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Editorial Correspondence: Correspondence should be sent to:
Editor, JCCP
ICA Council on Chiropractic Pediatrics
6400 Arlington Boulevard, Suite 800
Falls Church, Virginia 22042, U.S.A.
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The abstract should be 250 words or fewer. It may be either structured or unstructured. If structured, use the same sections as described below for the components of the report (Introduction, Case Presentation, Intervention and Outcomes, Discussion).

Case Report Components

• **Introduction**: State why this case is unusual or important.

• **Methods**: describe the search engine and key words used to review previously published literature on the subject

• **Case presentation**: Provide a brief summary of the patient's presenting demographics, other relevant characteristics, complaint(s) and related symptomatology.

• **Intervention and outcomes**: Describe the course of treatment, including frequency and duration, and summarize the patient's clinical outcomes, using recognized outcome measures if possible. Include whether informed consent was obtained and if there were any adverse events reported.

• **Discussion**: Succinctly state the important aspects of the case, in terms of its implications for patient care in general, or for specific patient populations or conditions. You may also compare/contrast the case to other cases in the published literature. Be cautious about overstating the importance/implications of your case.

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An Evidence-based Case Report (EBCR) is NOT the same as a traditional case report. The EBCR focuses on an answerable clinical question, how it was explored in the search, appraising the results and how it applies to the case, along with the integration of this information with the patient interaction. The final stage in this process is to audit the results.

These are the steps to include:[1,2]

• Brief summary of the chief complaint: 50-100 words

• Briefly describe the clinical case: 250-400 words

• Explain how you developed the clinical question: 200-300 words

• Explain your search for evidence (key words, databases used, number of articles retrieved): 50-100 words

• Evaluate the articles retrieved: critically appraise the evidence for validitiy and relevance: 200-300 words

• Describe how you made your clinical decision by applying these findings to the case, including how you considered and integrated the patient's preferences and values: 250-400 words

• Evaluate your performance: 50-100 words

1. Heneghan C, Badenoch D. *Evidence-based Medicine Toolkit*, 2nd ed. Oxford, UK: Blackwell Publishing, 2006. http://onlinelibrary.wiley.com/doi/10.1002/9780470750605.index/summary (download pdf of "all chapters" for free copy of the publication)

2. Jones-Harris AR. The evidence-based case report: a resource pack for chiropractors. *Clin Chiropr* 2003;6 73-84. (download for free from www.chiro.org/cases/FULL/Evidence-based_Case_Report.pdf)

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https://www-ncbi-nlm-nih-gov.uws.idm.oclc.org/pmc/articles/PMC1126937/pdf/302.pdf

Iran J Pediatr. 2010 Sep; 20(3): 261—268. Evidence Based Medicine in Pediatric Practice: Brief Review
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3446038/

J Can Chiropr Assoc. 2014 March; 58(1): 6—7. **Evidence-based case reports**
http://pubmedcentralcanada.ca/pmcc/articles/PMC3924510/

3 BMJ. Vol 7, Issue 3, 2002, **Evidence-Based Medicine in Practice: EBM Notebook**
http://ebm.bmj.com/content/7/3/68

Remembering Maxine McMullen, RN, DC, FICCP

By Sharon Vallone, DC, DICCP, FICCP

There are people who come into our lives who gently nudge (or in some cases, firmly bump!) us off the path we thought we were following with keen focus. They broaden our horizon and challenge us to excel by raising the bar. Whether inspired by awe (or "fear,") beguiled by humor, instilled with confidence, embraced with love or a kaleidoscope of all those experiences, we follow their lead which soon becomes the way of our own hearts as we begin to embrace the gifts they confidently declare that we have and must own so that we can be of the greatest service to the children who need our care and advocacy. One such very special and awesome woman crossed my path in 1992 and irrevocably changed the course of the years to follow.

It was with deep sorrow that the International Chiropractors Association and chiropractors around the world heard of the passing of Dr. Maxine McMullen, one of the icons of chiropractic and a pioneer of chiropractic pediatrics. Dr. McMullen passed away January 16, 2018 leaving a legacy of the love, leadership and encouragement for her family, friends and students. Dr. McMullen believed life was to be led to the fullest and she dedicated hers to her family of origin and her family of chiropractic encompassing thousands of patients, students and colleagues, many who claimed her friendship over the years.

