



**Congress of  
Neurological  
Surgeons**

# **GUIDELINES**

**CONGRESS OF NEUROLOGICAL SURGEONS  
SYSTEMATIC REVIEW AND EVIDENCE-BASED  
GUIDELINE ON THE MANAGEMENT OF PATIENTS  
WITH POSITIONAL PLAGIOCEPHALY: THE ROLE OF  
PHYSICAL THERAPY**

***Sponsored by***

Congress of Neurological Surgeons (CNS) and the Section on Pediatric Neurosurgery

***Endorsed by***

*Joint Guidelines Committee of the American Association of Neurological Surgeons (AANS) and the Congress of Neurological Surgeons (CNS) and American Academy of Pediatrics (AAP)*

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**No part of this article has been published or submitted for publication elsewhere.**

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This clinical systematic review and evidence-based guideline was developed by a physician volunteer task force as an educational tool that reflects the current state of

knowledge at the time of completion. The presentations are designed to provide an accurate review of the subject matter covered. This guideline is disseminated with the understanding that the recommendations by the authors and consultants who have collaborated in its development are not meant to replace the individualized care and treatment advice from a patient's physician(s). If medical advice or assistance is required, the services of a physician should be sought. The proposals contained in this guideline may not be suitable for use in all circumstances. The choice to implement any particular recommendation contained in this guideline must be made by a managing physician in light of the situation in each particular patient and on the basis of existing resources.

## **ABSTRACT**

**Background:** Evidence-based guidelines are not currently available for the treatment of positional plagiocephaly and, in particular, for the use of physical therapy for treatment.

**Objective:** To answer the question: "Does physical therapy provide effective treatment for positional plagiocephaly?" Treatment recommendations are created based on the available evidence.

**Methods:** PubMed and the Cochrane Library were queried using MeSH headings and key words relevant to the objective of this systematic review. Abstracts were reviewed, after which studies meeting the inclusion criteria were selected and graded according to their quality of evidence (Classes I-III). Evidentiary tables were constructed that summarized pertinent study results, and recommendations were made, based on the quality of the literature (Levels I-III).

**Results:** Three studies met criteria for inclusion into the evidence table. Two randomized controlled trials (Class I and Class II) and 1 prospective study assessing plagiocephaly as a secondary outcome measure (Class III) were included.

**Conclusion:** Within the limits of this systematic review, physical therapy is significantly more effective than repositioning education as a treatment for positional plagiocephaly. There is no significant difference between physical therapy and a positioning pillow as a treatment for positional plagiocephaly. However, given the American Academy of Pediatrics' (AAP) recommendation against soft pillows in cribs to ensure a safe sleeping

environment for infants, physical therapy must be recommended over the use of a positioning pillow.

**Running Title:** Physical Therapy for Plagiocephaly

**Key Words:** infants; physical therapy; physiotherapy; plagiocephaly, non-synostotic; positional plagiocephaly

## RECOMMENDATIONS

1. Physical therapy is recommended over repositioning education alone for reducing prevalence of infantile positional plagiocephaly in infants 7 weeks of age.

Strength of recommendation: Level I (high clinical certainty)

2. Physical therapy is as effective for the treatment of positional plagiocephaly and recommended over the use of a positioning pillow in order to ensure a safe sleeping environment and comply with American Academy of Pediatrics recommendations.

Strength of recommendation: Level II (moderate clinical certainty)

## INTRODUCTION

Infantile positional plagiocephaly occurs as a result of persistent mechanical forces on the malleable bones of the neonatal cranium. Asymmetric parietooccipital flattening with ipsilateral frontal bossing will result in a parallelogram deformity of the head. Alternatively, central bioccipital flattening with an anterior-posterior foreshortened head is characteristic of deformational brachycephaly. Both shapes are a manifestation of the same process, and the appearance of an individual child will often be along a continuum from one type to the other. Facial asymmetry with misalignment of the eyes and/or ears and postural congenital torticollis with restricted range of cervical and head motion may accompany this condition.

An increase in the prevalence of positional plagiocephaly occurred after widespread implementation of the American Academy of Pediatrics' (AAP) "Back to Sleep" recommendation that healthy term infants be positioned on their sides or backs during sleep.<sup>1</sup> Although the optimal timing and modality of intervention has yet to be

clearly established, primary treatments for plagiocephaly are non-operative and include observation, counter-positioning, physical therapy, and orthotic devices.

