Deformational plagiocephaly and chiropractic care: 
A narrative review and case report

By Jennifer L. Hash, DC
Jennifer L. Hash, DC, private practice, Lisle, Illinois, USA
Contact: jhashdc@gmail.com

ABSTRACT

An increase in deformational plagiocephaly has been noted since 1992, when the American Academy of Pediatrics began recommending infants be placed to sleep in the prone position, in an effort to decrease the number of Sudden Infant Death Syndrome (SIDS)-associated fatalities.1-5 Intrauterine constraint, late gestational age, birthing forces/trauma, and postnatal positioning also play a role in the development of this condition.4,6 Once believed to be a purely cosmetic problem, studies and reports are now linking deformational plagioccephaly to possible mental, psychomotor, or developmental delays, auditory processing disorders, strabismus, and mandibular asymmetry.1, 4, 6-12 Non-intervention, positional changes, physical therapy, cranial remodeling orthotics, and surgical procedures are traditionally utilized to treat this condition.7,12 A literature search was conducted using the Cochrane Library, UpToDate, PubMed, Science Direct, and the Index to Chiropractic Literature. Publications were included if they were systematic reviews, RCTs with a control group, or specifically related to plagioccephaly interventions. The intent of this case report is to describe the result of chiropractic care on a single patient with deformational plagioccephaly. No adverse effects were reported as a result of the therapy and the patient’s chief complaint of right-sided occipital flattening resolved completely during the course of treatment.

Introduction

After multiple international studies determined a direct relationship between placing infants in the prone position to sleep and the incidence of Sudden Infant Death Syndrome (SIDS),1,4,5 the American Academy of Pediatrics released a report recommending infants be placed supine when put to bed. Since the “Back to Sleep Campaign” began in 1992, the national SIDS rate has declined 40%,2 however, the incidence of deformational plagioccephaly has risen from 1 in 300 infants per year to estimates as high as 48% of infants under one year old.2,4 Other factors that are considered to contribute to the formation of deformational plagioccephaly include intrauterine constraint, birthing forces/trauma during delivery, and postnatal positioning of the infant.4,6

Deformational plagioccephaly, also known as positional, or nonsynostotic plagiocephaly, is a condition that describes changes in skull shape or symmetry.7 Postnatal positioning can play a role in the development of this condition. Tremendous growth of the brain and cranium occurs during the first weeks of life, yet weak cervical musculature will not allow the infant to actively reposition his/her own head at this time. If the child is placed in the same position for sleep, favors a certain side, or looks at stimuli while only in a certain position, this can culminate in deformational plagioccephaly of the malleable cranium, usually presenting by the fourth month of life.11 The deformity can be classified as brachycephaly, characterized by bilateral flattening of the posterior cranium, or plagiocephaly, characterized by unilateral occipital flattening. Unilateral asymmetry often presents with an accompanying hairless patch over the flattened area, anterior progression of the ipsilateral ear, and protrusion of the frontal bone on the affected side, resulting in a parallelogram-shaped cranium.7

It is important to differentiate deformational plagioccephaly from craniosynostosis or microcephaly since these conditions have very different neurological implications, which may require more aggressive intervention.8 Craniosynostosis involves deformation due to the premature closure of cranial sutures. Synostotic plagiocephaly results in the posterior progression of the ipsilateral ear, with contralateral frontal bone protrusion, typically resulting in a trapezoid-shaped cranium.13 Surgical correction is often necessary7 for craniosynostotic patients, as increased intracranial pressure and impairment in neurological development are likely to occur if the condition is left untreated.2 Microcephaly can follow any insult that disturbs early brain growth. It is typically diagnosed when head circumference is less than -2 SD14 from the normal range for the child’s age group. Referral to a chiropractic or pediatric neurologist, radiographs,14 or further imaging may be useful in identifying any structural causes of microcephaly. Targeted and specific genetic tests can be ordered when there is no clear evidence of an acquired or environmental etiology. Screening for coexistent conditions such as cerebral palsy, epilepsy, mental retardation, ophthalmologic disorders and sensory deficits may also be considered, depending on the individual presentation.14 Table 1 compares characteristics of each condition, which may be useful in determining the correct diagnosis. Figure 1 depicts an algorithm of appropriate diagnostic and treatment protocols for the plagiocephalic patient.
Table 1. Differential Diagnoses for Cranial Asymmetry

