

Evidence Based Table							
Research supporting parent education with infants with CMT and Plagiocephaly							
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First Author, Year	Study Purpose	Subjects	Intervention(s)	Results	Authors Conclusion	Notes	Clinical Practice Relevance
Bialocerowski, A. 2008. "Prevalence, risk factors, and natural history of positional plagiocephaly". Systematic review	To identify evidence-based modifiable risk factors which could be used in preventative programs for reducing the likelihood of positional plagiocephaly	17 of 18 studies, looked at 62 potential risk factors for positional plagiocephaly all were fair quality design.	Systematic review All studies included sample characteristics, methods of diagnosis of positional plagiocephaly	Occurrence appears to be age dependent, most cases around the first month of life. In one particular study, that was higher level evidence showed the skull shape naturally changes in the first 2 years of life. DP is associated with positional preference. Asymmetrical positioning and feeding habits and may link DP with neurodevelopment. Prone positioning seems important in reducing DP.	Pediatric physical therapy is important in preventing and reducing DP. Based on the evidence reviewed, recommendations included: Infants should experience a variety of positions other than supine while awake and in supervised play. Have regular periods of prone play time Early identification is needed for infants who show a strong preference in head turning and/or decreased cervical ROM Alternating head preference to both sides when sleeping	There is little high-quality evidence regarding the factors that increase the occurrence of positional plagiocephaly. Slower to develop infants spend more time in supine which increases the risk of PP. Strategies to prevent PP many reduce the risk of abnormal skull shape and potentially reduce DD.	Therapist should make sure that parents are putting infants in a variety of positions including prone and alternating sleep positions in supine. If infants present with strong preferences for head turning or decreased cervical rotation they should be identified. Early treatment is recommended for neck problem and/or strong head preference.
Dudek-Shriber, L. 2007. "The Effects of Prone Positioning on the Quality and Acquisition of Developmental Milestones in Four Month old Infants" Cohort study	To determine the number and amount of time that a four month old infant spends in various positions in a 24 hour period ;number of infants who achieved specific milestone; if time spent in prone was predictive; how much time was spent in prone.	100 four month old infants with 48 males and 52 females	Using the AIMS, the investigator evaluated motor performance, videotapping and Parent Questionnaire	Majority slept more than five hours a day in supine. 60% <30 minutes in prone, 79 sat supported for more than 2-5 hours, 73 infants spent this amount being held. Medium scores showed 2.5 hrs. spent in supine while awake and 30 minutes in prone	In this study infants spent more time in supine than prone when awake. Results suggest that infants positioned in prone, develop movement skills and weight bearing against gravity. Infants that spend slightly more than one hour or more a day achieved greater success in acquiring certain prone, supine, and sitting milestones developing a 4 months of age	This study was a non randomized convenience sample of limited ethnic diversity from one geographic location. Only four month olds and the interrater reliability calculation were not completed until the end of this study. Parent questionnaire used instead of log which may not be as valid.	Prone positioning while awake promote the acquisition of prone skills but also other skills. Recommendation to parents for at least 60 minutes non consecutively for prone positioning.
Fradette, J.; et al. 2011. "Clinical Decision Making Regrading Intervention Needs of Infants with Torticollis". Qualitative inquiry	To identify factors currently influencing the determination of intervention needs for infants with CMT and PoT.	Pediatrician survey and PT survey	Qualitative inquiry to generate a list of factors influencing intervention needs based on the ICF-CY domains	All infants with torticollis need intervention. Needs assessed according to ICF-CY domains and factors relating to family and environment are important.	Therapist should utilize family-centered assessment to better identify needs of infants with torticollis. Application of the holistic approach framed by the ICF-CY would improve quality of care provided by pediatricians and physical therapist	This research was obtained from pediatricians and PT's in Canada through qualitative inquiry. Hard to generalize results.	Environmental factors, such as caregivers attitudes and practices, play a role in choosing intervention strategies. The family centered care model includes the family and the child and the parents are the experts.
Kennedy, E. et al. 2009. "Motor Development of Infants with Positional Plagiocephaly" Cohort study	To compare motor development of infants with PP to matched groups without PP. Examine the positioning and motor development	27 infants with PP (3-8 month) matched with infants without PP. 16 males and 11 females in each group	Motor Performance evaluated with AIMS and PMDS. Parents completed diary over 3 days on positioning	Power analysis for total subjects of at least 25. Better performance on AIMS positively correlated to amount of time in prone for both groups p<.05.	Lower motor scores in both groups were associated with less time in prone. Therapist should be aware of risk for motor delays in infants with PP. Parents need to be informed about supervised play time for development of early motor skills. PT and pediatricians should make families aware of negative impact of prolonged support sitting positioning and it affect on symmetry of the skull	There was not as large an effect of PP on motor development as expected. Need for larger sample. Motor development assessed only once in study. Hypothesis was not confirmed that infants with PP had greater developmental delay than matched peers	Many parents are worried about SIDS and do not put their children in prone when awake. Therapists should encourage prone positioning when awake and supervised to promote early development. This positioning also will reduce the DP that occurs from constant pressure on the head in supine and sitting.