The purpose of this systematic review is to address the question: “Does physical therapy provide effective treatment for positional plagiocephaly?”

## **METHODS**

The Congress of Neurological Surgeons (CNS) and the Section on Pediatric Neurosurgery initiated a systematic review of the literature and evidence-based guideline relevant to the management of positional plagiocephaly. Additional details of the systematic review are provided below and within the introduction and methodology chapter of the guideline.

### **Potential Conflicts of Interest**

All guideline task force members were required to disclose all potential conflicts of interest (COIs) prior to beginning work on the guideline, using the COI disclosure form of the Joint Guidelines Committee of the American Association of Neurological Surgeons (AANS) and the CNS. The CNS Guidelines Committee and guideline task force chair reviewed any disclosures and either approved or disapproved the nomination and participation on the task force. The CNS Guidelines Committee and guideline task force chair may approve nominations of task force members with possible conflicts and restrict the writing, reviewing, and/or voting privileges of that person to topics that are unrelated to the possible COIs.

### **Literature Search**

The task force collaborated with medical librarians to search PubMed and the Cochrane Library for the period from 1966 to October 2014 using the MeSH subject headings and PubMed search strategies provided in Appendix A. Manual searches of bibliographies were also conducted.

### **Article Inclusion/Exclusion Criteria**

The task force reviewed the titles and abstracts to identify studies addressing the effectiveness of physical therapy compared to other treatment modalities or no treatment

for positional plagiocephaly. Studies in which there was no comparison group (uncontrolled) were excluded. The authors reviewed articles that met these criteria, and appropriate studies were selected for inclusion into an evidentiary table.

## **Search Results**

The search returned 47 unique articles. Thirty-four were excluded based on a review of the abstract. Thirteen full-text papers were reviewed. Ten articles were rejected for the following reasons: lack of a comparison group,<sup>2-5</sup> potential significant degree of confounding introduced by co-intervention(s),<sup>2</sup> lack of assessment of physical therapy as an independent outcome measure,<sup>6-10</sup> and comparison to a commercially unavailable orthotic device<sup>11</sup> (Figure 1). Three articles satisfied the inclusion criteria for inclusion into the evidentiary table (Table 1).<sup>12-14</sup>

There were 2 randomized controlled trials (Class I and Class II)<sup>12,13</sup> and 1 small, prospective, randomized study assessing, but not statistically analyzing, plagiocephaly as a secondary outcome measure in both groups (Class III).<sup>14</sup> These included articles compared physical therapy to parental instruction on repositioning, use of a positioning pillow, and length of treatment time needed with therapist versus parental treatment.

## **DISCUSSION**

### **Physical Therapy vs Repositioning Education**

A prospective, randomized controlled trial performed by Van Vlimmeren et al randomly assigned 65 infants noted to have positional preference at 7 weeks of age to receive either physical therapy (n = 33) or “usual care” (n = 32).<sup>12</sup> Usual care consisted of providing the parents with written instructions on repositioning and tummy-time. The primary outcome for the study was severe deformational plagiocephaly as assessed by plagiocephalometry, with secondary outcome measures of positional preference, motor development, and cervical passive range of motion. The treatment group received a maximum of 8 sessions of a standardized pediatric physical therapy intervention program delivered by experienced physical therapists. The authors found a reduction in the risk of severe deformational plagiocephaly by 46% (relative risk, 0.54; 95% confidence interval, 0.30-0.98) in the physical therapy group at 6 months of age, and by 57% (relative risk

0.43; confidence interval 0.22-0.85) in the physical therapy group at 12 months of age. No significant differences in the secondary outcome measures were found.

The findings of Van Vlimmeran *et al.* support the recommendation to treat young infants close to 7 week of age with physical therapy over repositioning education alone. It is unclear from available literature, however, if this recommendation could be extended to children younger or older than 7 weeks of age at the time of initiating treatment.

### **Physical Therapy vs Repositioning Device**

Wilbrand et al<sup>13</sup> describe a prospective randomized controlled trial of 50 infants younger than 5 months with a diagnosis of positional plagiocephaly.<sup>13</sup> Twenty-five infants were randomized to treatment with a BabyDorm bedding pillow, and 25 infants underwent stretching exercises delivered by their parents 5 times per day. The parents in both groups were encouraged to provide adequate “tummy-time.” A single blinded examiner assessed anthropometric caliper measurements before and after 6 weeks of treatment. The children in both groups demonstrated improvement in head shape; however, no significant difference between treatment groups was found in children with plagiocephaly alone. In children with a combination of brachycephaly and plagiocephaly, improvement in cranial asymmetry was slightly improved in the pillow group. The short interval of treatment was selected by the authors in order to be able to offer orthotic treatment to those infants who failed either of the study interventions provided. This short treatment time limits the ability of this study to assess for any long-term differences between the treatment modalities, leading to the downgrading of the evidence to Level II.

