Positional plagiocephaly: an analysis of the literature on the effectiveness of current guidelines

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Object. Positional plagiocephaly (PP) has been on the rise in recent years. In this review, the authors' aim was to assess the effectiveness of current recommendations to parents on this exceedingly common problem through a comprehensive literature search. Additionally, the current treatment options and the most recent studies on PP are reviewed.

Methods. A search of the existing literature was conducted to obtain all relevant studies on guidelines, recommendations, parental and clinician practices, and epidemiological aspects.

Results. Although the incidence and risk factors for PP have been well delineated, there continues to be debates on its management and association with developmental delays. Current guidelines and recommendations on prevention set by the American Association of Pediatrics may not be easily followed by both parents and clinicians. There is also evidence that certain populations, including those with lower education, socioeconomic status, and in particular geographic regions may be more affected by the condition. Additionally, the marketing and financial aspects of PP treatments exist and should be addressed.

Conclusions. Better awareness and education are necessary to inform the population as a whole, although certain populations should be given special attention. Additionally, current guidelines and recommendations can be modified to foster a better grasp of the condition by both parents and clinicians. Adjusting current recommendations, introducing initiatives, and offering elaborate educational campaigns would help deliver these aims. Educating parents on PP as early as possible through clearer guidelines and close monitoring is central to preventing and managing this common condition.

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KEY WORDS • positional plagiocephaly • deformational plagiocephaly •
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ASYMMETRICAL deformity in an infant's cranium is referred to as plagiocephaly, a condition that has been on the rise over the past few decades following the recommendation to place infants in a supine sleeping position.^{15,66} This term can be used to describe asymmetry in the skull resulting from both nonsynostotic and synostotic causes, or primary premature suture closure, which is much rarer.³⁹ Positional plagiocephaly (PP), also referred to as deformational plagiocephaly, occurs in the absence of suture synostosis and is due to external forces that deform the shape of the skull; forces such as those present when infants are placed supine.¹⁵ In this condition there is flattening of one side of the occiput, with anterior

displacement of the ipsilateral ear. The region of occipital flattening relates to the side that the head is toward when in the supine sleeping position.⁵ Prior to the American Academy of Pediatrics (AAP) "Back to Sleep" (BTS) campaign, the incidence of PP was relatively low.⁴⁵ Following this recommendation there was a gradual rise in its incidence, making it currently an especially common presentation at physicians' offices.

Considering the alarming increase in the incidence of PP, there has been much interest in investigating, managing, and preventing this condition. Figure 1 outlines the increase in publications concerning the deformity over recent decades.

Our aim, through a comprehensive literature search, was to assess the impact and effectiveness of the current guidelines and recommendations to parents. In addition, we reviewed current treatment options and we provide an update on the most recent studies regarding managing and preventing PP.

Abbreviations used in this paper: AAP = American Academy of Pediatrics; BTS = "Back to Sleep"; PP = positional plagiocephaly; PT = physical therapy; RCT = randomized controlled trial; SIDS = sudden infant death syndrome; TT = "Tummy Time."

Fig. 1. Graph showing number of publications concerning plagiocephaly between 1974 and the present. Note the increase beginning in 1996, a few years after the “Back to Sleep” campaign began.

Methods

A search on the National Library of Medicine search engine, PubMed, was conducted using the following terms: “positional plagiocephaly,” “deformational plagiocephaly,” “plagiocephaly guidelines,” “plagiocephaly recommendations,” and “plagiocephaly epidemiology.” Relevant articles on PP that covered aspects of current guidelines and/or recommendations, parental or clinician practices, risk factors, socioeconomic factors, or that were epidemiological were selected. Additionally, the reference lists from these selected articles were examined for other relevant papers. Overall, 15 articles were found to be relevant and were examined closely to match the aims of this review.

At the same time, previously published systematic reviews on the topic were used in reviewing current treatment options. Clinical studies in which there was a high level of evidence, as alluded to by evaluating these systematic reviews, were selected and reviewed. Additionally, we sought to provide an update on the most recent studies since the last systematic review. Studies that were published afterward were obtained based on a search with these terms: “positional plagiocephaly” and “deformational plagiocephaly.” Clinical reports in which there was new and/or relevant information on the current status of the condition were chosen and are reviewed here.