Her history, as shared so lovingly by her sister, encompassed caring for babies and students from her years in New Zealand as a surgical nurse, to her years of professorship and leadership at Palmer College as the first female academic dean of a chiropractic college. While also running a private practice, she continued to teach and served on the National Board of Examiners and as vice president in 1999 and 2001 of the International Chiropractic Association. Serving in many other capacities within the ICA, she was then the founder and first chair of the ICA's Council on Chiropractic Pediatrics, developing the professions first postgraduate diplomate in chiropractic pediatrics, the Diplomate in Clinical Chiropractic Pediatrics (DICCP) which fostered the education of graduate doctors of chiropractic who wanted to broaden their knowledge and gain new skills to serve this population that was so special to her.

Dr. McMullen's dedication to the supporting the chiropractic profession and the growing body of chiropractors who were pursuing further education in chiropractic pediatrics was inexhaustible. Next, she teamed up with the ICA again and created a venue to publish research, case reports and commentaries to support the field clinician and encourage research in the field. Her hope was that chiropractic pediatrics would have a seat at the table when long term planning of pediatric healthcare was conducted.

With the long time support of Molly Rangnath, the Journal of Clinical Chiropractic was born and as its editor, Dr. McMullen tirelessly encouraged authors to contribute and build a foundation of pediatric chiropractic literature. The journal carries on today with the continued dedication of Molly Rangnath and carrying her mission and vision further, we hope, as an open access journal. Interested chiropractors, healthcare professionals and web surfing families alike, will hopefully not only find an avenue of publishing their work, but also as a resource that will support their healthcare choices and management.

Dr Maxine, I do believe you will be remembered everyday as each of your students lay their hands on a child with the knowledge that they have the skill to make a difference in their health and well being. You also constantly cajoled us to attend to our stress levels and mental health as well as you attended to you're young patients. Your words ring out in my memory as a reminder to take life as it comes, slowly and with gratitude…."Don't Sweat the Small Stuff!". Thank you, dear Friend. Until we meet again.

Benign joint hypermobility – developing clinical significance

By Peter N. Fysh, DC, FICCP[1]

1. Emeritus Professor, Palmer College of Chiropractic West, San Jose, California;
Chairman, Board of Examiners, ICA Council on Chiropractic Pediatrics
Email: drfysh@gmail.com

ABSTRACT

The aim of this paper is to examine the clinical significance of joint hypermobility, and to suggest some diagnostic and management protocols which might be used in a chiropractic practice. Joint hypermobility is a largely unrecognized condition that is little understood, little talked about and often misdiagnosed. Clinicians may encounter patients with joint hypermobility but fail to appreciate the significance in terms of overall morbidity. The clinical significance of joint hypermobility is examined from many aspects. Considerations include the effect of joint hypermobility on different body structures as well as during pregnancy, on newborn, school-aged and adolescent conditions and the effect of different sports on the hypermobile child. Finally, the effects of joint hypermobility on spinal adjusting, and the modifications thereof, are discussed.

Key words: joint hypermobility, newborn, infant, child, pregnancy, sport, chiropractic, spinal adjusting, motor development, disc degeneration, scoliosis, attention deficit hyperactivity disorder.

History of Joint Hypermobility

An early clinical description of hypermobility was attributed to Hippocrates in the fourth century B.C., wherein he described the Scythians, a race of nomadic equestrian warriors who inhabited a region which is now the Ukraine.[1] One of the Scythians' main problems noted was the hyperlaxity of their elbow and shoulder joints which made it difficult for them to draw their bows or launch their javelins effectively. The clinical significance of hypermobility was not further reported until the late nineteenth century, when physicians were energetically describing and naming medical syndromes. During this period, the hypermobile character of joints became an important feature of conditions, notably in the Ehlers-Danlos and Marfan syndromes.