While both treatment groups demonstrated improvement and no significant complication was described, the use of the bedding pillow conflicts with the AAP’s recommendation to avoid such soft bedding items in an infant crib in order to provide a safe sleeping environment.<sup>1</sup> The guidelines committee therefore recommends physical therapy as the preferred and safer treatment modality when considering these two options (Level II).

## **Physical Therapy vs Orthosis**

No papers comparing helmet therapy to physical therapy in children with plagiocephaly met inclusion criteria. Rogers et al describe a Class III study using a non-helmet orthotic not currently commercial available (modifiable cranial cup) as a treatment for positional plagiocephaly (n = 23) in comparison to repositioning and physical therapy with parental cervical stretching (n = 28).<sup>11</sup> The orthotic used in this study is unique and not commercially available; therefore, this study was excluded from the evidence table. The treatment group was prospective and nonrandomized. The control group was historical, with parents instructed in repositioning and cervical stretching techniques. Anthropometric caliper measurements were taken before and after treatment. The infants were treated for a mean of 56.3 days in the treatment group and 61.6 days in the control group. The mean transcranial difference decreased from 11.2 to 3.5 mm in the treatment group and from 9 to 8 mm in the control group, and the authors conclude that the cranial cup is significantly more effective for correcting positional plagiocephaly than physical therapy and repositioning. This study is limited by a possible treatment bias, as the pre-treatment plagiocephaly was more severe in the treatment group. Physical therapy is also not assessed as an independent variable, and no information is given on whether parents in the control group chose to use other commercially available positioning devices or orthotics. The available literature fails to adequately assess for any superiority over physical therapy vs orthosis as a primary treatment for plagiocephaly.

A 2010 study by Ohman et al assessed the efficacy of physical therapy as performed by educated parents or by a physical therapist in patients with congenital muscular torticollis.<sup>14</sup> Plagiocephaly was present in 18 out of 20 study participants and was assessed as a secondary outcome measure. Plagiocephaly improved in both groups. One patient in the parent group crossed over due to severe plagiocephaly. No assessment of statistical significance of the plagiocephaly outcomes was given. The authors of this study conclude that experienced physical therapists can achieve faster results than parents and suggest that severe plagiocephaly in an infant with CMT could be an indicator for a physical therapist to perform the stretching exercises in order to optimize skull symmetry.

Papers describing efficacy of physical therapy as a treatment modality yet failing to control for physical therapy as an intervention were excluded from the evidentiary table. These studies include a 2014 retrospective analysis by van Wijk et al and a prospective observational study from 2013 by Cabrera-Martos et al. Van Wijk et al describe 657 infants between 2 and 4 months with positional preference and skull deformation who were assessed for characteristics related to physical therapy treatment efficacy.<sup>3</sup> A good response to physical therapy was demonstrated by 55.4%, and 44.6% demonstrated a poor response. The authors conclude that a poor response to physical therapy is predicted by starting physical therapy late (after 3 months of age), by a significant initial skull deformation, or by low parental satisfaction score at the start of therapy. No control group for physical therapy treatment was assessed. Cabrera-Martos et al studied 104 infants with mild, moderate, and severe plagiocephaly treated with non-surgical interventions.<sup>2</sup> All study participants were treated with physical therapy and no control group was assessed. Additionally, 36.5% of the infants were also treated with cranial orthotics concomitantly to physical therapy. The authors conclude that physical therapy is effective for correcting plagiocephaly and note that the severity of the plagiocephaly should be taken into account when designing the physical therapy program.

## **RECOMMENDATIONS**

1. Physical therapy is recommended over repositioning education alone for reducing prevalence of infantile positional plagiocephaly in infants 7 weeks of age.

Strength of recommendation: Level I (high clinical certainty)

2. Physical therapy is as effective for the treatment of positional plagiocephaly and recommended over the use of a positioning pillow in order to ensure a safe sleeping environment and comply with American Academy of Pediatrics recommendations.