Losee, J. et al. 2005. "Nonsynostotic Occipital Plagiocephaly: Factors Impacting Onset, Treatment and Outcomes" Case Controlled Study	To evaluate the factors impacting onset, treatment and outcomes of nonsynostotic occipital plagiocephaly, including many factors	Retrospective medical chart review on 105 infants	Using standardized questions to confirm chart information including family demographics, sleep patterns, behavioral modifications. Specific emphasis on breast feeding, torticollis, prematurity and DP.	Demonstrated trends that predict additional risks for PP including torticollis, multiple gestation pregnancies, increased socioeconomic affluence that may indicate increased compliance with supine sleeping.	Study stresses the importance of prevention, with primary care providers educating parents on the importance of supine sleep to prevent SIDS but also to prone playtime. Also recommending early diagnosis when PP is mild and behavioral therapy with repositioning is more effective. Breast feeding may be preventative, due to decrease sleeping periods and more frequent positioning changes.	Study notes trends about risk factors for plagiocephaly, including torticollis. Concur with other studies that helmet therapy more effective than repositioning	Breast feeding babies may be preventative lowering risk for DP than the general population because they are repositioned more and sleep less. Cranial molding helmet are more effective than than repositioning in DP. Early diagnosis when plagiocephaly is mild is need so behavioral therapy with repositioning can be initiated.

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Ohman, A. et al. 2010. "Evaluation of treatment strategies for muscle function in infants with congenital muscular torticollis" Randomized pilot study, cohort.	To compare treatment time for groups with different strategies for muscle function training in CMT	Total of 33 infants, Randomized to 3 groups Group I-9 Groups II-14 GroupsIII-13.	Group I-handling strategies Group II-III handling and specific strengthening exercises- Group III extra help 2-3 times per week. Handling strategies included: prone as much as possible when awake and supervised. Carrying the infants with nonaffected side facing upward and rotation of the affected side stimulated. Strengthening exercises tilted to an almost horizontal position with weaker side facing upward and hold 5-15 seconds and when standing in front of mirror lowered to horizontal position and held 5-15 secs. Repeated during 15 mins. periods	Start of treatment age 4.5 months, Mean treatment time 3.5 months. No significance in the two groups to achieve symmetrical head posture.	Covariates of MFS and age of start of treatment had a significant influence on treatment time. Most infants will probably need the primary program of treatment in handling. Treatment in handling may have better compliance because it is easier for parents to understand and integrate into their daily lives. exercise should be integrated into the daily routines.	Exercise diary did not work well to document strategies. No control groups without treatment in this study. Further studies on long term effects of muscular imbalance is needed	Early referral of infants with CMT and muscle imbalance in lateral righting could shorten treatment time. Parents may be better at following through with handling strategies than specific exercises. Handling strategies include prone, positioning and holding the infant in a sideways position with weaker side upward (nonaffected side ) and stimulating rotation to the affected side. We might remember that it is easier to be consistent with a smaller number of different handling strategies.
Ohman, Anna, 2009. Stretching Treatment for Infants with Congenital Muscular Torticollis: Physiotherapist or Parents? A randomized Pilot Study	To investigate the time needed to achieve a good result in the range of motion in the neck for infants with CMT	2.5 weeks to 4.9 month at start of treatment 10 males and 10 females 18 out of 20 with plagiocephaly and 20 with only CMT	N=10 Physical therapy treatment N=10 parent usual care	Both groups reached good ROM. The treatment duration performed by the PT was significantly shorter $p < .001$ with a mean time of 0.9 months. The parent group had a mean time of 3.0 months in lateral flexion and rotation. Symmetrical head position, no head tilt was achieved sooner $P = .03$ in PT group and mean of 2.5 month and parent group mean of 4.5 months	PT treatment is successful in treatment of CMT. CMT has been found to be a risk factor for the development of plagiocephaly. Stretching 3 times per week may be enough if conducted by experienced PT. Specific evaluation and assessment may be needed in order to decide which infants need stretching by experienced PT and which can be managed by home program with parents doing the stretching. Physical therapy treatment may be indicated initially along with parent training and handling and positioning in the treatment of CMT.	Small study with interpretation with caution.	Infants with CMT gained ROM 2 month earlier than parent group in this small study. Stretching 3 times per week may be enough if conducted by a physical therapist if there is an emotional component to parents not wanting to have the burden of performing the exercises everyday. If significant plagiocephaly is present along with CMT, a PT performing the exercises may get faster results.
