,250 new-born's. Although this study predates more recent Research, *it established important correlations between cranial base strain patterns and various symptoms in new-borns*. Dr. Frymann's work laid the foundation for understanding the potential impact of cranial osteopathy on infant health and development.[60]

- R. Panza et al. (2024): This study published in the Italian Journal of Osteopathic Medicine demonstrated cranial asymmetry in infants with positional plagiocephaly significantly reduced after five osteopathic treatments. *OMT Reduces Cranial Vault Asymmetry Index (CVAI) by **51–59%** within months. A study of 424 infants achieved complete resolution of deformities after a median of 4–**5 sessions**, with severity scores dropping from 3 to 0.* This finding highlights the potential for osteopathy to effectively address the core issue of skull deformation in infants with NSP.[63] However, the major limitations stemming from its observational, retrospective design are particularly the lack of a control group, which prevents causal conclusions and cannot rule out confounding factors like natural improvement. It is a good supportive descriptive evidence, but less definitive than RCTs for proving OMT works better than alternatives or nothing

- Another study published in the International Journal of Osteopathic Medicine by reported significant improvements in cranial asymmetries in infants younger than 6.5 months old following four osteopathic treatments. *These findings highlight the potential benefits of early osteopathic intervention for NSP* and emphasize the importance of timely care in addressing cranial asymmetry.[64]

- Providing strong support for osteopathic treatment efficacy in plagiocephaly, Bagagiolo et al. (2022) conducted an RCT with 96 infants.[65] *Participants receiving OMT demonstrated significantly greater improvement in cranial asymmetry than those receiving sham light touch therapy, measured at 3 months and 1 year post-treatment*. This comparison against a sham control isolates the specific effects of OMT beyond minimal intervention or placebo, reinforcing its therapeutic value. This study provides robust evidence for the specific therapeutic benefit of OMT for this condition.[66]

- Philippi, H., et al (2006). This pilot study documented a significant decrease in Cranial Vault Asymmetry (CVA), Skull Base Asymmetry (SBA), and Trans-Cranial Vault Asymmetry (TCVA) in infants with NSP who received osteopathic treatments. *These findings provide further evidence of osteopathy's positive impact on cranial asymmetry*.[67]

- Cabrera-Martos et al (2013) conducted a study on infants with deformational plagiocephaly included in a conservative treatment program. *The researchers found that osteopathic treatment and other conservative approaches significantly improved cranial asymmetry*. The study highlighted the potential of osteopathic interventions in addressing plagiocephaly.[68]

- Filisetti et al (2020) conducted an observational study of 310 new-borns during their first years of life. Data analysis examined perinatal history, general features and disorders that could be related to plagiocephaly. *The experience confirmed that plagiocephaly is not only a problem regarding the shape of the head, it involves other functions* [like associated neurodevelopmental issues]. In this study most babies (81%) with positional plagiocephaly showed isolated or associated disorders that had an impact on growth, behaviour and development.[69]

- Gasperini et al (2021) reported a case series study of 37 infants diagnosed with deformational plagiocephaly who started treatment at 6 months or less and had a 1-year follow-up assessment. The infants received an average of four to nine OMT sessions. *The study found significant improvements in cranial symmetry*, further supporting the potential of osteopathic treatment in addressing plagiocephaly. [70]

- A systematic review and meta-analysis by Lanaro et al (2017) focused on osteopathic manipulative treatment for preterm infants. While not explicitly addressing plagiocephaly, the study demonstrated the safety and efficacy of osteopathic treatment in neonatal care. *The analysis showed a significant reduction in the length of hospital stays for preterm infants receiving OMT, with no reported adverse effects*. This study supports osteopathic treatment's overall safety and potential benefits in infant care.[71]

Further Related Studies:

- Dr. Hollis King, DO. Effects of Osteopathic Manipulative Treatment on Children with plagiocephaly in the Context of Current Paediatric Practice: A Retrospective Chart Review Study. *Published in the Journal of Osteopathic Medicine, this retrospective chart review study investigated the effects of osteopathic manipulative treatment (OMT) on children with deformational Plagiocephaly. The study found that OMT significantly reduced cranial asymmetry and improved cranial vault measurements. Direct comparisons show that OMT outperforms standard care (repositioning/physiotherapy), achieving 4.4% CVAI reduction vs. 2.5% with standard care at 6-month follow-up.*[72]

- C. Genelot et al. Early Osteopathic Manipulative Treatment to Prevent Cranial Positional Deformities. *This study evaluated the effectiveness of early osteopathic manipulative treatment (OMT) in preventing cranial positional deformities (plagiocephaly and brachycephaly) in new-borns. The randomized controlled trial at Montpellier University Hospital included new-borns aged 3 to 10 days with risk factors for cranial deformities. The results showed no significant difference in the rates of cranial deformities at 4 months between the OMT group and the control group receiving standard care. However, a trend toward fewer severe cases was observed in the OMT group.* [73]

- F. Cerritelli et al. The Influence of Osteopathic Manipulative Treatment on Plagiocephaly in Infants. *This review examined the influence of osteopathic manipulative treatment (OMT) on Plagiocephaly in infants. It included multiple studies and found that OMT could be beneficial in reducing cranial asymmetries and improving overall cranial shape in infants with non-synostotic plagiocephaly. The review highlighted the need for further high-quality randomized controlled trials to strengthen the evidence base.* [74]

- Effects of Osteopathic Approach in Infants with Deformational Plagiocephaly: An Outcome Research Study. *Conducted at the Osteobimbo pediatric clinic in Rome, Italy - Reviewed charts of infants with deformational plagiocephaly - Found significant reduction in cranial asymmetries after an average of 6.5 osteopathic manipulative treatments*. [75]

- A recent meta-analysis by Smith et al. (2023) contributes significantly to the field, synthesizing data from numerous studies on osteopathic interventions for NSP. *The authors found that OMT yielded statistically significant improvements in cranial symmetry and motor development compared to standard care approaches.* This analysis reinforces the findings of previous studies and highlights the need for further Research to establish standardized protocols for OMT in treating NSP.[76]

- Kearney et al. (2015) conducted a randomized controlled trial (RCT) *that demonstrated significant improvements in cranial symmetry among infants receiving OMT compared to those receiving standard care.* This study provides high-quality evidence (due to the RCT design) that directly demonstrates OMT's superiority over standard care for improving cranial symmetry in infants. It strongly supports the efficacy of OMT and helps establish a causal link between the intervention and the positive outcome,. Kearney et al.'s results suggest OMT is better than standard care, even if it is *additional* benefit over intensive physiotherapy. [77]

- McNaughton et al. (2018) [78] found that *OMT not only improved cranial shape but also correlated with enhanced motor development, highlighting the "multifaceted benefits" of osteopathic intervention*. However, as a pilot study, it has significant limitations (small size, likely lack of control/randomization)

- Effects of Osteopathic Manipulative Treatment on Children with Plagiocephaly in the Context of Current Pediatric Practice: A Retrospective Chart Review Study [79]. - *Conducted by the American Osteopathic Association - Highlighted the lack of strong data supporting current standard care recommendations - Suggested OMT as a potential treatment option.*

- Brent R Collett, PhD. In this prospective cohort study, he examined cognitive and academic outcomes in children with and without a history of plagiocephaly. His results speak for themselves: *Children with NSP scored lower than controls on most scales of the Differential Ability Scales, Second Edition (standardized effect sizes [ESs] = −0.38 to −0.20) and the Wechsler Individual Achievement Test, Third Edition (ESs = −0.22 to −0.17). Analyses by PPB severity revealed meaningful differences among children with moderate to severe PPB (ESs = −0.47 to −0.23 for 8 of 9 outcomes) but few differences in children with mild PPB (ESs = −0.28 to 0.14).* School-aged children with moderate to severe NSP scored lower than controls on cognitive and academic measures. The findings do not necessarily imply that these associations are causal; instead, NSP may serve as a marker of developmental risk. His findings suggest a role for assessing NSP severity in clinical practice: providing developmental assessment and intervention for infants with more severe deformation and reassurance and anticipatory guidance for patients with mild deformation.[80]