Strength of recommendation: Level II (moderate clinical certainty)

## CONCLUSION

This systemic review demonstrates physical therapy to be an effective treatment option for positional plagiocephaly. Class II evidence suggests physical therapy to be a superior treatment modality to repositioning in cases of severe plagiocephaly, and an equivalent treatment modality to a positioning pillow. *The AAP recommends against the use of soft positioning pillows in the sleeping environment of an infant; therefore, the plagiocephaly guidelines committee recommends using physical therapy over positioning devices.* Class III evidence suggests that physical therapy performed by a professional physical therapist can lead to more results over a shorter treatment time, and thus be more appropriate in the setting of severe plagiocephaly.

Limited data is available to fully assess the efficacy of physical therapy as a primary treatment for positional plagiocephaly. The ideal timing for initiation of therapy, duration of treatment, and type of physical therapy stretches and/or exercises cannot be determined from the available literature. Additional prospective studies evaluating the timing of initiation of physical therapy, duration of treatment, and specific type of physical therapy are needed.

## ACKNOWLEDGMENTS

The authors acknowledge the Congress of Neurological Surgeons Guidelines Committee for their contributions throughout the development of the guideline, the American Association of Neurological Surgeons/Congress of Neurological Surgeons Joint Guidelines Committee for their review, comments, and suggestions throughout peer review, as well as Pamela Shaw, MSLIS, MS, and Mary Bodach, MLIS, for their assistance with the literature searches. Throughout the review process, the reviewers and authors were blinded from one another. At this time, the authors would like to acknowledge the following individual peer reviewers for their contributions: Sepideh Amin-Hanjani, MD; Maya Babu, MD; Kimon Bekelis, MD; Faiz Ahmad, MD; Daniel Resnick, MD; Patricia Raksin, MD; Jeffrey Olson, MD; Krystal Tomei, MD.

## Disclosures

These evidence-based clinical practice guidelines were funded exclusively by

the Congress of Neurological Surgeons and the Section on Pediatric Neurosurgery of the Congress of Neurological Surgeons and the American Association of Neurological Surgeons, which received no funding from outside commercial sources to support the development of this document. The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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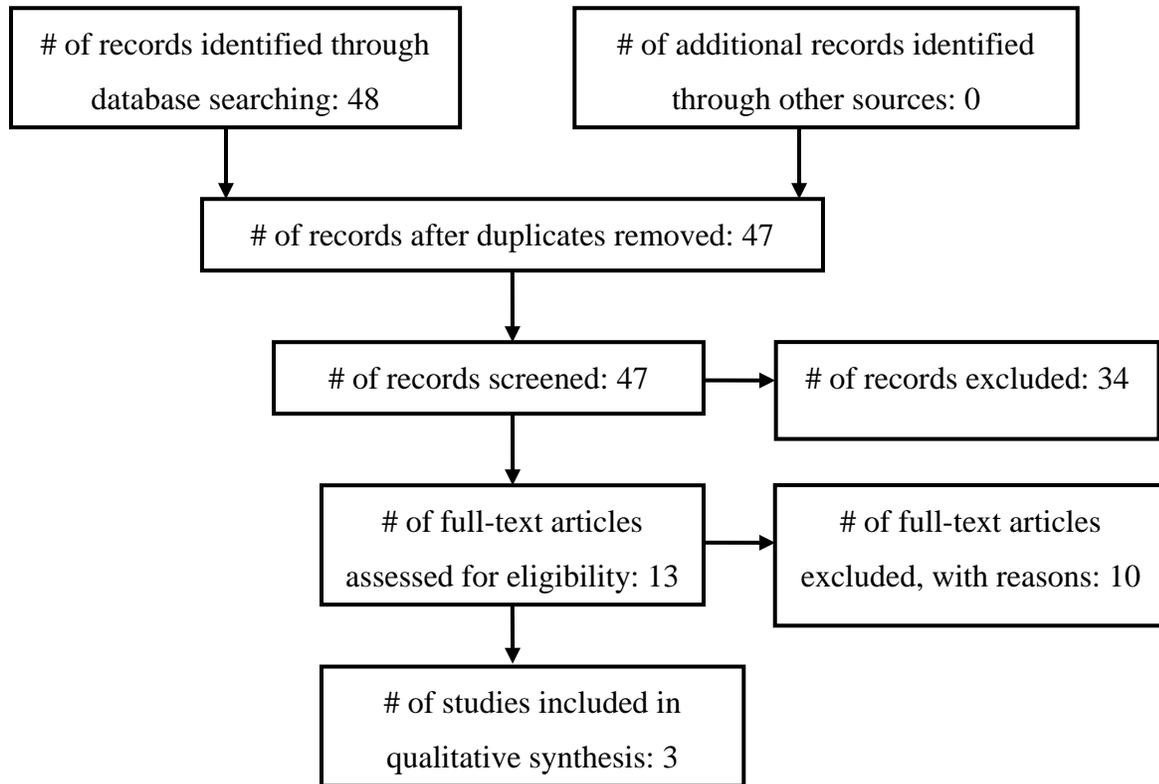
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**Table 1: Evidentiary Table**

