Response to Craniosacral Therapy in an Infant with Plagiocephaly

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RESPONSE TO CRANIOSACRAL THERAPY IN AN INFANT WITH PLAGIOCEPHALY

By

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RESPONSE TO CRANIOSACRAL THERAPY IN AN INFANT WITH PLAGIOCEPHALY

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Objective
The purpose of this study was to examine the effect of utilizing craniosacral therapy (CST) techniques to influence head symmetry and motor skill development of an infant with plagiocephaly. The study is an ex post facto single case study, analyzing the results of data from previously conducted intervention utilizing a craniosacral therapy approach.

Method
The infant in this case study received gentle hands on treatment using the cranium and sacrum to influence the membrane system that encloses the cerebrospinal fluid. Developmental positioning, myofascial release, and sensorimotor techniques were incorporated. The student investigator treated the infant 8 times over a 3-month period.

Results
The infant made significant progress in all areas. Head shape changed markedly with decreases in parietal and occipital bone compression, position of zygoma and ptosis of eyelids. Posture was more symmetrical overall with improved balance reactions and developmental skills.

Conclusion
Craniosacral therapy appears to be a potentially effective method of treatment for infants with plagiocephaly to positively influence head shape, posture, and developmental skills. Further investigation is recommended.
# TABLE OF CONTENTS

List of Figures...........................................................................................................iii
Introduction..................................................................................................................1
Plagiocephaly Etiology...............................................................................................1
Symptomatology.........................................................................................................2
Typical Treatment.......................................................................................................3
Craniosacral Therapy..................................................................................................3
The Prenatal Period.....................................................................................................5
Birth and the Infant’s Craniosacral System...............................................................6
Literature Review.......................................................................................................8
  Plagiocephaly...........................................................................................................8
  Craniosacral Therapy.............................................................................................8
  Craniosacral Therapy and Gastroesophageal Reflux...........................................8
  Craniosacral Therapy and Autism.......................................................................9
  Craniosacral Therapy and Cerebral Palsy..........................................................10
  Craniosacral Therapy and Conjoined Twins.......................................................11
Purpose of This Study..............................................................................................12
Method.......................................................................................................................12
Subject.......................................................................................................................12
Procedures...............................................................................................................12
Assessment Tools.....................................................................................................13
Results.......................................................................................................................16
Discussion ............................................................................................ 18
Implications for Clinical Practice ................................................................. 18
Limitations ........................................................................................... 18
Implications for Further Research ............................................................... 19
References ............................................................................................ 20
LIST OF FIGURES

1. Pre Treatment Anterior Facial Structure .............................................. 14
2. Pre Treatment Occiput and Parietal Structure ....................................... 14
3. Pre Treatment Prone Position ............................................................ 14
4. Post Treatment Anterior Facial Structure ............................................. 17
5. Post Treatment Prone Position ........................................................... 17
Introduction

Craniosacral Therapy is a gentle, hands-on technique of correcting imbalances in the craniosacral system. The Craniosacral system is comprised of the bones of the skull, the sacrum, the craniosacral fluid and the membranes surrounding the brain and spinal cord. Imbalances in the craniosacral system can lead to pain and dysfunction, (Upledger, 1983, 1995) including postural abnormalities and developmental disabilities (Upledger 1996). Other resulting deficits due to an imbalance in the system may include asymmetrical head shape (Frymann, 1966, 2000; Upledger, 1983) or posture (Barnes 1990), developmental difficulties, feeding problems, irritability or colic (Upledger, 1983; 1996)

Plagiocephaly etiology

There are multiple theories regarding the etiology and risk factors of plagiocephaly, a condition in which the shape of the head becomes abnormal due to external forces on the skull. Cranial Technologies and Dr. John Graham of Cedars-Sinai Medical Center (1999), report that the infant’s head may become compressed in a restrictive uterine environment. The infant may not have room to move or may become stuck in one position due to a variety of factors including a large fetus or multiple fetuses, small maternal pelvis or uterus, or lack of amniotic fluid. Firmness of the cranial vault is reported to increase 5-10 times during the last 10 weeks of gestation (Cranial Technologies), and premature delivery increases the risk for plagiocephaly due to the decreased firmness if the cranial bones and the malleability of the infant’s cranium to external forces. Brunteau and Mulliken (1992) found that premature pelvic descent in the left occipital anterior position may account for a high incidence of left sided
deformational plagiocephaly and ipsilateral torticollis. Another reported risk factor associated with plagiocephaly is the position of infants when they are at rest. There has been an increase in the reported incidence of plagiocephaly since 1992 when the American Academy of Pediatrics recommended placing babies on their backs to sleep (Kate, Crave, & Marsh, 1996)