Definition and Characteristics of Joint Hypermobility

Hypermobile joints are defined as those that typically move beyond the normally accepted ranges of motion, taking into consideration age, sex, and ethnic background. The maximal range of movement that a joint is capable of is determined by the degree of tightness of the restraining ligaments. Thus, it has been determined that the primary cause of hypermobility is ligament laxity. Epidemiological studies have determined that hypermobility is seen in up to 10% of individuals in Western populations and as high as 25% in other populations.[2] The incidence of joint hypermobility within individual families suggest genetic inheritance, while the incidence difference between genders would imply a hormonal contribution. Joint hypermobility seems to be transmitted by an autosomal pattern, and first-degree relatives with the disorder can be identified in many cases.

Hypermobility may occur in a few joints (pauciarticular) or in multiple joints throughout the body (polyarticular). All joints have mobility; it is when joints demonstrate the ability to move excessively that issues occur. Joint mobility can be considered as a sliding scale, with some patients falling at the stiff jointed end of the scale, while others fall at the other end, i.e. the hypermobile end of the scale. The remaining patients who fall somewhere in the middle of the range, with joint hypermobility but without demonstrable clinical symptoms may go unnoticed clinically, leading to a frustrating life of undiagnosed pain and disability. Hypermobility (provided it is looked for) is seen commonly in clinical practice. Measurement scales for joint hypermobility have been devised, which allow an individual to be assigned a hypermobility rating. More will be discussed on rating systems in a later section of this paper.

Most of the research publications in the literature describe syndrome manifestations and associated management protocols. For many years, discussions in the literature have emphasized and reported on patients with increased levels of joint hypermobility, such as in Ehlers-Danlos or Marfan syndrome. Fewer studies have discussed the type of hypermobility that has no associated syndrome, but which affects a larger percentage of the population. It is the author's contention that chiropractors more frequently encounter this latter type of patient, and it is on this group that greater emphasis is placed in this paper.

Benign Joint Hypermobility Syndrome

Joint hypermobility is a term used to describe excess joint movement. However, when joint hypermobility leads to

symptoms in joints or other areas of the body, it is called Benign Joint Hypermobility Syndrome (BJHS). The characteristics of BJHS involve proprioception impairment, increased frequency of pain within joints and the tendency to injure soft tissues while performing physical activities. Most papers in the literature relating to joint hypermobility discuss this form known as BJHS.

Hypermobility of the joints is a common clinical finding in children, although not symptomatic in the majority. In general, girls have greater joint mobility than boys of the same age, with ranges usually being greater on the non-dominant side of the body. In studies which included race, Asians have been found to be more mobile than Caucasians.[3]

Causes of Joint Hypermobility
Joint strength is dependent upon the supporting ligament structure that crosses the joint space. Ligaments are composed mainly of collagen, so it is important that we discuss the collagen factors that contribute to joint hypermobility. There are 28 known types of collagen in the body, identified as types I through XXVIII.

Collagen is the main component of connective tissue and is the most abundant protein in the body, making up between 25% and 35% of the whole-body protein content. It is mostly found in fibrous tissues such as tendons, ligaments and skin. Collagen tissues may be rigid, as in bones, compliant as in tendons, or have a gradient from stiff to flexible as in cartilage. Collagen is also abundant in the tissues of blood vessels, the digestive tract, intervertebral discs and viscera. In muscle tissue, collagen makes up about 6 percent of the tissue serving as a major component of the endomysium, the tissue that sheaths each individual muscle fiber. The fibroblast is the most common cell that creates collagen and plays a critical role in tissue repair and wound healing.[4]

Collagen Variants
Different types of collagen serve different purposes in the body.

Type I collagen is the most abundant type of collagen in the human body. It is present in scar tissue, tendons, ligaments, muscles, bone, skin and viscera.

Type II collagen forms articular cartilage and hyaline cartilage. It makes up 85 to 90% of collagen found in articular cartilage.

Type III collagen is an essential component of ligaments, vascular structures, arterial walls and veins, skin and the digestive tract. Some studies have suggested the possibility that type III collagen deficiency may be implicated in congenital heart disease.[5]

The collagen that exists within the ligaments and joints of the skeleton is mainly composed of collagen type I and type III. Types I and III are the major constituents of ligament tissue, with type I collagen accounting for approximately 90% and type III for the remainder.[6]

Genetic Inheritance
A study of joint hypermobility by Bridges, demonstrated that up to 65% of patients with joint hypermobility had first-degree family members with a history of joint hypermobility.[7]

In a large chiropractic practice, it is not uncommon to find 3 to 4 generations of family members demonstrating various symptoms associated with joint hypermobility.