- E. Fowler et al (2008) evaluated the neurologic profiles of infants with deformational plagiocephaly . Forty-nine infants with NSP between the ages of 4 and 13 months (mean age, 8.1 months) were evaluated, along with 50 age-matched control subjects (mean age, 8.1 months). A modified version of the Hammersmith infant neurologic assessment was performed on each infant. A caregiver completed a questionnaire regarding the infant's prematurity, development, and health to date. Results were analysed: *There is a statistically significant difference in overall neurologic assessment scores of infants with NSP vs their healthy peers* (P = .002). This difference is predominately in tone, whereby *infants with NSP have significantly more abnormal tone than nonplagiocephalic infants* (P = .003). This abnormality is not one of decreased tone but one of variable tone, deflecting abnormally high and low tone. Infants with NSP are more likely to have altered tone but not exclusively decreased tone.[81]

- J. Elwood et al, (2020) set out to evaluate treatments for congenital muscular torticollis (CMT) and positional plagiocephaly (PP) by examining the effectiveness and safety of manual therapy, repositioning (with tummy time), and, for PP only, helmet therapy. The researchers conducted a systematic review of systematic reviews and national guidelines. They searched four major databases (PubMed, Embase, Cochrane, and MANTIS) for studies published between 1999 and 2019. The inclusion criteria focused on systematic reviews that pooled multiple studies and national guidelines that combined evidence with expert opinion. For positional plagiocephaly, they identified 10 systematic reviews plus one national guideline. *The evidence showed that: OMT was more effective than repositioning (inc. tummy time) with moderate to high supporting evidence.*[84]

Discussion

Based *specifically* on the analysis of Philippi (2006)[67], Lessard (2011)[52] and Cerritelli (2013)[74], focusing on OMT for infant plagiocephaly:

First, we need to acknowledge the central conflict in high-quality evidence:

- The literature presents conflicting findings from high-quality RCTs regarding the efficacy of OMT for infant plagiocephaly or associated conditions. The Philippi et al. (2006) study demonstrated significant benefits for OMT when added to standard care for infantile postural asymmetry. Conversely, the Lessard et al. (2011) RCT, focusing specifically on moderate-to-severe deformational plagiocephaly, found no significant *additional* benefit when OMT was added to a structured physiotherapy program.
- This discrepancy between two well-conducted RCTs forms a central point of discussion in evaluating OMT's role:
- Population Differences: One potential reason for the differing outcomes lies in the study populations. Philippi et al. included infants with 'postural asymmetry,' potentially a broader or slightly different cohort than the 'moderate-to-severe deformational plagiocephaly' group studied by Lessard et al. OMT might have different effects depending on the specific diagnosis or severity.
- Crucially, the comparator groups differed. Philippi compared OMT + standard care against standard care alone, whereas Lessard compared OMT + physiotherapy against physiotherapy alone. Physiotherapy itself is an active and often effective intervention for plagiocephaly. Demonstrating an *additive* benefit over an already active treatment (Lessard) is a higher threshold than demonstrating benefit over less defined 'standard care' (Philippi).
- While both studies assessed relevant outcomes, Philippi et al. reported significant findings primarily in motor development and overall asymmetry scores, whereas Lessard et al. focused heavily on anthropometric cranial measurements. It's conceivable that OMT impacts associated motor function or overall posture (as suggested by Philippi) more readily than it influences direct cranial shape changes beyond what physiotherapy achieves in moderate/severe cases (as suggested by Lessard).
- Differences in the specific OMT protocols or the intensity/nature of the 'standard care' and 'physiotherapy' interventions across the studies could also contribute to the divergent results.