**Symptomatology.**

Plagiocephaly is a term used to describe an oblique head or asymmetrical head. (Brunteau & Mulliken 1992; Glat, Freund, Spector, Levin, Noz, Bookstein, McCarthy, & Cutting, 1996; Lo, Marsh, Pilgram, & Vannier, 1996) and is a diagnosis seen more commonly in the previous ten years to this case study. The head may become flattened in the occipital or parietal areas; the head tilted toward one side and turned toward the other side, and is often accompanied by a diagnosis of torticollis (Cedars-Sinai Medical Center 1996, 1999; Brunteau and Mulliken, 1992). Symptomatology of plagiocephaly includes asymmetries and malposition of cranial bones and may result in nervous system dysfunction.

Classification of plagiocephaly in the literature is varied. Brunteau & Mulliken (1992) found abnormalities in cranial facial features including supraorbital rims, nasal root, ears, malar eminences, chin point, palpebral fissures and facial height. Another study by Glat et al (1996) attempted to define a classification system for plagiocephaly using preoperative craniofacial computed tomography scans. They chose 20 skull base landmarks as the basis for analysis. Nine lateral landmarks, the superior orbital fissure, the optic foramen, the zygomatic arch, the greater palatine foramen, the foramen ovale, the mastoid tip, the hypoglossal canal, the external auditory canal, and the internal auditory
canal. Two midline landmarks, the crista galli and the internal occipital protuberance were used.

**Typical Treatment**

The most common form of treatment located in the literature for plagiocephaly is remodeling orthotic devices such as bands or helmets (Kelly et al, 1999; Moss, 1997). The validity of cranial remodeling orthotics has been contested by third party payers due to lack of outcome studies and prohibitive costs. Kelly et al (1999) conducted a study on the Dynamic Orthotic Cranioplasty (DOC) Band™ which is a cranial orthosis used to treat deformational plagiocephaly. The purpose of the study was to evaluate the growth of the head during correction of plagiocephaly. One hundred ninety children diagnosed with plagiocephaly were evaluated using head circumference, maximum cranial width, and maximum cranial length. Correction of plagiocephaly was evaluated by documenting the reduction of craniofacial asymmetry of the cranial vault, skull base, and face. Paired t tests were used to assess the significance of the measurements. Highly significant reductions in asymmetry (p<0.001) in all three regions were noted. Significant increases in head circumference, maximum cranial width and maximum cranial length (p<0.001) were also noted, indicating synchronous growth of the skull with use of the DOC.

**Craniosacral therapy**

Craniosacral therapy is based on the work of Andrew Still and John Sutherland, and pioneered by Dr. John Upledger, an osteopathic physician. Dr Upledger discovered a previously unexplained motion in the brain while assisting with brain surgery. This was
an arhythmical motion that did not correspond with heart or respiration rates. He later coined this phenomena the craniosacral rhythm (Upledger, 1983; 1996).

The craniosacral system consists of the dural membranes (fascia) surrounding the brain and spinal column, the cranial bones to which the membranes attach, the cerebrospinal fluid and the tissues that produce and reabsorb cerebrospinal fluid, and the sacrum. The dural membranes surrounding and protecting the brain are given shape by fluid pressure within the craniosacral system and by the cranial bones to which the membranes attach (Barnes, 1990; Upledger, 1983). These membranes, like the cranial bones, are susceptible to compression forces (Upledger, 1983), and imbalances or tensions can influence all systems affected by the central nervous system, including sensory and motor problems (Upledger, 1996). The bones in the cranium are in constant motion and should be able to accommodate ever-changing fluid dynamics. When the dural membranes are subjected to abnormal tension, they often organize and align themselves in the direction of tension, creating more asymmetries in cranial features (Upledger, 1983). The dural tube surrounds the brain and spinal cord with attachments at the foramen magnum of the occiput, the second and third cervical vertebrae and at the second sacral segment. The sacrum is directly connected and influenced by the cranium through the dural tube (Barnes, 1990)

Upledger (1983; 1996) describes the craniosacral system as a semi-closed hydraulic system. The tough outer meningeal membrane surrounding the brain, the dura mater, is water-tight and forms a container for the craniosacral system. The fluid in this system is the craniosacral fluid and is extracted from the blood by the choroids plexus
located primarily in the lateral ventricles of the brain. There is a rhythmical inflow and a constant outflow of the fluid in the system.