Assessment of Joint Hypermobility
The most widely used method of joint hypermobility assessment is to test whether a patient can perform a standard set of maneuvers, providing a numerical score, known as the Beighton score. Unfortunately, many clinicians omit these tests from their examination; as a result, joint hypermobility is often overlooked and its importance passes undetected.

Beighton Score
The Beighton score for assessing joint hypermobility is considered the gold standard for diagnosis, because it is quick, it is easy to use, and it has high intra-rater reliability.[8]

The 9-point scale is based on the following assessments:

1. passive apposition of the thumbs to touch the flexor aspect of the forearm,
2. passive dorsiflexion of the 5th fingers beyond 90°,
3. hyperextension of the elbows beyond 10°,
4. hyperextension of the knees beyond 10°, and
5. ability to place the palms of both hands flat on the floor, with knees in extension.

By this method a score can be assigned, with a maximum of nine points, one point for each thumb, one point for each 5th finger, one point for each elbow, one point for each knee, and one point for the ability to place the hands flat on the floor (spinal hypermobility). The maximum score is 9. A score of four or greater, on the 9-point scale, confirms the classification of hypermobility.

The Beighton score is a useful starting point, but it has a few shortcomings. For instance, it gives no indication of the severity of the hypermobility throughout the body. It merely indicates how widely that hypermobility is distributed throughout the musculoskeletal system. Because collagen is ubiquitous throughout the body, it became increasingly apparent that organ systems may also become involved and

should be considered as part of any evaluation. Further, certain individuals in different ethnic groups can demonstrate striking hypermobility, without any apparent symptomatology.

Brighton Criteria
The British Society of Rheumatology addressed the issue in 1999 and developed an updated evaluation system which became known as the Brighton Criteria.[9]

The advantage seen with the Brighton Criteria is that it incorporates symptomatology, thereby increasing the specificity for the diagnosis of benign joint hypermobility syndrome (BJHS).

The Brighton Criteria requirements are classified into major and minor criteria. According to the Brighton Criteria, benign joint hypermobility syndrome (BJHS) is diagnosed in the presence of 2 major and 2 minor criteria or 4 minor criteria. Two minor criteria will suffice if there are first degree relatives with a diagnosis of BJHS.

Major Criteria
- A Beighton score of 4 or greater (either currently or historically)
- Arthralgia for longer than 3 months in 4 or more joints

Minor Criteria
- Beighton score of less than 4
- Arthralgia in 1 to 3 joints for more than 3 months
- Back pain for more than 3 months
- Spondylosis, spondylolysis or spondylolisthesis
- Dislocation/subluxation in more than 1 joint, or in 1 joint on more than one occasion
- Soft tissue inflammation (epicondylitis, tenosynovitis, bursitis) in more than 3 locations
- Marfanoid habitus (tall, slim, arm span/body height ratio >1.03, upper/lower segment ratio <0.89, arachnodactyly)
- Abnormal skin striae, hyperextensibility, thin skin, thin (papyraceous) scars
- Eye signs: drooping eyelids, myopia, antimongoloid (medial to lateral upward) slant
- Varicose veins, hernia or uterine/rectal prolapse

Joint hypermobility is regularly identified in clinical practice. Use of the Beighton scoring system provides a quick and simple method of identifying those patients whose joint hypermobility may require further assessment.

Hypermobile patients often create the need for variation in delivery of spinal adjusting techniques. Close assessment of extremity joint hypermobility is important since it may be a factor contributing to other symptoms in the body. Joint hypermobility can have different effects in each age group and gender. In this regard, we will further examine specific problems of each age group and gender with appropriate recommendations for care.

Joint Hypermobility in Infants
The onset of hypermobility can be recognized at birth and, because it can significantly affect the newborn, diagnosis becomes important for the pediatric population. The recognition of potential problems is important when examining the infant as is the importance of the recently recognized effects linked with slowed motor development. Infants who test positive for joint hypermobility typically can bend further than typical. As a result, the trunk and extremity joints can appear weak and floppy. This increased flexibility also affects the muscles causing them to appear similarly floppy and weak.