Cleyar, A., 2000. "Congenital muscular torticollis: Early and intensive treatment is critical" Prospective study.	To define factors related to treatment duration, to compare different frequencies and intensities of home treatment programs and their effect on speed of recovery.	26 males, 19 females, Mean age initial 38.6 months and mean duration 3.2 months Clinical diagnosis of CMT for all 45 with 19 with plagiocephaly	N=45 for treatment of passive range of motion exercises performed by caregivers following specific instruction for intensive home-treatment protocol. Instructions provided by pediatric surgeon due to no PT in hospital during study period	Successful outcome in passive exercise performed by parents in children under age 4 months. CMT treated early there is no need for surgical intervention.	Successful outcome in passive exercise performed by caregivers in children under age 4 months. CMT treated early there is no need for surgical intervention.	Poor quality prospective study due to limited very small group with limited outcome measures documented. They did not include other outcomes such as plagiocephaly but had mentioned them in the result section.	Successful outcomes can be accomplished if passive ROM exercises are performed by cooperative parents especially if no PT are available.
Tessmer, A., 2010. "A Developmental Perspective on Congenital Muscular Torticollis: A Critical Appraisal of the Evidence" Systematic Review	To identify and evaluate evidence based research on orthopedic based and developmental based outcomes of infants with CMT.	48 peer reviewed articles. No RCT or systematic reviews regarding the effectiveness of intervention for CMT were found.		The importance of considering developmental outcomes of CMT is supported by limited existing research evidence. There was no evidence on the long term influences of CMT on the development of perceptual, cognitive, and motor skills.	Agreement that early diagnosis and intervention is necessary. PSE is the most common treatment and is considered safe. The implications that a different approach may be better in the treatment of CMT which includes principles of neurophysiology and sensorimotor development instead of just muscle stretching.	Evidence from noncontrolled intervention studies, descriptive single case reports and retrospective and prospective studies were included.	Even though the evidence is limited on the implementation of a comprehensive approach, including the principles of neurophysiology and sensorimotor development in the treatment of CMT instead of just passive ROM, physical therapist should be aware of the developmental outcomes that CMT can influence and treat with a broader influence on infant development.

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van Vlimmeren, L.A., 2008. "The Effect of Pediatric Physical Therapy on Deformational Plagiocephaly in children with Positional Preference" Randomized Control Trial	To study the effect of pediatric physical therapy on positional preference and deformational plagiocephaly	Enrolled at 7 weeks of age and had follow up at 6 and 12 month. Infants with CMT were excluded. At age 7 weeks 18 at in intervention group and 20 in control group had DP. But all 65 had positional preference	N=33 received Standardized PT program developed by 2 therapist based on best practice in literature, includes: Exercises to reduce positional preferences, Stimulation of motor development, Parental counseling about counterpositioning, handling, nursing, and the causes of positional preference. Parents also received leaflets preventative measures, encouraged. N=32 received only leaflet describing basic preventative measures with no further education or instruction	Intervention group reduced by 46% at 6 months. No infant needed treatment at follow up. No difference in motor scores in either intervention and usual care group. 2 month standardized pediatric physical therapy program to treat positional plagiocephaly reduced prevalence of severe deformational plagiocephaly compared with usual care	DP is associated with positional preference. Asymmetrical positioning and feeding habits and may link DP with neurodevelopment. Prone positioning seems important in reducing DP. Pediatric physical therapy is important in preventing and reducing DP.	Only randomized control trial supporting physical therapy to reduce DP in treatment over usual care	Physical therapist can be effective in preventive and reducing DP through exercises to reduce positional preference, stimulating motor development, parent training in handling, including tummy time, counterpositioning, nursing and the causes of positional preference.