Extraction or production of CSF from the blood is rhythmical. Most likely turned on and off by fluctuations in the volume of CSF within the container formed by the dura mater. This is the inflow of the semi-closed hydraulic system. Outflow of cerebrospinal fluid is constant and occurs in the arachnoid villae and granulation bodies within the venous sinuses and is returned to the blood system (Upledger 1996). Upledger (1996), states that “since the inflow of craniosacral fluid into our semi-closed hydraulic craniosacral system is relatively rhythmical and the outflow is relatively constant...the inflow of fluid must be greater than the outflow in order to avoid depletion of fluid from the craniosacral system”. Typically the fluid volume rises for 3 seconds and then lowers for 3 seconds, and this rhythmical volume fluctuation repeats itself at about 10 cycles per minute (Upledger, 1996) or an average of 6-12 cycles per minute (Upledger 1983). Due to the attachments of the meningeal membranes to the skull and spine, the fluctuation of fluid volume can be palpated as motion in the skull, spine or pelvis.

The prenatal period

Shock or trauma at any point in human life can have devastating consequences. This is true for the fetus as well. Upledger (1996) reports that maternal illness or toxicity can result in a generalized tightness of the dura mater, the tough membrane that surrounds the brain, particularly during the last 6 months of pregnancy. The reduces rhythmic volume change in cerebrospinal fluid and the craniosacral system manifesting as central nervous system dysfunction, including sensory and motor problems. Toxic substances include those taken as food and drink, medicines or street drugs, or inhaled as
air pollutions. Maternal injury, emotional upset, including thoughts of abortion or adoption (Shea, 2000) or malposition of the fetus in the pelvis may also produce symptoms of craniosacral system dysfunction.

**Birth and the infant’s craniosacral system**

The birth process can be very traumatic for an infant, whether it is a natural vaginal birth, a caesarian birth, an assisted birth or an extremely rapid and forceful birth. Shea (2000) sites Emerson (1999) and reports that 95% of western births involve shock and trauma to the infant. During labor and delivery the bones of the infant’s skull are designed to override and change the shape of the head so the head can descend and withstand compression of the birth canal (Upledger, 1996; Frymann, 1998), and then expand fully after birth when the baby takes its first breath. The sacrum at the lower end of the central nervous system is also designed to absorb compressing forces and then be restored after birth. During delivery, the trip through the birth canal involves a series of twists and turns, that essentially mobilize each joint in the infant’s spine and pelvis, and stretch and all of the muscle and soft tissue (Upledger, 1996). Frymann (1966) conducted studies on over 1200 infants and found that 90% had cranial distortions or pelvic torsions.

Problems with labor and delivery may compromise these structural areas and compromise the nervous system and physiological development. False labor is one aspect that can be damaging due to compressive forces on the babies head when the head has no room to move into a birth canal that is not ready for the baby’s descent. Dr Upledger (1996) and Dr Frymann (1998) both report that the occipital region of the infant’s head takes the brunt of delivery.
When delivery is rapid, the occiput may become jammed on the atlas, (Upledger, 1996) compressing the occipital condyles (Barnes, 1990). When this danger signal is present, musculature in the neck may contract or splint. If the occiput is jammed when the splinting occurs, the occiput may remain jammed on the atlas, compromising the jugular foramina and foramen magnum. Many important structures pass through the skull at the jugular foramina, including the jugular veins and cranial nerves IX (glossopharangeal), X (vagus), and XI (spinal accessory). The glossopharangeal nerve and vagus nerve work together to control swallowing and airway function and to control the esophagus, larynx and pharynx. The vagus nerve also innervates the heart, stomach, and bowels. The spinal accessory nerve controls muscles of the neck and dysfunction may lead to spasm in the sternocleidomastoid or trapezius muscles. Ongoing compression of the spinal accessory nerve as it exits the jugular foramen can lead to continuous spasm and resulting torticollis.

Occipital base compression may occur on one or both sides of the occipital base. Colic, compression of the neck, gastroesophageal reflux, regurgitation of food, respiratory problems, rapid heart rate and bowel or bladder dysfunction may be seen with compression of both sides of the occipital base. Upledger (1983) states that repeated compression can lead to attention deficit and hyperactivity disorders. Compression on only the right side may result in right-sided neck muscle spasm, reflux or regurgitation, rapid heart rate, or respiratory problems.