Results

General Considerations and Factors

Positional plagiocephaly is a common diagnosis. The incidence of PP varies with infant age, with an incidence of 19.7% at its peak and 3.3% at its lowest.^{15,27} Misdiagnosis is common and the condition may be confused with lambdoid synostosis. Therefore, a detailed examination of the infant’s cranium is necessary. The risk factors for PP are numerous; they include both prebirth and postbirth

causalities.^{15,65,68} Most significant are supine sleeping and congenital torticollis. Mostly recently, controversy over whether the deformity is associated with lower developmental abilities has sparked multiple debates.^{39,54}

Guidelines and Recommendations

In 1992, the AAP announced their recommendation of placing infants on their backs while asleep to combat the risk of sudden infant death syndrome (SIDS).^{1,36} Within a few years of this “Back to Sleep” campaign, as it became known, what had been a relatively uncommon diagnosis rapidly began to increase in incidence. There was a dramatic increase in publications concerning PP shortly after this recommendation (Fig. 1). Studies began to emerge on the effect of this new sleeping position on infant milestones.^{17,19,36,41,58} The AAP’s “Tummy Time” (TT) recommendation to parents was intended to decrease the likelihood of both skull deformation and lag in developmental skills. This called for placing infants on their stomachs while awake and overseen by the parent. The guideline was bolstered by multiple studies,^{9,48,54,68} although the potential difficulty in orchestrating it among both parents and clinicians was highlighted by others.^{10,17,36,68}

Socioeconomic and Environmental Considerations

The perception of a “normal” head shape can depend on many factors, including family opinion, cultural background, ethnicity, genetic makeup, and different time periods.^{3,6,23,39,51} Some reports have pointed to poor knowledge and awareness of the condition in parents with lower education levels.^{9,60,68} There is also a question of whether some parents may be refusing recommendations because of misconceptions.^{10,17,68} Another study investigated the rise in PP incidence in the state of Texas for a significant number of years following the 1992 recommendation and found that it was mainly attributed to an increase in the number of referrals, although the reason for that increase could only be speculated upon.⁶⁰ Last, the publicity about

Positional plagiocephaly guidelines analysis

the condition and marketing of its treatments, particularly cranial orthoses, cannot be denied.⁵⁴

Update of the Recent Literature

Four systematic reviews on the condition have been published,^{5,20,39,54,70} with the last one covering the literature up until the early part of 2011.^{20,39} These evidence-based studies report on the current situation of management through a number of quality studies (Table 1), although there is a scarcity of randomized controlled trials (RCTs). The literature continues to reflect the high interest in this topic among various pediatric and craniofacial circles. Since then, many new clinical studies have been added to the literature, including 1 prospective clinical trial.⁸ Table 2 lists 2 previous studies detailing surgical aspects specifically of PP. We reviewed a number of these newer studies in our update (Table 3).

Discussion

Extent of the Problem

The current incidence of PP is estimated at 8.2%, with variations according to infant age.^{7,34} Its frequency is significant at the age of 6 weeks, with estimates of 16%; it peaks at 4 months with 19.7%, and then declines gradually at the age of 2 years to 3.3%.^{15,27} These estimates are closely related to the infant's development. The first weeks of life are accompanied by poor head positioning, worsening PP,⁴¹ followed by a period of normal development during which the head shape slightly improves. During the subsequent stage the infant is not able to prop the rapidly growing head on his/her own until age 4 months, which corresponds to the peak (19.7%) at this time. The frequency of PP then begins to level down, with a normalization in shape by 6 months as the infant gains active control of the head.^{39,44} Unfortunately, there has been an accompanying false increase in the rate of synostotic plagiocephaly due to misdiagnosis and a lack of ability to differentiate the 2 conditions, leading to unnecessary referrals.²⁶

Craniosynostosis is an important differential diagnosis, particularly the lambdoid type. Though relatively infrequent, it characteristically presents with bossing in the occipitomastoid region and posterior shifting of the ear.¹⁵ A palpable bony elevation along the lambdoid suture is also usually present.³³ Additionally, bilateral coronal synostosis has the potential to present with brachycephaly.⁶ A thorough physical examination can distinguish between the 2 entities in almost all cases. In rare instances when the diagnosis remains indeterminate, skull imaging studies may be helpful to rule out this more serious condition and to initiate surgical intervention. More importantly, referral to a neurosurgeon and/or a craniofacial clinic is warranted.