Delayed Motor Development
Joint hypermobility is associated with an increased incidence of delayed motor development in infants.[10] Muscle weakness leads to difficulty sitting upright. Normal developmental milestones suggest that an infant should be able to sit unsupported in the upright, seated position by 6 months of age. Infants with joint hypermobility may not only be late sitting, but when they eventually sit, the spine characteristically flexes forward into kyphosis.

Three joints have been found to be significantly associated with motor delay. Joint hypermobility associated with motor delay is seen significantly with hip abduction, elbow hyperextension and foot dorsiflexion.[10] It is recommended that particular attention should be given to evaluation of these three joints when examining infants. Flexibility of the hip joints can affect an infant's ability to get up into a kneeling position or on to all fours. A hypermobile infant, on their tummy, will typically position their legs wider apart than usual, making it more difficult for them to flex the hips and come up to a kneeling position. One study identified that infants, from the ages of 8 to 14 months, who had hypermobile joints, also demonstrated a significantly increased incidence of motor delay.[11] This study further reported that within the following six months, normal motor development was achieved in the majority of subjects.

Congenital Hip Dislocation
Infants at high risk of developing congenital hip dislocation (CHD) are females, firstborn, and breech presentation deliveries. Many studies have demonstrated the association between congenital hip dysplasia and joint hypermobility. Breech births are two to eight times more common in females, which might explain why females account for 80 percent of all cases of hip dysplasia.[12] Salter described the likely etiology for CHD as involving marked congenital laxity of the hip joint capsule, being possibly hormonal and

possibly genetically determined.[13] Carter and Wilkinson showed that children who have congenital hip dysplasia, and their first-degree relatives, tend toward generalized joint hypermobility.[14] Wynne-Davies reported on the association between joint hypermobility and congenital hip dislocation as far back as the early 1970s.[15] A study by Carr demonstrated that children with congenitally dislocated hips had significantly more joint laxity than did controls.[16]

Developmental Dysplasia of the Hip

The term developmental dysplasia of the hip (DDH) which is now more commonly used, describes the whole range of deformities involving the growing hip, including frank dislocation, subluxation and instability, and dysplasia of the femoral head and acetabulum. Early diagnosis and treatment for DDH are critical. Screening for this condition is of utmost importance and traditionally has involved orthopedic testing after delivery (Ortolani test, Barlow test, and others). An awareness of a family history of generalized joint hypermobility can be of importance in early identification and management.

Joint Hypermobility in Childhood

In a British study by Adib, a group of 125 children (64 females) with joint pain were evaluated to help determine the etiology of their symptoms. Examination for hypermobility revealed that 94% scored more than 4/9 on the Beighton scale for generalized hypermobility. The joints most frequently involved were knees (92%), elbows (87%), wrists (82%), hand metacarpophalangeal joints (79%), and ankles (75%). The major presenting complaint was arthralgia in 74%, abnormal gait in 10%, apparent joint deformity in 10% and back pain in 6%. The mean age at first walking was 15 months; 48% were considered 'clumsy' and 36% as having poor coordination in early childhood. Twelve percent had 'clicky' hips at birth and 4% had congenitally dislocatable hips. Urinary tract infections were present in 13 and 6% of the female and male cases, respectively. Thirteen and 14%, respectively, had speech and learning difficulties diagnosed. A history of recurrent joint sprains was seen in 20% and actual subluxation/dislocation of joints in 10%. Forty per cent had experienced problems with handwriting tasks, 48% had major limitations of school-based physical education activities, 67% other physical activities and 41% had missed significant periods of schooling because of symptoms. Forty-three per cent described a history of easy bruising.[17]

Effect of Joint Hypermobility During Pregnancy

Questions one might consider, relating to joint hypermobility during pregnancy, include 1) does benign joint hypermobility during pregnancy cause an increase in low back or pelvic pain; 2) does benign joint hypermobility change birth outcomes; and 3) does benign joint hypermobility cause an increase in the time taken post-partum for the maternal pelvis to regain stability?