Frymann (1998) reports that 80% of children with developmental delays, including attention deficits and autism have a history of traumatic birth, which may include abnormal compressive forces. She contends that children who have undergone
abnormal compressive forces are in need of structural treatment to restore musculoskeletal integrity of the whole body. Upledger (1993) describes methods for remolding the cranium of infants with asymmetries. Very light and gentle pressure is applied directly to any asymmetries or bulges for long minutes at a time. This low load, long duration treatment is more non-traumatic than more forceful techniques.

**Literature Review**

The only research on the use of craniosacral therapy as a form of treatment located in a literature search consists of single subject case studies. No studies have been reported on its use in the diagnosis of plagiocephaly, although the symptomatology of plagiocephaly appears consistent with craniosacral deficits.

**Plagiocephaly**

One published study on nonsurgical, nonorthotic treatment was conducted at Phoenix Children’s Hospital in 1995. The study showed that 66 patients treated with physical therapy and repositioning of the head, showed improvement in average cranial vault symmetry from 9.2 to 4.7 mm over an average of 4.5 months (Moss, 1997).

**Craniosacral therapy**

Dr. Upledger conducted a study in 1978 of 203 grade school children to determine if there was a relationship between restricted mobility of the craniosacral system and developmental problems. Positive relationships were found between elevated total craniosacral motion restrictions and behavioral problems, leaning disabilities and motor coordination deficits.

**Craniosacral therapy and gastroesophageal reflux**
A condition that affects some infants is gastroesophageal reflux. Gastroesophageal reflux (GER) refers to the backward flow of acidic stomach contents into the esophagus, and may result in vomiting. Gastroesophageal reflux has been considered a result of impingement of the vagus nerve where it passes through the jugular foramen and at the cranial base (Upledger, 1988).

Joyce and Clark (1996) conducted a case study on an infant with GER and reported that CST may prove the most effective tool in treatment of this condition due to eliminating or reducing restrictions at the occipital cranial base and jugular foramen, impacting the vagus nerve and all of its functions. The infant in their case study was 8½ months old at initiation of treatment and received 12 CST treatments and report no return of GER after the first four sessions. Other positive benefits were reported as well. The infant initially displayed subtle motor concerns and had difficulty transitioning in and out of sitting and other positions due to difficulty with sensory processing and motor skills. Within one month she was pushing herself onto hands and toes and occasionally onto hands and knees. Over the next 2 months of CST she began crawling, using a half kneel position, and pulling to stand.

Craniosacral therapy and autism

Nancy Lawton-Shirley conducted case studies utilizing craniosacral and myofascial techniques on children with diagnoses of autism. She observed improved pelvic mobility, weight shift, trunk rotation, thoracic expansion, and shoulder/head/neck alignment. A decrease in withdrawal from tactile, visual, and auditory information was noted. Decreases in echolalia and squinting and increases in exploring movement were also observed. In the case of one child, CST and myofascial techniques were excluded...
and sensory integration became the focus of treatment. Within 2 weeks of cessation of craniosacral and myofascial therapies, a regression to previous levels of function were reported, and the child requested specific techniques again be included in his program. His functioning returned to his highest level quickly after resuming craniosacral and myofascial techniques.

Craniosacral therapy and cerebral palsy.

Barnes, Lawton-Shirley, Wanzek and Weis, (1990) preset a case study of a 3 1/2 year old girl with hemiparesis following a bleed in the right basal ganglia at age 2 ½. The child received occupational, physical and speech therapy two to three times per week. Neurodevelopmental and sensory integration techniques were used with special emphasis on inhibition. The child made many gains in all areas but response to therapy and progress was inconsistent, with slow gains for 6-8 weeks followed by periods of regression. Irritability and sensitivity to touch improved, although they continued to impede progress. Sleep patterns were restless and interrupted with screaming and crying 2-10 times per night. Breathing patterns were irregular, with breath holding both at rest and during activity.