Established Risk Factors

Aspects that increase the likelihood of PP have been well delineated and include supine sleeping, bottle feeding, male sex, congenital torticollis, being awake fewer than 3 times a day (so-called tummy time), and lower

activity level.^{15,27,68} Other studies have proposed obstetric concerns such as constraints of the birth canal on first-born babies, prolonged labor, breech position, assisted deliveries, intrauterine restrictions, and plural births.^{39,54,63} The impact of supine sleeping position on PP is best illustrated by the AAP's 1992 recommendation for infants to sleep on their backs.¹ This BTS campaign decreased the incidence of SIDS by more than 40%, but increased consultations for PP by 600%.^{2,39,48} In terms of neck problems, torticollis is the most common associated abnormality and most likely occurs prior to the formation of PP.^{39,57} It has been estimated to occur in up to one-sixth of infants and to be highly underdiagnosed.^{39,65} The issue of torticollis needs to be recognized early and managed as a distinct entity because it has major repercussions on PP development and treatment.

The evidence circulating about the lower activity level and developmental delays and its association with PP is controversial.^{39,54} Previously, nonsynostotic plagiocephaly was acknowledged to be unrelated to abnormal neurological development.^{39,46} More recently, however, studies have built a possible association between disruptions in infant development and PP.^{10,21,28,30,63} Multiple reports over the past decade have pointed to links between PP and abnormal ophthalmological findings, auditory processing, and motor development.^{4,10,25,27,28,35,44,47,62,63,68} Two case-controlled studies, by Speltz et al.⁶³ and Fowler et al.,²¹ found significant variability in gross motor development and body tone. However, almost none of these studies account for sleep position and many have problems with their design, suggesting that there are probably other factors at play.^{53,54} With that being so, at this point the best recommendation for clinicians is to closely monitor their patients' neurological development.^{39,54}

Evaluating the AAP Guidelines

Both of the AAP's recommendations (BTS and TT) have profoundly impacted the plagiocephaly abnormality.^{1,36} With the BTS recommendation to prevent SIDS, a corresponding increase in PP frequency began to emerge, which in turn brought about the TT suggestion to parents.³⁶ Interestingly, at the same time, newer studies pointed out that since implementation of BTS recommendations and the resulting increase in supine sleeping, infant motor milestones began to be attained later.^{17,36,41} In a prospective study of 351 infants, it was found that prone sleepers achieved a number of motor milestones at an earlier age than supine sleepers, and another similar study reported similar lags in motor skills.⁴¹ However, in both studies supine sleepers eventually caught up in their motor development at latest follow-up. Multiple other analyses have also highlighted the influence of sleep position on infant motor performance.^{19,58} Dudek-Shriber and Zelazny¹⁹ determined that the time spent in the prone position while awake (or in TT) was directly correlated to earlier achievement of milestones, whether they were prone milestones, supine milestones, or sitting milestones. Importantly, as in previous reports,^{17,58} the authors called attention to infants who did not tolerate the prone position while awake and how it directed parents to discontinue the position.

TABLE 1: Summary of clinical findings and outcomes from 5 select studies analyzing repositioning, PT, and helmet therapy in the management of PP*

