Comparison of Developmental Milestones Between Pediatric Populations With and Without Cranial Deformities

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Clinical Question: In infants diagnosed with cranial deformities, does the application of clinical developmental scales identify differences in motor development compared to a normative population?

Background: Since the introduction of the "Back to Sleep" program in 1992, a large increase in cranial deformities, such as plagiocephaly and brachycephaly, has been noted among the pediatric population.[1] Infants with plagiocephaly have an elevated risk for hearing issues,[2] deficiency in language,[3] as well as psychological issues regarding self-confidence.[4] A prevailing concern among the parents of these children is the potential for delayed development. This CAT aims to examine the literature regarding cranial deformities, focusing on plagiocephaly, and potential correlations to developmental delay.

Search Strategy
Databases Searched: PubMed, Google Scholar, EBSCO, CINAHL
Search terms: (Plagiocephaly OR brachycephaly OR cranial deformity) AND (Infants OR children OR pediatrics) AND (Developmental delay OR motor delay OR gross motor function)
Inclusion/Exclusion Criteria: 2000 - present, English

Synthesis of Results: Five studies were identified (see evidence table). All articles reviewed included participants with plagiocephaly and the number of subjects ranged from 20 to about 77,000 infants.[5-9] The collected data provide evidence comparing infants with a cranial deformity diagnosis to control populations without a diagnosis[6] and children with a plagiocephaly diagnosis to children ages 0-5 without plagiocephaly,[7] all of which included the progression of deformity over set periods of time, ranging from 6 months to 5 years.[5-9] One study examined mental development based on cognition, language and social abilities.[5] The results showed that infants with plagiocephaly displayed significantly weaker motor skills, but cognitive skills were not significantly different. Another study examined individual education plans, enrollment in special education practices, ADHD diagnoses, and any form of special help.[8] The results showed that infants with plagiocephaly showed a higher risk for developmental difficulties that began to present during school aged years when compared to siblings without plagiocephaly. Potential limitations presented from the studies included are the number of participants, reliance on EMR for plagiocephaly and development delay diagnoses; potential for misdiagnoses, use of observation in the studies, biased results from the surveys provided and the lack of a control group for comparison.[5-9]

Clinical Message: The results of these studies indicate that positional cranial deformities in infants are associated with an increased risk of developmental motor delays compared to normative pediatric populations. Future research should emphasize understanding the potential influence of a CRO on motor development to allow clinicians to better educate caregivers on what changes, if any, may occur during treatment. Additionally, these findings may help clinicians monitor patients more effectively by identifying deviations from typical developmental scales during CRO use that may warrant further evaluation.

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Population	***Knight et al., 2013***	***Miller and Clarren, 2000***	***Rohde et al., 2021***	***Collet et al., 2011***	***Hutchinson et al., 2012***
	21 infants with plagiocephaly (14M, 7F)	63 infants with plagiocephaly (42M, 21F)	77,108 children ages 0-5 years old with diagnosis of plagiocephaly by 12 months old	227 children with plagiocephaly ages 4 to 11 months; 232 matched children without plagiocephaly	123 infants with cranial deformity (87M, 36F)
Study Design	Cohort Study	Retrospective review	Retrospective analysis	Longitudinal study	Longitudinal cohort study
Assessment	Bayley Scales of Infant Development, 2nd edition (BSID-II), Degree of Craniofacial Deformity Scale	Recording any special services required including therapies (physical, occupational, speech) and education plans	Review of health records through EMR system for ICD-9 and ICD-10 diagnoses codes classified as developmental delays or associated conditions	Bayley Scales of Infant Development, 3rd edition (BSID-III), Craniofacial specialist plagiocephaly diagnosis	Ages and Stages Questionnaire, Second Edition (ASQ-2),
Comparison	Standardized, normal sample from the BSID-II	Siblings without plagiocephaly or other medical diagnoses	Children ages 0-5 years old without diagnosis of plagiocephaly by 12 months old	Matched infants without plagiocephaly diagnosis	Standardized, normal sample score cutoffs for development from ASQ-2
Methodology	Assessed by the same graduate psychology researcher trained in the scale in outpatient clinical room at hospital; all conducted in the morning with the infant's caregiver present; lasted 60-90 minutes	63 families contacted and agreed to medical record review through telephone interview; assessed developmental outcomes in the child with and the sibling without plagiocephaly based on required accommodations or treatments	Retrieved data from EMR for children who had first primary care visit from May 2000 to October 2017 and were diagnosed with plagiocephaly by 12 months; classify them into plagiocephaly group or non-diagnoses; pulled relevant ICD codes (primary outcome) and sorted into type of delay (secondary outcome); reviewed exclusion criteria to	Apply assessment tools within first 4 weeks of diagnosis and within 2 weeks of 18-month birthday to examine changes in cranial deformity; have parents fill out a developmental scale at both time periods	Assess development through age defined questionnaires in the home at the initial appointment; repeated assessment in the home at 3, 6, and 12 months

			standardize data		
Outcomes	Mental developmental index (cognitive, language, personal-social abilities), psychomotor index of development (fine and gross motor skill)	Use of individual education plans, enrollment in special education practices, ADHD diagnoses, any form of "special help", use of therapies	Primary: any developmental delay classified ICD-9 or ICD-10 codes; Secondary: specific categories of delay (motor, language, social, cognitive, or general)	Rating of the severity of cranial deformation; a medical and intervention history; composite scores (cognitive, language, motor development); parents' reports of the child's adaptive behavior	Five domains of development (communication, gross motor, fine motor, problem solving, personal/social, and total delays)
Key Findings	Infants with plagiocephaly displayed significantly weaker motor skills; cognitive skills not significantly different	Infants with plagiocephaly showed a higher risk for developmental difficulties that begin to present during school aged years when compared to siblings without plagiocephaly	Plagiocephaly was independently associated (controlled for sociodemographic and clinical factors) with an increase of any developmental delay diagnosis; significantly increase risk of motor, language, social, and general delays; independently associated with motor language, and general delays	Children with plagiocephaly scored on average lower than children without plagiocephaly on the developmental scale; group differences were larger at second time period (18 months old ± 2 weeks)	At initial assessment, 30% had one or more delays, 42% at the 3-month assessment, 33% at 6 months and 23% at 12 months; delays prominently in gross motor function
Study Limitations	Small number of participants; observational	Number of participants in the study; recall of parents about their children's activities and accessibility options; observational	Reliance on EMR for plagiocephaly and development delay diagnoses; potential for misdiagnoses or missed diagnoses; observational	Only two time points used for differences; parents could have bias for surveys; observational	Lack of control group for comparison; age of child at enrollment varied which required different versions of the questionnaire to be used; observational