Majnemer, A. 2005. "Influence of supine sleep positioning on early motor milestone acquisition." Cross sectional observational study	To determine whether 4 and 6 mos infants sleeping supine are at risk for gross and fine motor delays. And association between daily exposure to prone and upright postures in motor performance	71-typically developing 4 mos olds, 50 typically developing 6 mos olds	No infants with torticollis, or other developmental delays were included. Questionnaire, diary, was completed by parent and motor evaluation was completed by PT using AIMS and OT using PMDS. Mean age 4.4 months and 6.4 months. At 15 mos. Assessment used were PMDS and Batelle.	Noted delays of infants at 4 and 6 mos in gross motor delays and fine motor delays at 6 mos. The degree of exposure to awake prone positioning correlates to motor scores especially at 6 mos.	Physician and parents (therapists) need to understand the influence of daily positioning routines on motor milestone. Motor assessment may need to be modified due to supine sleeping patterns. Strongly encourage tummy time to counteract the effects of sleep position on awake positioning	Sample size was small for prone sleeping group because parents are following the recommendation to place infants to sleep in supine. At 15 mos. The Batelle may not have been sensitive enough to detect significant differences between groups	Infants are spending little or no time in prone which is affecting early motor development. Parents need to understand that daily positioning is required to counterbalance supine sleeping. There may be need to re-normalize some of our standardized tests to reflect the changes in the "Back to Sleep" recommendations.
Ohman, A. 2013. "Children who had congenital muscular torticollis are not at higher risk for a delay in motor development at preschool age." Cohort study	To investigate if CMT or the time spent in prone as an infant influences motor development at preschool age	58 children CMT group and 23 control- no CMT	Used the MABC-2 to eval, fine and gross motor	CMT as an infant had no impact of motor performance at preschool. This study contradicts previous studies that implied children with CMT had demonstrated a higher risk of acquiring neurodevelopmental problems	Time spent in prone as an infant during the first 6 months of life or CMT had no influence on motor development at 3-5 years of age as measured by the MABC-2. Early head turning may have some association with hand dominance.	The groups were unequal in size. Only testing used was MABC-2. Study comparison between this study and that of Schertz et al because results were very different.	This study concluded that CMT does not have an impact on motor performance at preschool. Time spent in prone as an infant does not have any significant long term affect on motor performance. This study is conflicting with following study.
Ohman, Anna, 2009. "Are infants with torticollis at risk of a delay in early motor milestones with a control group of healthy infants." Cohort study	To investigate whether infants with CMT are at risk of delay in early motor milestones compared to healthy infants. Time spent in prone or plagiocephaly had any influence on motor development.	2-10 months of age at the time of the study 35 females and 47 males with CMT 18 females and 22 males healthy infants	N=82 CMT daily treatment instructed by PT and control group had were encouraged to give their infants prone position when awake	Motor development was delayed in CMT group at 2 months and 6 months more than for the control group. Infants who spent at least 3 times per day in prone had higher scores on AIMS at 2 months, at 6 months and 10 months. Prone positioning correlated more strongly with lower scores on the AIMS at 2 and 6 mos than CMT did.	Little or no time in prone when awake implies a higher risk of delay in early motor milestones than CMT, but CMT contributes to the risk of delay. Even more important for infants with CMT to spend time in prone to eliminate at least one risk factor. We need to provide parent education on the importance of tummy time when awake. Unfortunately, infants with CMT may have decreased tolerance to tummy time. We need to clarify that a prone position to play is not a risk factor for SIDS.	The AIMS may not be able to detect minor to moderate differences between groups at 18 mos since there are few items after the 15 mos.	Infants with CMT showed delay in early motor milestones until the age of 10 months. The risks were more strongly related to time spent in prone.

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Abbott, AL. 2000. "Infant motor development and equipment use in the home." Cross sectional correlation study	To determine the relationship between total equipment use in the home and motor development and 8 mos. And individual pieces of equipment use	42 mother infant dyads in Canada	Relationship of home environment, AIMS. Data collected in a single occasion with infant 8 months old	Typically development infants with high equipment use tend to score lower on infant motor development.	It is evident that equipment use and infant motor development are related. An association was detected in this sample of infants developing typically that high equipment use tend to have lower scores on infant motor development. Limitation in this cross-sectional study make it difficult to determine causality between equipment use and infant motor development.	Sample size need to detect a modest correlation was 60 and this was not achieved. Sample size of 43 - 8mos olds provided a power of .77 and felt to be adequate. Further studies are need to determine the relationship with an at risk population of infants. It is hard to determine if higher equipment use causes lower scores or families are responding to slower development so they are using equipment more	This study suggests that infants with high equipment use tend to score lower on infant motor development. Especially for infants who score in the lower range of infant motor development, PT's working in early intervention need to remind parents to schedule floor time.