Concerning low back and pelvic pain, Mogren identified that women with joint hypermobility had more persistent low back and pelvic pain after pregnancy and had significantly earlier onset of pain during pregnancy.[18]

Knoepp identified that benign joint hypermobility syndrome may facilitate spontaneous vaginal birth but does not appear to be a risk factor for pelvic floor disorders in the first decade after childbirth.[19]

Calguneri conducted a study of changes in peripheral joint laxity occurring during pregnancy in 68 females. A significant increase in joint laxity measured during the last trimester of pregnancy was greater than measurements from the same individuals after parturition. When primigravida and multigravida were compared, a highly significant increase in laxity was found in women having their second baby over those having their first though no further increase in laxity occurred in subsequent pregnancies.[20]

A French study of obstetric outcomes in women with joint hypermobility indicated no significant increase in the incidence of deliveries by cesarean section or premature births: the incidence of both multiple and singular spontaneous abortion however, was significantly higher.[21]

Sandoz conducted a radiographic study of pubic symphysis stability post-partum.[22] With subjects standing, weight-bearing on one leg, it was determined that significant unilateral height deviation on the weight-bearing side of the pubic symphysis could be measured, indicating hypermobility of the joint supporting structure. Serial radiography determined that this hypermobility persisted for up to 6 months post-partum. No information was provided however relating to the subjects' joint hypermobility status or family history of joint hypermobility.

Joint Hypermobility and Musculoskeletal Pain

Children and adolescents with increased joint laxity have been found to frequently suffer from chronic musculoskeletal pain complaints.[23, 24]

One study found that 81% of Israeli school-children with fibromyalgia had joint hypermobility,[23] and another study based in the United States reported that 40% of adolescents with fibromyalgia also had joint hypermobility.[26]

An increasing number of studies have demonstrated a significantly increased incidence of back pain in subjects with BJHS. Morris (2017) conducted an extensive literature review on the topic of hypermobility and musculoskeletal

pain in adolescents. [27]

Joint Hypermobility and Intervertebral Disc Degeneration
A controlled study was carried out on male subjects aged between 20 — 30 years with lumbar disc herniation diagnosed by MRI. Joint hypermobility scores were evaluated based on the Beighton scale. The prevalence of joint hypermobility equal to or greater than 4/9 was significantly greater in the study group (13.2%) than in controls (5.1%).[26] An increasing number of studies have been conducted to determine the incidence of disc herniation in adolescents.[29-33] A controlled MRI study of 39 students at 15 years-of-age identified disc degeneration was present in 15 (38%) of the children with LBP and in 10 (26%) of the control subjects.[29] Although an increasing number of studies have identified disc degeneration as a cause of low back pain in children, no studies could be located that considered collagen gene mutations to be a potential cause of early deterioration of the intervertebral disc. This is an area of research that may help refine the etiology of intervertebral disc degeneration in the pediatric population.

Joint Hypermobility and Osteoarthritis
Joint hypermobility is common, familial and associated with joint pain and osteoarthritis. A U.S. study of 130 adult patients demonstrated a statistically significant association between joint hypermobility and the premature development of osteoarthritis.[7] There is increasing evidence that joint hypermobility is an important, yet largely unacknowledged, risk factor in the pathogenesis of osteoarthritis (OA). Hypermobility might be considered to place additional stress on the cartilage supporting and insulating the joint capsule, resulting in premature degeneration. Remember, we have already identified type II collagen as being responsible for the formation of most of the articular cartilage in joints. Genes have been identified as the strongest risk factor for OA in the general population and mutations in the genes for Collagen I, II, IX and X1 have been implicated in osteoarthritis.[34] A further study by Mustafa suggests that female hip OA is linked to a defect in the type IX collagen gene.[35]

Association between Joint Hypermobility and Adolescent Idiopathic Scoliosis
The prevalence of BJHS in a group of 1584 adolescents, 14 years of age, was 60.6% in girls and 36.7% in boys, when using the standard Beighton cut-off score of ≥4.[36]