Authors & Year	Study Design, Yrs†	No. of Pts	Mean Age at Initiation of Therapy	Adverse Events	FU/Length of Tx (mos)	Main Outcomes
Hutchison et al., 2010	RCT, 2005–2008	rep 61; positioning wrap 65	10% <3 mos; 60% 3–6 mos; 30% 6–12 mos	none	17.1†	no difference in head symmetry btwn the 2 groups; most infants improved over the 12-mo period, w/ 80% having “good” improvement
Lipira et al., 2010	case-controlled study	rep 35; helmet 35	rep 4.8 mos; helmet 4.9 mos	NR	rep 5.2; helmet 3.1	through 3D asymmetry analysis, helmet Tx is statistically superior in improving head asymmetry compared w/ rep
van Vlimmeren et al., 2008	RCT, 2005–2006	PT 33; usual care 32	7 wks	none	FU at 6 & 12 mos	in PT group the risk for PP was reduced by 46% & 57% at 6 & 12 mos, respectively; NNT was 3.85 & 3.13, respectively
Plank et al., 2006	case-controlled study	rep 17; helmet 207	range 3–12 mos	none	4	96.3% of pts w/ helmet improved in 4 variables used to measure head symmetry; 30% of those w/o helmet Tx showed worsening in those same variables, & in those w/ improvement it was to a lesser extent than in the helmeted group
Graham et al., 2005 ²²	retrospective cohort, 1994–2001	rep 176; helmet 159	rep 6.6 mos; helmet 4.8 mos	none	rep 3.5; helmet 4.2	helmet Tx had a significantly greater reduction in diagonal difference than rep, & initiating helmet Tx earlier resulted in better outcomes

* FU = follow-up; NNT = number needed to treat; NR = not reported; pts = patients; rep = repositioning; Tx = treatment.

† Years the study was conducted or from which data were compiled.

‡ Mean age at last follow-up.

TABLE 2: Clinical findings and outcomes in 2 previous reports on surgical management of PP

Authors & Year	Study Design, Yrs*	Pts w/ Op Tx/ Total Cases	Mean Timing of Op (mos)	Op Techniques	Complications	FU	Main Outcomes
Marchac et al., 2011	retrospective cohort, 1992–2006	30/2363	20.2	“switch cranioplasty” (Group A), 180° occipital graft rotation (Group B)	dural tears (17%), venous sinus breaches (13%), epidural hemorrhage (3%)	“long term,” not specified	results ranged from poor to excellent; median of Group A was “good,” median of Group B “excellent”
David & Menard, 2000	retrospective cohort, 1981–1997	19/204	7.6	occipital craniectomy w/ lambdoid suture removal	NR	assessed at mean age of 7 yrs	1 pt had inadequate improvement in symmetry, the rest were deemed adequate & any remaining defects were unnoticeable

* Years the study was conducted or from which data were compiled.

TABLE 3: Literature review of the most recent studies centered on the PP deformity

Authors & Year	Study Design, Yrs*	No. of Participants	Mean Age, No. of Pts	Outcome Measures	FU (mos)	Main Outcomes
Collett et al., 2011	longitudinal study, 11-mo period	227 w/ PP; 232 w/o PP	assessments at 7 & 18 mos	toddler developmental outcomes	at 18 mos of age	toddlers w/ PP scored lower on development scales, although a causal relationship cannot be implied
Lennarsson, 2011	prospective pilot study, 2008–2009	59 infants adhering to nursing guidelines on PP prevention, 40 infants not adhering to all such guidelines	from birth to 6 mos	development of PP	at 6 mos	8.5% in guidelines group had persistent PP vs 25.6% in comparison group ($p < 0.05$); child health care nurses have a key role in preventing PP
Michels et al., 2012	retrospective, case-controlled study, 2003–2007	PP group: 75 moms w/ infants w/ PP; control group: 54 moms w/ infants w/o PP	NR	folic acid dosage & duration	NR	in PP group, 20% had used double the recommended dosage of folic acid, vs 6% in control group ($p < 0.05$)
Hutchison et al., 2012	longitudinal cohort study	126 w/ PP	<3 mos, 14 (11.1%); 3–5.9 mos, 75 (59.5%); 6–8.9 mos, 31 (24.6%); & 9–11.9 mos, 6 (4.8%)	incidence of developmental delays	12-mo FU, mean age 17 mos	30% had developmental delays initially, 42% at 3 mos, & 23% at 12 mos; mainly gross motor delays
Roby et al., 2012	cross-sectional analysis	1045 teenagers	15.7 yrs	prevalence of plagiocephaly & brachycephaly	NR	prevalence of plagiocephaly 1.1% & brachycephaly 1.0%; most infants outgrow the deformity w/o intervention
Collet et al., 2012	case-controlled	20 w/ PP, 21 controls	7.9 mos	brain vol & shape on MRI	NR	no difference in brain vol seen on MRI; infants w/ PP had asymmetry/flattening of posterior brain structures, cerebellar vermis, & corpus callosum abnormalities
Seruya et al., 2013	retrospective study, 2009–2010	346 infants w/ PP: <20 wks, 26; 20–23.9 wks, 59; 24–27.9 wks, 82; 28–31.9 wks, 62; 32–35.9 wks, 45; 36–40 wks, 29; >40 wks, 43	see 3rd column	pre- & post-Tx symmetry improvement	variable	improvements in head shape w/ a molding helmet are better when initiated at an earlier age, although improvements can still be achieved at older ages
Cabrera-Martos et al., 2013	prospective clinical trial, 2009–2012	104 infants w/ PP	4.2 mos	improvement in PP deformity	15 mos	PT is effective in correcting plagiocephaly; molding helmet was more prevalent in those w/ severe deformity