<table>
<thead>
<tr>
<th>Characteristic Effect(s) on Ears</th>
<th>Characteristic Effect(s) on Frontal Bone</th>
<th>Shape of Cranium from Superior View</th>
<th>Defining Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior migration of the ipsilateral ear with outward flaring</td>
<td>Minute to absent anterior protrusion on ipsilateral side; possible anterior protrusion on contralateral side</td>
<td>Parallelogram-shaped</td>
<td>May have accompanying hairless patch over area of flattening</td>
</tr>
<tr>
<td>Posterior migration of the ipsilateral ear</td>
<td>Sloped posteriorly, to varying degrees</td>
<td>Trapezoid-shaped</td>
<td>Palpable ridge may be present over lambdoid or occipitomastoid sutures</td>
</tr>
<tr>
<td>Normal position typically, may be low set or larger in size</td>
<td>Smaller than normal, with varying cranial asymmetries</td>
<td></td>
<td>Small, posteriorly-sloping forehead with hypoplastic cranium</td>
</tr>
</tbody>
</table>

Widely considered the least serious of the three conditions and sometimes thought of primarily as a cosmetic issue\(^7,8\) without neurological implications,\(^1\) the literature is now linking plagiocephaly to possible detrimental sequelae.\(^1,7-10,12-16\) The most evident effect, facial asymmetry, can incur emotional costs that must be considered.\(^9\) In addition, several studies have suggested that infants with positional plagiocephaly “may be at risk for a delay in the acquisition of certain motor skills.”\(^9\) The American Academy of Pediatrics reported increased rates of nonsynostotic plagiocephaly among children with developmental delay and/or neurological injury, although a causal relationship has not been defined.\(^10\) A study, using standardized mental and psychomotor developmental tests, showed that no infants affected by positional plagiocephaly scored in the accelerated range.\(^10\) It also suggested that affected infants were actually more likely to score in the mildly-to-severely delayed range on both outcome assessments.\(^10\) These delays during infancy may contribute to subtle developmental difficulties, which one study reported may present more commonly at elementary school age in affected children. Stallings et al also demonstrated an association between plagiocephaly and auditory processing disorders, mandibular asymmetry, and strabismus.\(^15\) Still others have said that the condition requires intervention, as it can worsen over time, resulting in cosmetic and neurological problems.\(^12,16\)

Many physicians adopt a “wait and see” approach for treating these patients, believing that the condition does not cause any long-term physical or cognitive problems.\(^7\) While it has been suggested that more than 70% of cases will spontaneously correct themselves,\(^1\) 10% of affected infants will demonstrate persistent cosmetic deformities.\(^5,8\) Flannery et al conducted a review of the literature and reported that the condition will worsen without intervention, with the possibilities of serious complications occurring as a result.\(^12\) Other studies have suggested a possible relationship between deformational plagiocephaly and decreased mental and psychomotor development,\(^10\) thus making proactive care an option, worthy of consideration across multiple health care disciplines.

There are several treatments currently being utilized for infants with deformational plagiocephaly. The use of physical therapy is quite common. This is especially important in cases where torticollis is present. Torticollis results when the sternocleidomastoid, trapezius, splenius capitis, scaleni, levator scapulae, semispinalis, or paraspinous erector trunci muscles become contracted.\(^17\) Congenital torticollis, which presents at birth, may be caused by factors such as intrauterine constraint, physical injury to the muscles during delivery, and subluxations of the upper cervical spine.\(^18,19\) Acquired torticollis typically presents within the first four to six months of life. It is associated with physical trauma to the cervical spine and musculature, sometimes resulting in atlantoaxial subluxation, infections, metabolic disorders, and syndromes with associated skeletal anomalies.\(^18\) A pseudotumor (palpable area of non-tender, fibrotic tissue and edema)\(^20\) may also be present within the musculature, particularly within the mid to lower portion of the sternal head of the SCM. These cases may present with more severe torticollis (deficits greater than 30° in cervical range of motion) that can be difficult to treat, sometimes requiring multiple approaches and even surgical release in some cases.\(^20\)

Despite the cause, the contracted musculature restricts range of motion, perpetuating the position of the head on
Figure 1: Algorithm for Treatment of Deformational Plagiocephaly/Cranial Asymmetry

Thorough case history and visual examination provide vital clues in diagnosing deformational plagiocephaly. Radiography and computed tomography (CT) scans are not typically utilized, due to the radiation exposure to the patient and occasional need to sedate the patient in order to obtain the views. These tools are reserved for further investigation in cases where the infant exhibits an atypical skull pattern, has a moderate to severe deformity, or fails to respond to care. If obscured sutures are found on x-