Controlled studies to assess the incidence of joint hypermobility in adolescents with idiopathic scoliosis demonstrated that joint hypermobility occurred in 51% of the study group, whereas in the control group, joint hypermobility was identified in only 19% of cases.[37] No significant relationship was found between the prevalence for joint hypermobility and the Cobb's angle, degree of apical vertebral rotation, the number of vertebrae within the curve or the age of the subjects. Joint hypermobility prevalence however, was found to be higher in children with single curve scoliosis than in children with double curve scoliosis. The prevalence of generalized joint hypermobility in girls with idiopathic scoliosis varied by age. The younger the subject, the more likely she was to have joint hypermobility. The prevalence for each group was determined to be 9—12 years (34.2%), 13—15 years (25.6%), and 16—18 years (5.6%).[37] These findings suggest that children with a higher risk of developing adolescent scoliosis can be identified earlier by performing assessments for joint hypermobility. The prevalence and severity of scoliosis is higher in girls than in boys. For mild curves (10° to 20°) the ratio has been reported to be 1.4 to 1, whereas for more severe curves the ratio is reported as 7.2 to 1.

A study of 2600 female junior high school students demonstrated that classical ballet training was most common in adolescent girls with idiopathic scoliosis. The odds of adolescent idiopathic scoliosis developing increased as the frequency of training, the number of years of experience, and duration of training in ballet increased.[38]

Children with joint hypermobility have increased joint flexibility and are more likely to develop adolescent idiopathic scoliosis. Joint hypermobility is a physical characteristic that provides a distinct advantage for participation in classical ballet. Subjects with joint hypermobility may be drawn to ballet as a sport because their body is better able to perform the required movements. This fact may help to explain the predominance of ballet dancers with scoliosis. Dancers who are naturally predisposed to their sport may proceed to higher levels of performance, being reflected in their frequency of training and duration and years of experience. They perform at a higher level because their body affords them this ability.

Effect of Joint Hypermobility on Muscles
A clinically consistent finding in patients with BJHS is tight paraspinal muscles. Affected patients seek out exercise routines and home care to help with this affliction but the effects appear to be only short term. Involuntary muscle contraction in these patients is likely associated with nerve compression or irritation of the nerve supply to the involved muscles. The increased motion of the spinal joint capsules, being a cause of mechanical stimulation, could be a result of irritation of the free nerve endings (nociceptors) in the intervertebral facet joint capsules and associated ligaments. Peripheral nociceptive fibers transmit sensory impulses to the spinal cord, performing a "loop", similar to the neurology of deep tendon reflexes, before transmitting a motor stimulus out to skeletal muscle fibers. The brain

is simultaneously informed of the painful stimuli but can significantly suppress the pain signals by secreting endogenous opioids. The result of this muscle stimulation activity likely produces the common finding of tight paraspinal muscles in patients with FLL.

Patients with tight muscles associated with BJHS will frequently find their way into yoga classes where the exercise routines stretch and loosen the tight spinal muscles. Because such patients naturally have increased joint flexibility they find yoga movements quite easy to perform. "Pilates" exercise routines also seem to have similar effects on patients with BJHS. Massage also would appear to help, but the effect is only short term. Because these patients' muscles are chronically tight, possibly due to the build-up of lactate due to anaerobic metabolism, patients with FLL will often complain of intense muscle soreness when tissues are pressed upon as in a deep soft tissue massage. It is not uncommon for such patients to have been previously diagnosed with fibromyalgia. An increasing number of studies, previously discussed, have shown a significant link between fibromyalgia and BJHS.[26, 39]

Infants and toddlers with joint hypermobility tend to have tight hip muscles affecting their ability to crawl, walk and balance. This may contribute to a delay in their ability to sit independently, often sitting with a very rounded back or sitting cross-legged in the "W" position (flexed, internally rotated hips, with flexed knees). These infants often skip crawling completely, being inclined to bottom shuffle instead. Children with joint hypermobility tend to develop co-ordination and attention problems as they get older.[17] This characteristic may be attributed to their having tight muscles and, since movement helps to loosen and stretch out tight muscles, it may be that their more frequent mobility provides them with some level of comfort. The question arises: Could such children be labeled as "hyperactive" simply due to the difficulty they have in sitting still in class?