* Years the study was conducted or from which data were compiled.

The second AAP guideline to parents (TT) called for a certain length of time for the infant to be awake in the prone position to prevent head distortion and improve motor development. At least 30 minutes of TT while awake can significantly diminish the predisposition for PP formation.^{48,54} Van Vlimmeren et al.⁶⁸ conducted a large-cohort study to analyze risk factors for PP in infants at 7 weeks of age. They found that fewer than 3 TT sessions per day, along with a poor attainment of motor milestones, had a significant association with PP. In a prospective and controlled study, Cavalier et al.⁹ investigated environmental factors on PP prevalence in 139 newborns. The intervention group in the study was instructed to alternate infant sleeping positions, to have prone position time while the infant was awake, to minimize time in car seats, and to promote an environment that allowed spontaneous movement. It was found that these practices decreased PP prevalence in the intervention group (13%) when compared with the control group (31%) ($p < 0.001$) at 4 months of age. It is difficult to ascertain from this or previous studies whether there is a direct causation of PP by poor motor development, or vice versa. It is important to highlight, however, that the report by van Vlimmeren et al. revealed significant findings related to a mother's educational level and its impact on PP. Mothers with low educational levels were more likely to offer TT for the first time at more than 3 weeks of age, more likely to position their infants on the same side during bottle feeding, and more likely to offer bottle feeding only. It is thus plausible that parents with low educational levels provide briefer and more infrequent TT to their children, decreasing position change and hindering motor growth, which in turn results in the PP abnormality.⁶⁸

In the most recent AAP recommendations for parents, the revised TT section advises that the practice should begin as early as possible and should increase in frequency and length with time.³⁶ Even though the recent guidelines provided suggestions on how to avoid head asymmetry and how to promote TT in infants, the recommendations still had ambiguities just like their predecessors.³⁶ Because there is evidence that some parents may be misconstruing the AAP's TT recommendation and others are completely unwilling to place their infants prone,^{10,17,68} parents should be clearly educated about PP, its causes, and possible effects. Koren et al.³⁶ attempted to investigate these glitches in communication and comprehension among both parents and clinicians, and their results were eye-opening. They found multiple obstacles for implementing TT including frustrated and unhappy infants, time limitations for the parents, and uncertainty regarding recommendations. Barriers cited by clinicians for educating parents about TT were emphasis on SIDS, time constraints, and also confusion. Additionally, Internet resources on the topic provided variable and unclear information. Their study determined that a surprisingly low percentage of mothers received information on awake TT both at the child's birth (55%) and at 2 months (26%), that most of the mothers (71%) practiced TT twice per day or less, and that more than half of the infants were in TT for 3–5 minutes or less. In fact, propping the infant in a supine position when awake was the most frequent finding. More resources should be used to prevent

development of this condition, especially in more affected populations.