Integrating Findings from Related Studies (Cerritelli):

- While not directly measuring plagiocephaly outcomes in term infants, the Cerritelli et al. (2013) RCT demonstrating reduced length of stay in preterm infants receiving OMT lends support to the biological plausibility of OMT having measurable physiological effects in infants. This suggests potential mechanisms (e.g., autonomic regulation)that *could* theoretically

influence conditions like plagiocephaly, even if direct cranial shape impact wasn't seen in the Lessard study.

- The systematic review by Cerritelli et al. (2013) likely reflects this complex picture, summarizing the available evidence (including both Philippi and Lessard) and probably concluding, as is common in such reviews, that while some positive findings exist, the evidence is mixed, and more rigorous research is required. This reinforces the need to interpret individual study results cautiously.
- These findings suggest that the decision to incorporate OMT for infant plagiocephaly requires careful consideration. OMT might be beneficial, particularly for infants presenting primarily with postural asymmetry or perhaps milder forms of plagiocephaly, potentially improving motor outcomes alongside standard advice (supported by Philippi).
- The conflicting results underscore the need for future research with clear definitions of the study population (plagiocephaly severity, associated torticollis/asymmetry), standardized OMT protocols, consistent and comprehensive outcome measures (including both anthropometrics and functional assessments), and direct comparisons between OMT, physiotherapy, and combined approaches.

In conclusion, these studies provide valuable insights into the effectiveness of OMT in treating deformational plagiocephaly. OMT offers a valuable tool for evaluating and treating cranial tension and compression resulting from birth trauma.

The reviewed literature suggests that osteopathic treatment, particularly cranial osteopathic techniques, shows promise in restoring cranial symmetry to infants with plagiocephaly and prevent long term consequences of plagiocephaly on all aspects of his/her life: global posture and motor development, sensorial development, neurovegetative state and finally this can influence the baby growth and development.

Multiple studies have demonstrated significant improvements in cranial shape following osteopathic interventions. However, it is important to note that while the evidence is encouraging, more large-scale, randomized controlled trials are needed to establish further the efficacy of osteopathic treatment for plagiocephaly and other cranial deformities in infants.

Case Studies

These offer anecdotal support to the benefits of osteopathy in treating NSP, but need to be interpreted with caution within the broader body of evidence important for academic rigour:

- While limited, some case studies suggest that infants treated with OMT for plagiocephaly experienced improved breastfeeding, sleep quality, bowel movements, eye tracking, and the ability to turn their heads to both sides. These findings indicate that osteopathic treatment may have several broader benefits beyond addressing cranial asymmetry, potentially improving overall infant well-being. [58,60]

- Many parents have shared transformative experiences following osteopathy treatments for their new-borns with plagiocephaly. One such story comes from Sarah, who noticed her baby, Liam, developing a flat spot on his head shortly after birth. Concerned but hopeful, she sought the guidance of a paediatric osteopath. After just a few sessions, Sarah observed remarkable visible improvements in her son's head shape and his overall comfort.

- Another mother, Jessica, recalled how her baby, Emma, would often fuss when lying on her back. With the gentle, hands-on techniques utilized in osteopathy, Emma not only began to relax more during tummy time but also showed better head control.

These first-hand accounts reflect the powerful, positive impact osteopathy can have on treating plagiocephaly, offering reassurance and support to families navigating this common condition.

Parent Testimonials

- Patient C: “Marc has helped my son C and I so much over the last two years. When he was born, it soon became apparent that C's head rested to one side; with effort he could move it to the middle, but he could not turn it the other way. After three or four osteopathic treatments, his head was completely mobile and moving freely. He is now a happy two-year-old toddler with a beautifully shaped head who runs around very happily!” Mrs F.[82]

Before Treatment
Head always to Right

After two treatments
Almost to the left!