At 15 months post stroke, the child was treated at the Myofascial Release Treatment Center with myofascial release and craniosacral therapy. She received one 40-60 minute treatment per day for 10 days. No other therapy was provided during that time. Myofascial and craniosacral evaluation revealed many postural dysfunctions. The sacral base was unlevel; the right anterior superior iliac spine was low, and the right posterior superior iliac spine was high. The right lower extremity was long and the right femur was internally rotated, with internal rotation of the foot during ambulation.
Myofascial restrictions were noted in the pelvic diaphragm, respiratory diaphragm, and thoracic inlet. Occipital condyles were compressed, the right temporal bone was internally rotated, sphenoid bone was restricted, and sutures were compressed.

Significant progress was noted including pelvis and foot alignment 95% of ambulation. Increased symmetrical use of both arms, and reciprocal arm swing were emerging by the tenth session. Decreased tension was noted in the pelvic and thoracic diaphragms, posture was improved with decreased lordosis. The child also appeared more relaxed and her mood changed from solemn and dull to alert and smiling. Irritability and overarousal decreased with improved adaptability to change. Breathing patterns also improved.

Craniosacral therapy and conjoined twins

Dr Upledger (2002) has reported on benefits of CST in conjoined twins. The twins, from Egypt received intensive treatment at Upledger Institute Healthplex Clinical Services. Initially the boys were subdued and the smaller of the twin was not eating. They were not babbling, could not play with their feet, or pull themselves into a crawling position. The twins were conjoined at the head and shared brain matter and extensive blood vessels. Flat sots were formed on each of the twin’s heads. The flat area was directly on the vagus nerve nucleus that controls the stomach, gall bladder and liver, and Dr. Upledger believed compression of the vagus nerve may explain the reason for the smaller twin not eating. The twins received intensive treatment for approximately 5 hours per day. Treatment was focused on the sacrums and the skulls to stimulated fluid flow and decompression, and to facilitate nervous system, spleen, heart, and liver function.
The boys began babbling, eating, playing, and sleeping shortly after initiating intensive treatment.

Purpose of this study

The purpose of this study is to examine the effectiveness of craniosacral therapy for an infant with plagiocephaly and developmental delays. The investigator theorized that due to symptomatology of plagiocephaly, craniosacral techniques may influence a more symmetrical head shape, as well as facilitate development of postural control and motor skills.

Method

Subject

A. was referred at the age of 5 months to a mid-western, university based program that assesses children who have undergone suspected or confirmed trauma. She was referred by a Family Independence agency to determine the extent of trauma and whether A. had Fetal Alcohol Syndrome. A.’s mother reportedly used cocaine and marijuana during pregnancy and A. was born 8 weeks prematurely following a rapid delivery of approximately 20 minutes per her mother’s report. At the time of the assessment, A. was in foster care due to her mother’s drug use.

Procedures

A. was evaluated by a team of 2 occupational therapists, a psychologist and a Doctor of Osteopathic Medicine. She did not have symptoms that would warrant a diagnosis of Fetal Alcohol Syndrome, but was diagnosed with plagiocephaly. A. was subsequently treated by one of the occupational therapists over a period of 10 weeks for a
total of 8 sessions. Treatment was initiated when A. was 7 months of age and was terminated when she was 9 months of age.

**Assessment Tools**

Clinical observations and the Hawaii Early Learning Profile were used to assess muscle tone, postural control, gross motor, fine motor, cognitive, language and social skills.

A. presented as a 5 month old female infant with structural abnormalities including asymmetrical cranial facial features and decreased range of motion in the neck. Her entire head and face appeared torsioned to the left with the left side of her face more anterior. Her right zygomatic arch was higher than the left and her left ear was rotated and protruding from the temporal bone with a floppy pinna. The physician observed bilateral ptosis of the eyelids. (See figure 1) Her occiput and left side of the head were significantly flattened with restrictions at the coronal and lamdoidal sutures. (See figure 2).

A. was unable to maintain her head in midline and her neck was rotated to the left and laterally flexed to the right in supine, prone and supported sitting positions. She did not display active neck rotation to the right and passive neck rotation to the right was limited to approximately 10 degrees with severe tightness in left lateral neck tissues. The right side of her trunk was shortened and the right side of the pelvis and hip was higher than the left. In the prone position A. was unable to fully extend her right hip and knee, resulting in external rotation with the right knee lateral to her body and both legs held to the left. (See figure 3) A. tolerated the prone position for only a few seconds at a time. Her foster mother reported that at times, A.'s feet would turn purple.
Figure 1. Pre Treatment Anterior Facial Structure

Figure 2. Pre Treatment Occiput and Parietal Structure

Figure 3. Pre Treatment Prone Position
Decreased muscle tone in the right upper extremity and increased tone in the left upper extremity were observed. A.'s foster mother also reported high incidence of "spitting up" or gastroesophageal reflux.