Assessing the Effect of Socioeconomics and Geography

Cultural backgrounds and practices can influence what is deemed to be a normal head shape. In ancient periods and cultures, certain practices to deliberately deform an infant's skull were a norm and part of social status.^{3,39} Brachycephaly, the condition in which there is entire flattening of the occiput, is customarily found in many Asian countries where infants traditionally sleep in the supine position.^{23,39} The cephalic index, or the ratio of the width of the head to its length, has been reported to be as high as 91% in Japan's and Korea's schoolchildren. Conversely, in Nigeria, an infant's cephalic index can be as low as 75% because traditionally they are placed in the prone position for sleep.³⁹ Infant cephalic index in the US has seen a corresponding change from a mean of 78% in the 1970s to a range of 86%–88% in the 2000s as a result of changes in sleep position recommendations.^{23,39} Furthermore, it is imperative to compare an infant's head shape to that of his/her parents and to factor in the role of heredity along with environment during assessment.⁵¹

Sheu et al.⁶⁰ explored aspects involved in the 9-fold increase in plagiocephaly in Texas between 1999 and 2007. The prevalence of PP had increased an average of 21.2% per year, resulting in an incidence of 28.8 cases per 10,000 live births (up from 3 cases per 10,000 live births in 1999). These investigators found that the increasing trend was similar regardless of demographic factors such as maternal age, race/ethnicity, infant sex, and gestational age. However, the trend was greatest in mothers with less education ($p = 0.01$), as had been reported previously. The authors pointed out that the common assertion that the AAP's BTS campaign was responsible for the drastic increase during that period cannot be supported because their study was conducted more than 7 years after the introduction of BTS, although a minimal part of the increase could be due to delayed compliance. They attributed another small increase in incidence to an increase in preterm births. However, factors such as changes in birth defect coding, incidence of multiple births, torticollis, and oligohydramnios were ruled out. Interestingly, they noticed that major increases were seen mostly at certain self-prescribed "craniofacial clinics" or other similar specialized facilities. It is highly likely that these facilities fostered an increase in consultations and thus in diagnosis and treatment of PP. However, the increase in referrals could not be explained and could only be speculated on, with issues such as decision of the primary care physician, parental wishes, reimbursement incentives, and increased publicity about PP and its treatment options as probable reasons. Sheu et al. concluded that modifications in therapeutic options and insurance compensation policies could be likely to be contributing to the increased prevalence.

The preceding study brings into question 2 other important issues: 1) the marketing and financial aspects of PP treatments; and 2) the impact of income and race. First, the issue of increased publicity about PP and marketing of its therapies has its roots in 1998, when cranial orthoses became categorized as Class II devices by the FDA as a

Positional plagiocephaly guidelines analysis

result of petitioning by a commercial corporation, Cranial Technologies.⁵⁴ This forced independent orthotic specialists who had worked directly with pediatric neurosurgeons to provide inexpensive orthoses to those in need, to either contract with large companies, or to acquire their own FDA approval.⁵⁴ This, along with the sweeping marketing of therapies and the media coverage that ensued, created a massive rise in the cost of the orthoses and tremendous concern surrounding the condition on the part of parents. Unfortunately, the rise in cost caused many insured patients and those with Medicaid to lose coverage of these helmets for their children. Second, the issues of income and race have been well documented to be factors in limiting families from appropriately following the infant supine sleeping recommendations for prevention of SIDS.^{13,14} Barriers within low-income and African American populations have been cited as a cause and include absence of information or advice, receiving wrong advice, loss of trust in health care workers, apprehension about infant safety and comfort, and lack of knowledge about risks involved.¹⁴ It can only be assumed that these barriers are also applicable to recommendations on PP prevention such as TT. Furthermore, the study by Sheu et al. provides evidence for a need to concentrate efforts on another more endemically affected population, that in the Southern region of the US.

Current Treatment Options

Over the last decade there have been 2 RCTs and 4 systematic reviews that analyzed management of PP.^{5,20,28,39,54,67,70} For nonsynostotic plagiocephaly, treatment options include alternate head positioning, physical therapy (PT), and helmet therapy.¹⁵ A recent RCT determined that adding PT is superior to parental counseling on head positioning alone.^{15,67} Therapy with a molding helmet has also shown a significant improvement in skull shape, with 1 study indicating relative improvement in skull shape in comparison with repositioning therapy.^{15,22} Generally, mild disfigurement should be managed with repositioning techniques and PT, whereas helmet orthosis is reserved for more serious defects, especially lasting past the age of 6 months.⁵⁴