Neck exercises are often recommended. The parent is instructed to gently rotate the infant’s head toward the shoulder, hold for ten seconds, then repeat with the head rotated to the other side. The neck is then laterally bent and held for ten seconds on each side. The exercises should be performed at every diaper change and can be very effective, as one study found that one-half of the plagiocephalic infants improved with physical therapy alone.
Deformational plagiocephaly and chiropractic care: A narrative review and case report

Methods
A search of the literature was conducted using the key terms “deformational plagiocephaly,” “positional plagiocephaly,” “chiropractic and plagiocephaly,” and “torticollis,” using the Cochrane Library, PubMed, Science Direct, UpToDate, and the Index to Chiropractic Literature. Publications appraised included systematic reviews, randomized controlled trials, case studies, or those specifically related to plagiocephaly interventions. Literature published before 2002 was excluded in order to determine current trends in intervention for plagiocephaly. Twenty-three articles met this criteria. Other articles and resources were used to provide background information.

Case Report
Clinical Presentation
The intent of the case report is to describe the result of chiropractic care on a single patient with deformational plagiocephaly. A two-month old girl was brought into the Palmer Clinic by her parents, with the chief complaint of right-sided occipital flattening. They reported that the flattening began when the baby was approximately one month old and was gradually worsening. The infant was placed supine while sleeping, for approximately eight hours each night, and would nap lying supine in a swing for approximately three hours per day. The parents had tried placing the baby prone for “tummy time” and, while this would improve the occipital flattening, the baby would become angry and fussy so that she would only remain prone for several minutes at a time.

A comprehensive exam was performed by the student intern at the first visit. The mother reported that the baby was in the transverse position until the thirty-sixth week of gestation, when she turned head down. Delivery was induced at forty weeks and three days of gestation and an epidural was administered. The child was born twenty-three hours later, with Apgar scores of 8 and 9, and all vitals within normal limits. She was exclusively breast fed and had no difficulties with latching or suckling.

Visual examination of the patient showed noticeable flattening of the occipital bone on the right. The infant also had a small, hairless patch on the right, in the same region as the flattening. The right ear appeared more anterior and flared than the left ear. Readings of the Atlas fossae, located slightly inferior and anterior to the mastoid processes bilaterally, were taken with a DT-25 thermal instrument, as outlined in the Palmer College of Chiropractic Adjusting Technique Manual.23 This reading is of clinical significance to the chiropractic physician, as the corresponding body readings should be symmetrical. While less than one degree of asymmetry is considered normal, in certain cases, less than one degree can be clinically significant. Variations between bilateral areas of the body are indicative of differences in the underlying physiology and often correlate to levels of sympathetic nervous system dysfunction.23,24 There was a one degree differential in temperature between the right and left fossae of the patient.

A thorough chiropractic examination and orthopedic/neurologic assessment followed. The child’s length, weight, and head circumference were appropriate for gestational age. Perceived increased acetabular sponginess was found on the right when the child’s legs were raised, knees flexed, and a downward pressure was applied through the knees toward the acetabuli, in a procedure known as the acetabu-
lar pump. Barlow’s and Ortolani’s tests were performed to assess the stability of the hip joint. While supine, the child’s hips were flexed and her thighs were adducted, while a posterior and slightly lateral pressure was applied down the longitudinal axis of the femur. The motion of the femoral head during abduction of the thighs was then assessed. Both tests were negative for hip dislocation or instability so a modified version of the inverted heel swing was performed next.20 While being supported by her father, the child was inverted by her legs over a padded chiropractic adjusting table. While still being fully supported, the tension in each leg was released unilaterally for approximately 5-10 seconds, and the decreased ability of the child to rotate her head to the right was noted. This finding indicates possible somatic dysfunction along the ipsilateral side of decreased range of motion, commonly in the form of joint fixation in the upper cervical region, myospasm, and dural/fascial restriction.20

Motion palpation examination revealed decreased right posterior to anterior occipital glide as well as right lateral bending and rotation of C1. Accompanying muscle guarding was noted on the right at C1, along with increased tonicity of the right sternocleidomastoid and suboccipital muscles. Frontal and parietal bone overlapping was also noted bilaterally, with a palpable ridge along the coronal suture. All other vitals, reflexes, organ system examinations, infantile automatisms, and developmental assessments were within normal limits and appropriate for gestational age.