<b>Author</b>	<b>Title</b>	<b>Study Description</b>	<b>Data Class, Quality and Reasons</b>	<b>Results and Conclusions</b>
van Vlimmeren et al, 2008	Effect of pediatric physical therapy on deformational plagiocephaly in children with positional preference: a randomized controlled trial	Analysis of 68 infants, age 7 weeks, randomized into physical therapy group or “usual care” group. Usual care = parents given pamphlet on repositioning and tummy-time.	Class I: RCT	<p>PT group demonstrated significant decrease in the risk for severe DP at 6 months (relative risk, 0.54; 95% confidence interval, 0.30-0.98) and 12 months (relative risk, 0.43; 95% confidence interval, 0.22-0.85) compared to control group.</p> <p>PT is more effective for preventing severe plagiocephaly than educating parents on repositioning and tummy-time.</p>
Wilbrand et al, 2013	A prospective randomized trial on preventative methods for positional head deformity: physiotherapy versus a positioning pillow	Analysis of 50 infants, mean age 4 months, randomized to PT or use of a positioning pillow.	<p>Class II: RCT</p> <p>Short treatment time (6 weeks) limits assessment of long-term efficacy between modalities</p>	<p>Both treatment groups demonstrated significant improvement in head shape. There was no significant difference between treatment groups for plagiocephaly. There was a slightly significant greater improvement in pillow group for treatment of combined plagiocephaly and brachycephaly.</p>

<b>Author</b>	<b>Title</b>	<b>Study Description</b>	<b>Data Class, Quality and Reasons</b>	<b>Results and Conclusions</b>
Ohman et al, 2010	Stretching Treatment for Infants with Congenital Muscular Torticollis: Physiotherapist or Parents? A Randomized Pilot Study	Analysis of 20 infants with congenital muscular torticollis, mean age 2.1 months, randomized to PT administered by parents or therapist.	Class III: plagiocephaly assessed as secondary outcome, statistical significance not assessed	Plagiocephaly present in 18 out of 20 study participants. Improvement occurred in both groups and statistical significance was not assessed. Physical therapists achieved greater improvement of CMT in a shorter period of time, suggesting optimal choice for a patient with severe plagiocephaly.

**Figure 1 Flow diagram showing the selection of studies for inclusion in the systematic review**



## APPENDIX A

### Search #1 – Medline plagiocephaly

#### Root Search:

1. "Plagiocephaly, Nonsynostotic"[Mesh terms]
2. "nonsynostotic plagiocephaly" OR "Positional plagiocephaly" OR "deformational plagiocephaly" OR "flat head"
3. 1 or 2

#### Terms specific to physical therapy

4. 3 AND “physical therapy” OR “physical therapy modalities”[Mesh terms]

Limits: “NOT animals”, English language, NOT Comment[publication type], NOT Letter [publication type]

### Search #2 – Medline Brachycephaly

#### Root Search:

1. brachycephaly[tiab] OR brachiocephaly OR brachycephalic[tiab] OR brachycephalies[tiab]

#### Terms specific to physical therapy

2. 1 AND “physical therapy” OR “physical therapy modalities”[Mesh terms]

Limits: “NOT animals”, English language, NOT Comment[publication type], NOT Letter [publication type]

### Search #3 – Cochrane brachycephaly and plagiocephaly

#### Search Strategy:

1. MeSH descriptor: [Plagiocephaly, Nonsynostotic] explode all trees
2. Title, Abstract, Keywords: “positional plagiocephaly” OR “deformational plagiocephaly” OR “nonsynostotic plagiocephaly” OR “flat head”
3. Title, Abstract: “brachycephaly”
4. 1 or 2 or 3

Limit to English, Humans