Pin, T. et al 2007. "A review of effects of sleep position, play position, and equipment use on motor development in infants". Systematic review	To evaluate the effects of sleep and play positions, and the use of infant equipment on motor development in the first 2 years of life.	19 studies of Level II evidence scored against PEDro.	Most of all studies were correlation studies. Less than half studies included demographic data. Impact on equipment may be different in disadvantaged families.	It does not appear the use of infant equipment speeds up or slows down development in healthy normal infants. Transient detrimental effects on motor development from use of baby walkers.	There is a transient delay in motor milestone in healthy infants if they are not exposed to prone but most walk within the expected range. Equipment may have a transient effect on healthy infants. It is important to educate parents to continue putting infants to sleep in supine but varying position during wake time	The effects of equipment on development in higher risk populations needs to be study with more rigorous methodology with outcome measures on movement quality not just reaching developmental milestones	It is important for parents to continue to put their infants to sleep in supine but vary their position during waking play time.
Fetter, L.. 2007. "Motor development and sleep, play and feeding positions in very-low-birthweight infants with and without white matter disease." Cohort study	To evaluate typical sleep and awake positioning with motor milestone acquisition in preterm infants with WMD and comparison group of health PT and term infants	30 VLBW infants with pre term white matter disease (PTWMD) 21 VLBW without PTWMD and 17 term infant. Born between 24 and 31 weeks 6 days	Testing at 1, 5 and 9 mos of age using AIMS and parent interview. Corrected age was use throughout the testing	Prone sleeping was positively associated the motor development at all ages. At 5 mos, prone play was associated with positive AIMS scores	Supine sleeping has been beneficial in reducing the incidence of SIDS. Supine sleeping does not have negative effect on motor development. Prone positioning has a positive effect on motor development. Prone positioning should be encourage for awake time particularly for infants with PTWMD	Further studies are necessary to link positional experiences and motor outcome. Even though there appear to be a relationship between sitting and its negative effect on motor development, this may be due to the way the authors did the coding and the small sample size, however similar results were mentioned in the study by Majnemer and Barr.	Sleeping supine does not have a negative effect on motor development and prone positioning has a positive effect. Prone positioning should be encouraged in children with preterm white matter disease.
Schertz, M. et al. 2011. "Long term neurodevelopmental Follow-up of Children with Congenital Muscular Torticollis." Prospective Follow up Study	To report results of long term neurodevelopmental outcome in a cohort of children with history of CMT	68 children aged 7 to 9 yrs. Born with CMT detected within the first 6 mos	Physical and neurological exam MABS-2 or BOTMP and MAASE by speech pathologist, phone interview	No significant differences in type of CMT, or developmental outcomes at 1 year. Trend for postural CMT associated with later motor skill in this group	Suggest that children with history of CMT and plagiocephaly may need ongoing observation for neurodevelopmental differences at different stages. These results are different than study at 1 year when motor differences had resolved.	Small sample size and retrospective report of normal by parents. Comparison studies are need with CMT and plagiocephaly. Relying on parent report is not enough when assessment of differences. No control groups was noted in this study.	Ongoing follow up through early preschool should be suggested in children who had CMT in infancy.
Stellwagen, L. et al. 2008 " Torticollis, facial asymmetry and plagiocephaly in normal newborns" Prospective cross-sectional study	To evaluate the incidence and characteristic of torticollis, plagiocephaly, and facial asymmetry in normal infants	102 healthy newborns were examined for torticollis, facial and manibular, cranial asymmetry	Parent questionnaires, Neck ROM assessment, photographs were taken for analysis	73% of newborns had one or more asymmetry. Torticollis associated with parent report a feeling "stuck" in one position for more than 6 wks. Moderate facial asymmetry associated with longer second stage labor, forceps, bigger baby and birth trauma. Newborns who have restricted neck ROM are at risk of developing DP could have been prevented with early identification and preventative treatment.	Most newborn have asymmetries and as many as one in six have restricted neck ROM. Torticollis in related to uterine crowding rather than delivery trauma. Providers should carefully assess infants for asymmetry in order to provide guidance to parents. Prone positioning may have helped to resolve the minor asymmetry. Prone positioning also puts a stretch on the SCM. Children with greater restriction in neck ROM and poor tolerance to tummy time should be referred to PT to decreased risk for developing DP.	Difficulty in accurate assessment. Larger sample size needed. Standardization of neck ROM assessment and recommendations for initiation of PT is needed. Further research on which newborns with asymmetries are at risk for unresolved torticollis and DP.	One in six newborns have torticollis, Most newborns have mild to moderate craniofacial asymmetries. Asymmetries are very common in normal newborns. Early identification is important so early positioning recommendations and/or physical therapy in order to prevent secondary craniofacial deformation.