Intervention
The treatment schedule is summarized in Table 2. Cranial work was performed on various visits, as indicated. This consisted of decompression of the occiput, which was performed on the supine infant by applying a slight, postero-lateral tractioning force to the occipital bone and mastoid processes bilaterally, using the pads of the second through fourth digits. A frontal bone lift was also performed, using the pads of the second through fourth digits to apply a slight, anterosuperior tractioning force. The temporals were tractioned bilaterally, with a gentle anterior, inferior pull on the ear lobes. Chiropractic spinal manipulation was performed at C1 for a right lateral displacement with anterior rotation after decreased right lateral flexion and right rotation were found at that level through motion palpation of the atlantooccipital and atlantoaxial joints. Segmental dysfunction was assessed in a similar manner at each visit, with increased range of motion noted after specific spinal manipulations were performed when indicated, as summarized in Table 2.

To administer the manipulation, the infant was placed supine and a high-velocity, low amplitude (HVLA), modified toggle-like thrust was administered to the tip of the right transverse process of C1, using the tip of the third digit. The left hand was used to stabilize occiput and C2. Similar spinal areas were manipulated in recent studies by McWilliams and Gloar22 and Alcantara and Anderson; in the latter, a 3 month old girl was treated successfully for gastroesophageal reflux (GERD), nursing issues, torticollis, and plagiocephaly.21

The parents in this study were also instructed to perform the following home care daily: increase the baby’s amount of “tummy time” to at least thirty minutes per day, place a rolled washcloth behind her head on the right side while she was lying supine, and stretch the right sternocleidomastoid at every diaper change by gently rotating and laterally bending the child’s head to the left and holding for ten to twenty seconds. The parents were advised to bring the child in for adjustments every week for four weeks, but were unable to schedule the next appointment until two weeks later, due to the limited availability of appointments in the student clinic. They were able to schedule all other appointments as recommended and fully complied with the home care instructions as directed.

Outcomes
No adverse effects were reported by the parents or noted by the clinicians during the course of treatment. The patient was re-evaluated at the ninth visit, during the fourteenth week of treatment. Visual inspection of the child’s cranium and external ears revealed no abnormalities. All vitals, reflexes, organ system examinations, infantile automatisms, and developmental assessments were within normal limits and appropriate for gestational age. The infant was discharged to wellness care. A comprehensive physical examination six months later again revealed no cranial abnormalities or deficits in motor or neural development. The child is now five and has had no reoccurrence of plagiocephaly.

Discussion
Based upon visual assessment, the infant’s condition of positional plagiocephaly resolved within eight visits, over the course of 12 weeks. The management plan was designed to span four months, with weekly visits for the first month and bi-weekly visits for the remaining three months. A four month interval for treatment was chosen, as most studies indicated resolution of the condition within three to four months.10,17 The weekly frequency was recommended for the first month in order to closely monitor the progression of the condition. Once it was determined that the child’s plagiocephaly was improving, a bi-weekly recommendation was advised. It was determined after eight chiropractic visits that the child had achieved full resolution of the condition. The length of time until resolution was two weeks before the estimated date and the comprehensive re-evalu-
## Table 2: Summary of treatments and parent reports by week and visit number