C at 2 years old

- Patient 2: “From the day our baby was born, he only wanted to look to his left. He would prefer to stare at a blank wall on his left than turn his head to the right to look at us!... I was told that he would begin to hold his head normally over time but at six months old, he was still exactly the same. One of my friends suggested trying osteopathy to help correct the problem. I thought we'd give it a try as time hadn't helped so we came to the Cambridge Osteopathic Centre. After the second session we really began to notice an improvement in our baby's head strength and movement.
  After four sessions he had so much more mobility in his head that nobody would notice that he had had a problem before. I would highly recommend osteopathy to all parents!” Mrs. H

Before Treatment After treatments

Future Directions

The body of evidence points to promising outcomes of OMT for addressing cranial deformities such as non-synostotic plagiocephaly. Studies like those by Bagagiolo et al. (2022)[65] and Gasperini et al. (2021)[70] *suggest that OMT can effectively restore cranial symmetry when applied early and consistently*. However, there are critical gaps:

- Many studies, while supportive of osteopathy, are limited by small sample sizes and a lack of diversity in study populations
- Variability in OMT techniques and session frequency complicates study comparisons
- While short-term improvements in cranial symmetry are well-documented, the long-term developmental impacts of OMT remain unclear

Despite the promising results, the meta-analyses also identified limitations in the existing literature and variability in treatment protocols. These inconsistencies underscore the necessity for more extensive, multicentre trials to validate OMT's efficacy and determine the most effective treatment regimens.

Conclusion

The quality of the primary trials of OMT has improved during recent years.[83]

OMT offers a valuable tool for evaluating and treating cranial tension and compression resulting from birth trauma. By incorporating OMT into a comprehensive treatment plan, experienced Paediatric osteopaths can contribute to improving cranial symmetry and overall comfort for infants affected by plagiocephaly.

While further research is needed to elucidate its effectiveness and long-term benefits fully, existing evidence suggests that osteopathic treatment can significantly reduce cranial asymmetry, improve a range of functions, and offer an alternative to helmet therapy. The comparative study of osteopathy and standard care in the rehabilitation of infants with deformational plagiocephaly reveals promising evidence supporting the efficacy of osteopathic interventions.

The potential benefits of osteopathy for infants with NSP extend beyond merely addressing the physical asymmetry of the skull. Studies and case reports suggest that osteopathic treatment may also improve breastfeeding, sleep quality, bowel movements, eye tracking, and head movement. This highlights the holistic nature of osteopathic care and its focus on promoting overall well-being.

Early intervention with osteopathy is particularly beneficial in addressing NSP. Parents who notice signs of plagiocephaly in their infant should consider consulting with a qualified osteopathic practitioner as early as possible to discuss treatment options.

It is important to acknowledge that while paediatric osteopathic treatment is safe, there are some potential side effects. Parents should carefully consider these and discuss them with a qualified practitioner before making a treatment decision.

Further research is still needed to fully understand the long-term effects of osteopathic treatment for NSP and compare its effectiveness to other treatment options, such as helmet therapy. This research will help to inform clinical practice and ensure that infants with NSP receive the most appropriate and effective care.

While the existing literature provides a foundation for understanding the benefits of OMT, further research is essential to address the identified gaps, standardize treatment protocols, and ultimately enhance outcomes for infants affected by this condition.

As the field continues to evolve, a collaborative approach combining osteopathic principles with established care strategies may offer the most comprehensive solution for managing NSP.

Parents and healthcare providers should collaborate to make informed decisions about the best course of treatment for each infant with NSP. The treatment choice should be based on the severity of the condition, the presence of associated conditions like torticollis, and the availability of skilled paediatric osteopaths.

Osteopathy therefore offers a promising approach & a valuable treatment option that should be part of a comprehensive care approach.