Because the conventional treatment of PP is multifaceted, the literature is vast but remains limited. In their retrospective cohort, Graham et al.²² reported on 176 infants treated with repositioning and 159 treated with a molding helmet. They found that the reduction in diagonal difference was better with orthotics than with repositioning (0.71 vs 0.55, $p < 0.0001$). Although treatment with a helmet required a longer time, the earlier it was initiated the more effective the outcomes were. In 2006, Plank et al.⁴⁹ reported on 207 helmeted infants, compared them with a control group of 17 infants, and determined that there was much greater deformity improvement with helmet therapy. More recently, Lipira et al.³⁸ reported on a study that used 3D imaging analysis on 35 helmeted infants compared with 35 repositioned infants, and found that the former group had a higher percent decline in head asymmetry (4% vs 2.5%; $p = 0.02$). In an RCT conducted in New Zealand, a total of 126 infants received either repositioning therapy alone or repositioning combined with a positioning wrap.²⁸ No difference was found in outcomes after 12 months of follow-

up, with 80% of infants displaying “good” improvement. In another RCT assessing the utility of PT, van Vlimmeren et al.⁶⁷ assigned 33 patients to PT and 32 to usual care. The PT group was determined to have a lower risk of PP at both 6 and 12 months (46% and 57%, respectively). These studies are summarized in Table 1.

The surgical management of PP is rare, and has even been criticized, because it is deemed to be unwarranted for PP treatment.⁵⁶ Because there is no evidence that it can cause elevations in intracranial pressure, and the association with delays in development is questionable at best, it leaves aesthetic considerations as the only reason to consider a risky surgery.⁵⁶ Others have pointed out that head asymmetry eventually improves with time and seldom worsens beyond 4 months,^{16,45,50,52,56,69} suggesting that watchful waiting rather than invasive surgery is a more reasonable option. However, the more recent evidence indicates that the deformity may not improve after 15 months of age,^{24,32,40,48,61,64} which brings to the table another highly controversial issue surrounding PP. Another argument proposed for surgical adjustment involved those who are referred at a later age when remodeling of the skull is no longer possible.¹⁸

An Update: Most Recent Studies

Since the last systematic review,^{20,39} multiple studies have been published on the subject (Table 3), reflecting the great interest in the topic in the pediatric, neurosurgical, and craniofacial worlds. Collett et al.¹² found that toddlers with a history of PP have developmental (motor, cognitive, and language) delays relative to those without such a history, although the investigators concluded that it does not imply a causal relationship. Furthermore, the reported developmental scores were still within the normal range, and long-term follow-up would be more beneficial.³¹ Along the same lines, Hutchison et al.²⁹ found that although patients with PP do have gross motor delays initially, when these patients are followed for a longer period the presence of these delays drops to expected levels. Roby et al.⁵⁵ explored the presence of PP and brachycephaly in teenagers born after the BTS campaign and found an overall prevalence of 2% for deformational abnormalities, suggesting that in most infants the deformity eventually resolves. A Swedish pilot study demonstrated a significant reduction in incidence when guidelines for PP prevention were followed by nurses (8.5% vs 25.6% incidence in the comparison group, $p < 0.05$), and concluded that applying simple strategies in child health care programs can help parents prevent PP.³⁷ A Dutch study investigated another potential factor to consider for PP that was also fueled by its own campaign over the past 2 decades: folic acid.⁴³ The study found that women whose infants had PP were more likely to have taken double the recommended dosage of folic acid during their pregnancy than those whose infants did not have PP (20% vs 6%, respectively; $p < 0.05$).

Conclusions

Positional plagiocephaly is a common condition in infants that has been rife with controversy in many of its

aspects including its natural history, the grading schemes assessing its severity, the value of its multiple treatments, the financial incentives and commercial parties involved, and doctor/parent understanding and implementation of preventive measures. These controversies are not expected to be resolved in the near future. Better awareness and education are necessary to the population as a whole, although certain populations such as lower socioeconomic and Southern populations should be given special attention. Additionally, current guidelines and recommendations can be modified to foster a better grasp of the condition by both parents and clinicians. Along with new initiatives and elaborate campaigns, educating parents on PP as early as possible is central to avoiding and managing this exceedingly frequent problem.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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Positional plagiocephaly guidelines analysis

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