<table>
<thead>
<tr>
<th>Visit</th>
<th>Parent Report</th>
<th>Motion Palpation Findings</th>
<th>Atlas Fossae Readings</th>
<th>Treatments</th>
</tr>
</thead>
</table>
| 1     | • “Flat head on right side”  
• Small “bald spot” over affected area | Pre ↓P-A Occipital glide  
↓Right lateral bend at C1  
↓Right rotation at C1  
Post ↑Occipital glide  
↑Right lateral bend at C1  
↑Right rotation at C1 | Pre Right: 94  
Left: 92  
Post Right: 93  
Left: 92 | • Occipital decompression  
• Frontal bone lift  
• Active right SCM stretch and myofascial release of diaphragm and abdomen  
• C1 manipulation (ASR)  
• Home care instructions, to be performed daily by parents |
| 2     | • Flattening is “getting better”  
• Infant slept “almost the whole day” after 1st visit  
• Tolerates “tummy time” for longer periods  
• Full compliance with home care instructions | Pre ↓P-A Occipital glide  
↓Right lateral bend at C1  
↓Right rotation at C1  
Post ↑Occipital glide  
↑Right lateral bend at C1  
↑Right rotation at C1 | Pre Right: 91  
Left: 92  
Post Right: 90  
Left: 90 | • Occipital decompression  
• C1 manipulation (ASRA)  
• Continue home care |
| 3     | • Flattening was “visibly improving”  
• Full compliance with home care instructions | Pre ↓Craniosacral rhythm  
C1 ROM unrestricted  
Post ↑Extension at L1  
↑and synchronous cranial rhythm | Pre Right: 81  
Left: 81  
Post N/A | • Occipital decompression  
• C1 manipulation not indicated  
• L1 manipulation (P)  
• Continue home care |
| 4     | • Flattening is “steadily improving”  
• Full compliance with home care instructions | Pre ↓Cranial rhythm at temporals  
C1 ROM unrestricted  
Post ↑ and synchronous cranial rhythm | Pre Right: 93  
Left: 93  
Post N/A | • Cranial work on the temporal bone  
• C1 manipulation (ASR)  
• Continue home care |
| 5     | • Flattening has “vastly improved”  
• Full compliance with home care instructions | Pre ↓Cranial rhythm at temporals  
↓Right lateral bend at C1  
Post ↑ and synchronous cranial rhythm  
↑Right lateral bend at C1 | Pre Right: 91  
Left: 90  
Post Right: 90  
Left: 90 | • Cranial manipulation not indicated  
• Myofasical release  
• Continue home care |
| 6     | • Flattening is “only slightly visible”  
• Full compliance with home care instructions | Pre ↓Extension T12  
C1 ROM unrestricted  
Post ↑Extension T12 | Pre Right: 80  
Left: 80  
Post N/A | • C1 manipulation not indicated  
• T12 manipulation (P)  
• Continue home care |
| 7     | • Flattening appears to be “resolving”  
• Full compliance with home care instructions | Pre ↓P-A Occipital glide  
↓Left lateral bend at C1  
↓Right rotation at C1  
Post ↑Occipital glide  
↑Left lateral bend at C1  
↑Right rotation at C1 | Pre Right: 88  
Left: 89  
Post Right: 88  
Left: 88 | • C1 adjustment (ASLP)  
• Continue home care |
| 8     | • Flattening seems to have “resolved”  
• Full compliance with home care instructions | Pre ↓Left lateral bend at C1  
↓Right rotation at C1  
Post ↑Left lateral bend at C1  
↑Right rotation at C1 | Pre Right: 90  
Left: 89  
Post Right: 90  
Left: 90 | • C1 adjustment (ASLP)  
• Continue home care  
• Reevaluation scheduled for next visit rather than 10th visit |
| 9     | • Flattening is “still gone”  
• Full compliance with home care instructions | N/A | N/A | • Child discharged to wellness care per resolution of chief complaint |
A limitation of the study was the use of visual observation as a subjective outcome assessment. Methods including calipers, photographs, articulated rulers, manual tracings of molded head shape impressions, elastic/thermoplastic bands, radiographs, CT scans, and MRI have been used to more accurately assess and follow the deformity over time.11,12 As the student clinic was not equipped with such measurements, and since the diagnosis of deformatinal plagiocephaly is typically made on the basis of a thorough history and physical exam findings2,5,6,11 the use of visual inspection was used as the main outcome assessment in this case.

Motion palpation findings were also used to determine areas of somatic dysfunction. Wolff identifies the atlantoaxial subluxation as a cause of torticollis,19 which often accompanies somatic dysfunction. The intern noted increased range of motion post-manipulation. Improving the range of motion at the joint and decreasing tension within the surrounding musculature may have contributed to the resolution of this patient’s symptoms. This finding would be consistent with Persing’s observation of improvement of the condition with restoration of cervical range of motion.15 Although chiropractic spinal manipulation was utilized as the main treatment for this patient, it cannot be ignored that the use of physical therapy, active counter-positioning, and increasing the amount of prone “tummy time” may have contributed significantly to the resolution of the infant’s positional deformity as well.26,27

Conclusion
Primary health care professionals can focus on preventing the development of positional plagiocephaly through the education of parents28 and the full compliance of the parents, in this case, may have been a significant factor in the child’s recovery. Parents should also be advised to place the infant in alternating positions while lying supine, and to put the infant in the prone position for “tummy time” while he/she is awake and being observed. The infant’s orientation to outside activity/stimulation could also be alternated in order to prevent the development of positional preference. The infant can be fed or nursed from alternating sides and parents should also limit the amount of time the infant lies prone in car seats, swings, bouncers, or jumpers.5 If plagiocephaly has already developed, the same strategies can minimize its progression.2

For this specific patient, chiropractic care provided a successful resolution of the condition. While this finding is in accordance with the results of other case reports,10,17,21,22 the actual research on the effect of chiropractic care on plagiocephaly is scant and conflicting.29 Further research and investigation into this topic should be pursued to produce evidence for chiropractic care as an alternative, if not adjunct therapy for deformatinal plagiocephaly.

Acknowledgement
I would like to acknowledge Cherie Marriott, DC DICCP and Pamela Gindl, DC DICCP for their personal guidance and hands-on support.

References


