Point at which repositioning therapy is no longer effective treatment for deformational head shapes

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Clinical Question: At what point is repositioning therapy no longer effective treatment for infantile deformational head shapes?

Background: Deformational head shapes are nonsynostotic conditions seen on the skull and can be referred to as deformational plagiocephaly (DP), brachycephaly, scaphocephaly, or a combination of these shapes.[1] Repositioning (RP) therapy is commonly the first line of defense against these conditions[2-5] and is a time-sensitive, conservative treatment modality[1] for deformational head shapes. In order for RP therapy to be effective, parents must initiate RP therapy while the infant's skull is malleable[4,6] and remain consistent with the placement of their infant's skull to relieve pressure from the flattened area of the head.[1] Defining the point at which RP therapy is no longer effective includes considering factors like the age of the infant, growth potential, degree of severity, positional preferences, and presence of torticollis, among other factors.[1] More specifically, some studies identify the presence of torticollis as a risk factor for the failure of conservative treatment methods.[5,7] RP therapy is supported for infants <4 months of age due to the infant becoming more mobile and acquiring motor skills after 4 months of age.[1,4] RP therapy has also been suggested for use in infants <6 months due to the high success rate.[5] If there is a lack of improvement in the deformity with RP therapy, a cranial remolding orthosis (CRO) is considered and indicated for the infant.[1-5,7-8] Optimization of treatment method algorithms used to identify, intervene, and manage deformational head shapes could increase the reliability of success found within this patient population and provide a clear method of treatment for clinicians. The goal of this CAT is to provide clinicians with the current literature regarding when RP therapy is no longer effective in the treatment of deformational head shapes.

Search Strategy:

Databases Searched: PubMed, Google Scholar, Ovid Medline, Science Direct, www.oandp.org, Journal of Craniofacial Surgery, Journal of Prosthetics and Orthotics

Search Terms: (positional plagiocephaly OR "deformational plagiocephaly" OR "posterior plagiocephaly" OR "positional posterior plagiocephaly" OR "occipital plagiocephaly" OR "nonsynostotic plagiocephaly" OR "brachycephaly" OR "brachiocephaly" OR "brachycephalic" OR "asymmetrical brachiocephaly" OR "positional therapy") AND ("repositioning therapy" OR "counterpositioning" OR "active counterpositioning") AND ("care" OR "therapy" OR "time" OR "length" OR "follow-up" OR "milestone") NOT ("craniosynostosis" OR synostosis")

Inclusion Criteria: published 2000-present, English, plagiocephaly, brachycephaly, RP therapy, >50 subjects

Exclusion Criteria: concerns children >18 months old, children with craniosynostosis or similar

Synthesis of Results: Five studies were found to meet the inclusion criteria (see Evidence Table).[4-8] The conclusion for when RP therapy is no longer effective varies among the studies. Three studies favor RP therapy prior to the use of a CRO.[4,6-7] One study found preventative RP education resulted in a significantly lower prevalence of DP among the intervention group versus the control group.[6] Another study produced a treatment method paradigm with a 77.1% RP therapy correction rate and a significant difference between the start age of the RP therapy group (5.1±2.1 months) compared to the helmet (7.1±3.8 months).[5] Two studies included in the Evidence Table found the presence of torticollis to be a significant factor in the failure of RP therapy.[5,7] The inability to compare the studies due to inconsistent start ages and different objective measurements (cranial vault asymmetry index (CVAI)[2,4], oblique diagonal difference (ODD)[5,8], severity scores[7], and cephalic index[4-5]) used for comparison limits the conclusion one can make on when RP therapy is no longer effective. Limitations of the included studies are lack of randomization[5,8], lack of blinding[4-5,7-8], incomplete data[8], and bias[4-8].

Clinical Message: Overall, the results of these studies suggest RP therapy as the first line of treatment for deformational head shapes if the infant presents younger than 4 months in age. However, an infant presenting at 4-6 months of age requires more consideration, as the results are controversial. The literature suggests that an infant presenting with a deformational head shape >6 months of age will most likely benefit from a CRO. Further studies are necessary to provide randomized controlled trials with follow-up data comparing RP therapy and CRO treatment to determine the age, risk factors, or developmental milestone at which RP therapy is no longer effective treatment.

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Evidence Table

	Aarnivala et al., 2015[6]	Lam et al., 2017[8]	Losee et al., 2007[7]	Naidoo et al., 2015[4]	Steinberg et al., 2015[5]
Population	*Number of subjects:* 96 *Clinical diagnosis:* DP *Exclusion criteria:* Craniosynostosis, dysmorphic features	*Number of subjects:* 991 *Mean age:* 6.2 months *Clinical diagnosis:* occipital plagiocephaly, occipital brachycephaly or a combination of both *Exclusion criteria:* craniosynostosis, severe medical/developmental studies, complex cranial deformities unrelated to positional mechanisms, prior orthotic treatment to presentation in this clinic	*Number of subjects:* 133 *Mean age:* 6.5 months *Clinical diagnosis:* nonsynostotic occipital plagiocephaly *Exclusion Criteria:* craniosynostosis, synostotic head shapes	*Number of subjects:* 100 *Clinical diagnosis:* DP *Exclusion criteria:* craniofacial deformities, anomalies, syndromes, and initial diagnosis after 6 months	*Number of subjects:* 4378 *Clinical diagnosis:* nonsynostotic DP or deformational brachycephaly *Exclusion criteria:* prior RP therapy/ physical therapy (PT) before initial evaluation, deviated from standardized treatment protocols, incomplete data, lost to follow-up
Study Design	Randomized Control Trial	Retrospective Chart Review	Retrospective Chart Review; Telephone Survey (Case-Control)	Longitudinal Cohort Study	Retrospective Cohort Study
Intervention	RP education	RP therapy, PT, CRO	RP therapy and CRO	RP therapy and CRO	RP therapy, RP therapy plus PT, CRO
Comparison	2 dimensional (2D) digital photographs – Oblique Cranial Length Ratio (OCLR-2D) and Cephalic Index (CI); 3 dimensional (3D) digital photographs – Anterior Cranial Asymmetry Index (ACAI) and Posterior Cranial Asymmetry Index (PCAI) were compared.	Oblique diagonal difference (ODD) was compared pre-and post treatment.	Change in posterior occipital deformation severity score is compared.	Anthropometric measurements (cephalic index (CI) and CVAI) are compared.	Using the normal values of diagonal difference <5mm and cranial ratio <0.85, treatment modalities were compared.