The Hawaii Early Learning Profile (HELP) was used to assess developmental status. Overall development was between 2 and 4 months. Developmental concerns were observed in areas of Language (2-4 months), Gross Motor (1-2 months), and Fine Motor (2-4 months) skill areas. The biggest area of concern was gross motor skills which seemed to be impaired due to delayed reflex integration, muscle tone imbalances, and restrictions in range of motion. The asymmetrical tonic neck reflex was not integrated with head turning to the left and equilibrium reactions were delayed. She was not able to localize sound due to limitations in neck range of motion. She was not inspecting her hands at midline or actively reaching for objects.

A was seen for occupational therapy using primarily a craniosacral therapy approach for 8 sessions. Other approaches that were incorporated into treatment include myofascial release therapy and neurodevelopmental treatment. Craniosacral techniques administered included:

1. Respiratory diaphragm, pelvic diaphragm and thoracic inlet transverse plane releases.
2. Occipital condyle/occipital cranial base releases.
3. Frontal decompression.
4. Parietal decompression.
5. Sphenoid decompression.
6. Temporal derotation and decompression.
7. Direction of energy through sutures and falx cerebri.
8. Myofascial release to both lower extremities, plantar surface of feet, and cervical area.


**Results**

After 8 treatment sessions there were notable changes in all areas. After one session, A.’s feet no longer turned purple. She was tolerating the prone position for longer periods of five to ten minute intervals, and pivoting from right to left. After two sessions she began sitting with minimal support. After 3 sessions, A. was rolling from prone to supine both left to right and right to left, bringing both feet up in supine. After 5 sessions, A was rolling prone to supine in directions, pushing onto hands symmetrically while prone, and beginning to pivot in prone. She began sitting independently for 8 second intervals, and her foster mother and acquaintances were commenting that A.’s head “looked better”.

By the eighth session, the left side of A.’s face, parietal and occipital bones were less flat and there was more mobility at the lamdoidal and coronal sutures. The zygoma were more level (See figures 4-5). She was able to hold her head in midline in all positions and there was significant lengthening in the right side of the trunk with her pelvis level. Only slight external rotation at the hip, and slight knee flexion were observed in the prone position. By the end of treatment, A. had full neck rotation to both the left and right. A. was using both hands at midline, sitting independently for extended periods, pushing to her hands and knees and beginning to crawl. Incidence of gastroesophageal reflux had diminished.
Figure 4-Post Treatment Anterior Facial Structure

Figure 5-Post Treatment Prone position
Discussion

Implications for clinical practice

Craniosacral therapy has been reported to be of benefit for infants and children with a multitude of diagnoses. The results of this study indicate that craniosacral therapy appears to be a potentially viable treatment option for children with plagiocephaly and other asymmetrical head and neck features. Barnes, et al (1990) and Upledger (1983) contend that myofascial and cranial techniques are gentle and safe and most newborns should be treated immediately after birth. The results of this study support the use of CST with young infants. There were no apparent adverse side effects for treatment and significant gains were observed.

This study examines a previously undocumented therapy for infants with plagiocephaly. Positive effects of CST in infants with plagiocephaly add another diagnosis to the spectrum of cases in which CST has been shown to be effective.

Craniosacral therapy is a non-invasive and cost-effective treatment compared to helmets or bands, which are the current recommended treatment for plagiocephaly, and should be considered for infants with this diagnosis prior to more invasive procedures.

Limitations

There were several limitations to this study. At onset of treatment, A. was not intended to be the subject of a case study. She was evaluated for developmental and attachment concerns and specific cranial measurements were not taken at initial assessment or during treatment. Treatment began 2 months after the initial evaluation, at which point there was some natural maturation of developmental skills. Progress was documented by observations, hands on assessment, and photographs only. A.'s treatment
was terminated without notice when she was returned to her mother's care, at which time she was fitted with a helmet.

Implications for further research

The need for more studies involving larger samples is necessary to determine the validity of craniosacral therapy for infants with a variety of diagnoses including plagiocephaly. Longitudinal studies would also be beneficial to determine permanency of results and to document ongoing progress of developmental skills. Research comparing results of CST to helmet use in infants with plagiocephaly is another potential study since no studies of progress utilizing helmets in infants with plagiocephaly were located.
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