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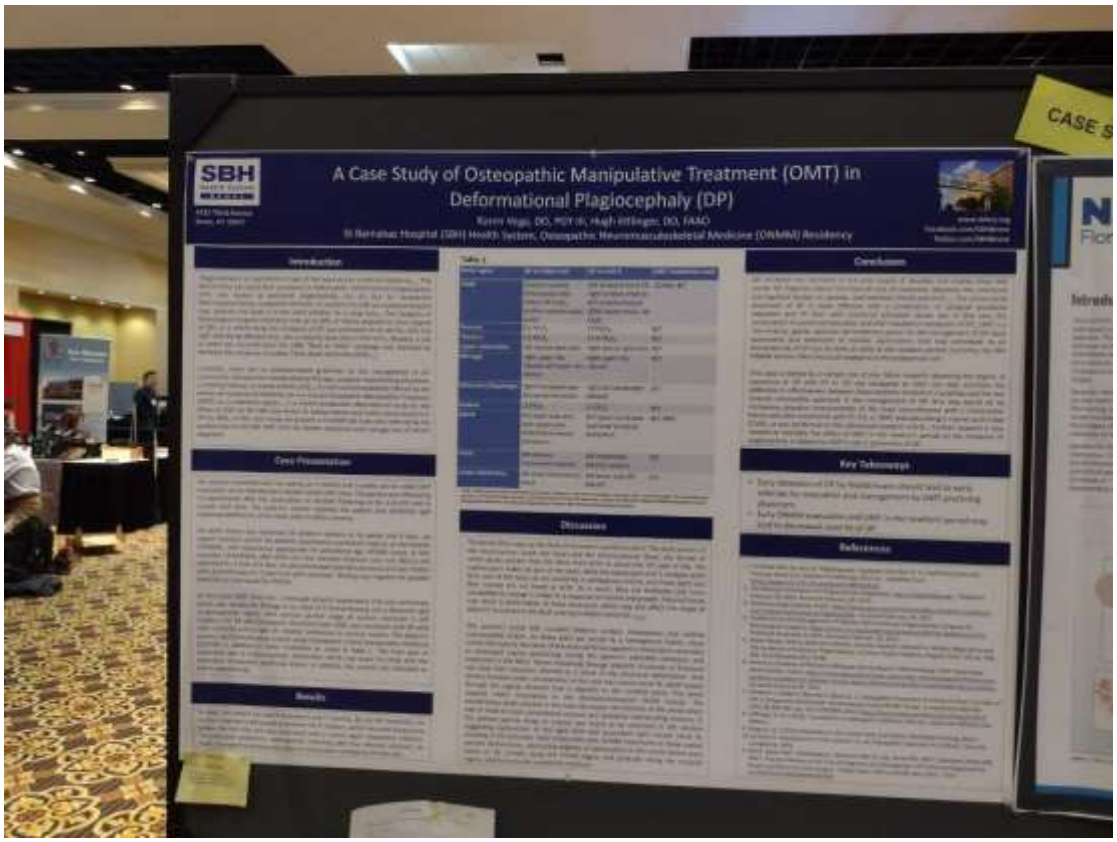
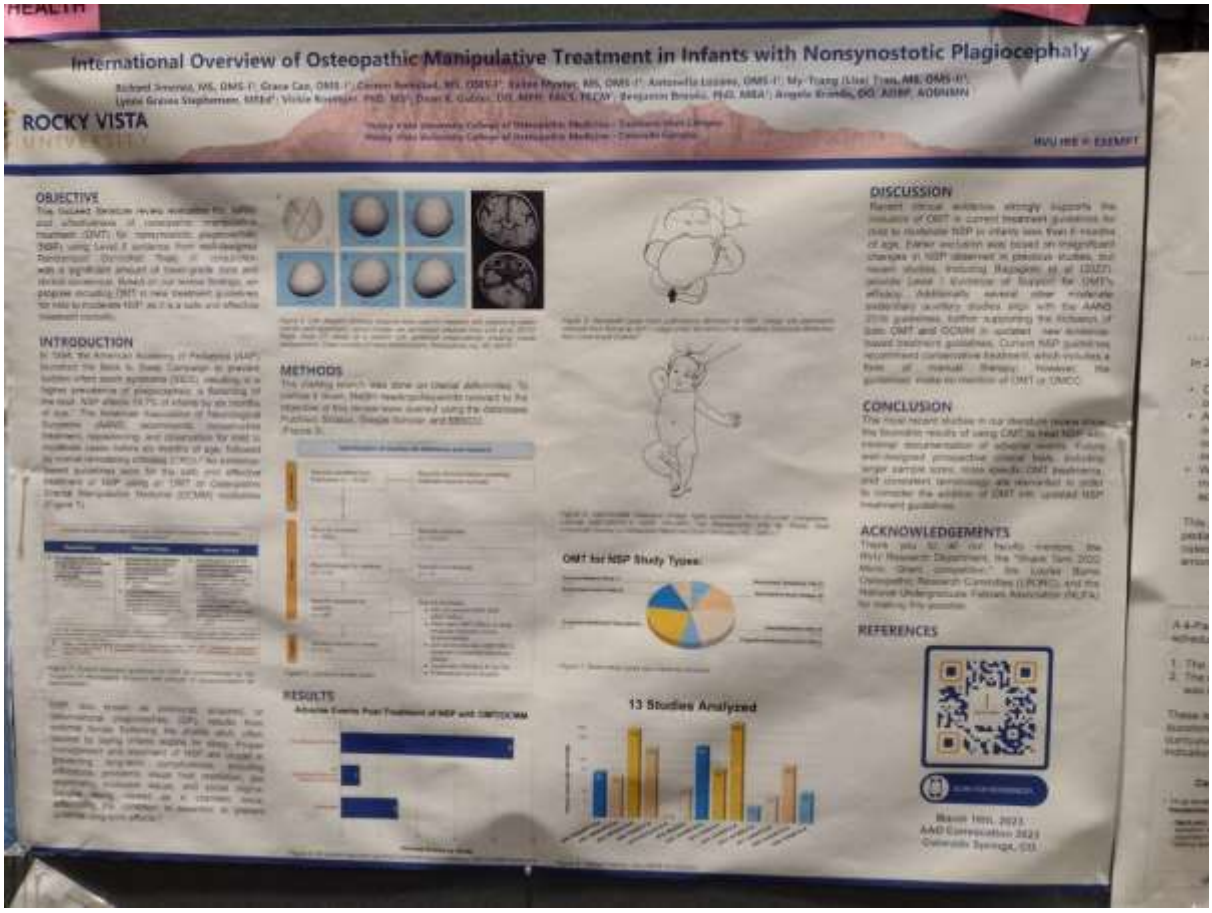
Poster Presentations:




International Overview of Osteopathic Manipulative Treatment in Infants with Nonsynostotic Plagiocephaly
ROCKY VISTA
OBJECTIVE
INTRODUCTION
METHODS
RESULTS
DISCUSSION
CONCLUSION
ACKNOWLEDGEMENTS
REFERENCES
OMT for NSP Study Types
13 Studies Analyzed

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Websites and Online Resources:

Several reputable websites and online resources provide valuable information on osteopathy for infants with NSP:

- Osteopathy's Promise to Children: This non-profit organization is dedicated to advancing the understanding and application of osteopathic care for children. They conduct Research, provide educational resources, and offer information on clinical trials related to osteopathic treatment for various paediatric conditions, including NSP.
- Osteopathic Healing Hands: This website offers comprehensive information on osteopathic treatment for various paediatric conditions, including plagiocephaly. It provides details on the benefits of osteopathy, the types of treatments used, and how to find a qualified practitioner.
- Osteopathic Center for Children: This organization is committed to providing high-quality education and training for osteopathic practitioners interested in treating children. They offer continuing medical education (CME) events and resources on various paediatric topics, including plagiocephaly.
- Cranial Technologies: This website focuses on the DOC Band, a cranial remoulding orthosis used to treat plagiocephaly. While not specifically focused on osteopathy, it offers valuable information on plagiocephaly treatment options and can be a helpful resource for parents considering different approaches.