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Methodology	Subjects were recruited and randomized into 2 groups (intervention or control) after an initial physical examination 36-72 hours after birth. At this evaluation, cervical range of motion was measured and a 2D digital photograph of the vertex view of the infant's head was taken. During a follow-up, the same digital photograph was repeated, a 3D image of the head was created, and the parents completed a questionnaire. Parents in the intervention group received a 15 minute detailed recommendation regarding their infant's environment, positioning, and handling. Parents in the control group received the standard guidance on infant positioning before they were discharged.	A detailed history was recorded and a screen for torticollis was taken on all healthy infants in the clinic who met the inclusion and exclusion criteria. The STARscanner was used for measurements at the initial evaluation and each follow-up appointment. Software from Orthomerica was used and the oblique diagonal difference (ODD) and cephalic ratio were recorded. Measurements obtained at the initial visit and last visit were used for comparison.	A retrospective chart review of 133 patients. 105/133 families consented in a telephone survey to complete and confirm the chart review. The severity of the plagiocephaly was scored by a single craniofacial surgeon using a posterior occipital deformity severity score ranging from 1-9, where 9 is the most severe. Statistical testing was performed.	100 children (50 CRO, 50 RP) were evaluated at 6 months of age. 67 parents partook in a one time study visit. The remaining participants were randomly recruited via phone call (n=37). The recruiter only knew the child's treatment category. Each group's baseline measurements were compared to their follow-up measurements.	Parents completed a survey and objective anthropometric measurements of the infant's CVAI were recorded using a 3D laser scanner. The patient was nonrandomly assigned to 1 of 3 treatment groups (RP therapy, RP therapy and PT, or CRO). Every 2-3 months there would be a follow-up appointment until complete correction or the infant reached 18 months of age.
Outcomes	"Providing parents with instructions about their infant's environment, positioning, and care prior to their discharge from the maternity ward can reduce the prevalence and severity of DP and improve cervical range of motion at 3 months."[1]	A treatment algorithm and rationale showing how age at presentation and type of treatment impact the amount of correction obtained in positional plagiocephaly.	Trends that may predict risks for developing plagiocephaly Importance of educating parents to avoid persistent sleep positions for their infants Breastfeeding was suggested as a preventative measure to nonsynostotic plagiocephaly.	Improvements in CI with both treatments were statistically significant. The mean change in cranial vault asymmetry (CVA) was statistically significant (3.32mm for the RP group and 6.65mm for the CRO group).	All treatment modalities included were effective for 4062 of 4378 infants (92.8%) with positional cranial deformation retrospectively analyzing the treatment algorithm that was developed.

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Key Findings	The prevalence of DP was lower in the intervention group, using both 2D (11% vs. 31%) and 3D analyses (15% vs. 33%). The degree of asymmetry was also significantly milder in the intervention group ($p<0.05$).	Infants <4 months are recommended for RP therapy and PT (if torticollis is present). An infant presenting at 4-6 months without prior RP therapy is recommended RP/PT (if torticollis is present) with a recommendation of a CRO at the 4-6 week follow-up if there is no improvement. For infants 6-9 months, the time between RP/PT and the recommendation for a CRO is shortened. At >9 months infants are generally not treated with RP therapy or a CRO. The measured improvements in ODD were 36.7%, 33.5%, and 15.1% for patients receiving CRO, RP/PT/CRO, and RP/PT, respectively.	38% of the RP therapy group was successfully corrected. 62% of children with torticollis failed initial conservative treatment compared to 41% of children without torticollis that failed conservative treatment, a statistically significant difference. Persistent sleep position is nearly impossible to alter once the infant is 4-6 months of age	Helmet therapy can produce a superior outcome to RP therapy alone. >4 months, infants are too mobile for RP therapy alone to be fully effective	For low risk patients (<6 months, cranial ratio <0.95, diagonal difference <10mm, absence of neuromuscular developmental delay, or persistent torticollis), an initial trial of conservative treatment is favored. 77.1% of conservative treatment patients achieved complete correction.
Study Limitations	Recall bias, Reporting accuracy between intervention and control groups Short follow-up time	Lacks randomization, control, and complete clinical data Follow-up was not mandatory	Bias towards low income and minority patients Severity score is subjective and lacks objective measures Includes the withdrawals from the inclusion group	Data was collected from one craniofacial center and may not be generalizable Limited by 2D caliper measurements	Lacks randomization

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