Effect of Joint Hypermobility on Vascular Tissues

Joint hypermobility and Ehlers-Danlos syndrome (EDS) has been well documented. The increased flexibility and fragility of the soft connective tissues in such patients results in a wide range of changes in the skin, ligaments, joints, blood vessels and internal organs. Ehlers-Danlos syndrome has been sub-classified into six types based on the associated clinical manifestations. The type IV classification of EDS has increased vascular findings.[50] These findings include easy bruising, early onset of varicose veins, fragile arteries, intestinal symptoms and uterine fragility or rupture. Abnormalities with the expression of collagen type III have been identified as being associated with EDS.

Patients with a similar problem in the expression of type III collagen, but who are not as far along the hypermobility scale as those with EDS, may well have some of these vascular signs and symptoms as seemingly unrelated findings. Patients with varicose veins are commonly seen to have joint hypermobility. Along with a high frequency of occurrence of varicose veins, hemorrhoids and uterine prolapse have also been identified.[40] The development of varicose veins during pregnancy is recognized as being due to hormonal mechanisms which create venous dilatation. The contributing factors are mechanical obstruction of the venous outflow in the pelvis due to the increasing size of the baby, increase in the circulating blood volume and hormonal effects causing smooth muscle dilatation with an inhibition of normal contractility.

Pulmonary Embolism

A pulmonary embolism occurs when an embolus, usually a blood clot, blocks the blood flowing through an artery that feeds the lung. The most common cause of these emboli is deep vein thrombosis (DVT) in an extremity. The cause of DVT can be an injury to the muscles, soft tissues or blood vessels causing clots to form which travel to the lungs. An inherited weakness of the tissues forming the walls of the blood vessels could be a precipitating factor in pulmonary embolism in which type III collagen rich systemic arteries may be predisposed to undergo dissection, aneurysm, or rupture. A study to evaluate the hypermobility of patients diagnosed with pulmonary embolism may well add to the knowledge base of BJHS.

Effect of Joint Hypermobility on Bones

When treating a large cohort of patients, it may often be noticed that patients who present with joint hypermobility also have a history of one or more fractures. The question arises: is there a link between joint hypermobility and fractures?

Joint hypermobility syndrome is a characteristic feature of osteogenic imperfecta (OI), a disorder caused by genetic defects that affect the body's ability to make strong bones. The affected individual has too little type I collagen or a poor quality of type I collagen due to a mutation in one of the type I collagen genes. Collagen is the major protein of the body's connective tissue and genetic mutations that interfere with collagen production result in fragile bones that break easily. Type I collagen defect is also associated with ligament laxity, so it is likely that the possible link between JHS and OI is noticeable.

OI has various subtypes, some of which are lethal. OI Type I is the most common and mildest form of OI and the two conditions may therefore be linked clinically. The following list describes the clinical features of the mildest form of OI.

- Most common and mildest type of OI.

- Bones fracture easily; most fractures occurring before puberty.
- Normal or near-normal stature.
- Loose joints and muscle weakness.
- Sclera (whites of the eyes) usually have a blue, purple, or gray tint.
- Triangular face.
- Tendency toward spinal curvature.
- Bone deformity absent or minimal.
- Brittle teeth possible.
- Hearing loss possible, often beginning in early 20s or 30s.
- Collagen structure is normal, but the amount is less than normal.

Osteoporosis
Studies have shown that femoral and trochanteric bone mineral density scores were significantly lower in hypermobile patients compared to controls. Low bone mass was more frequently found among subjects with hypermobility (p=0.03) and hypermobility was found to increase the risk for low bone mass by 1.8 times (95% confidence interval).[41]

Effect of Joint Hypermobility in Sports
Individuals possessing joint hypermobility seem to have an advantage in certain sports and artistic occupations, gymnastics and ballet being most noticeable. Individuals with an increased degree of hypermobility may self-select into sports for which joint hypermobility provides a distinct advantage. Sports coaches too may well be aware of such advantages and be on the look-out for novices who at an early stage of training are already demonstrating the flexibility characteristics required for success.

Gymnastics
Gymnastics is a sport for which joint hypermobility is required to become competitive at a high level of the sport. A young gymnast who at an early age is able to do a backbend and place her head down behind her heels may quickly catch the attention of a coach. Increased joint range in many a hypermobile child is a familial trait that helps with their performance ability. So, can joint range be increased into the hypermobile range by sheer hard work and training? Of course, many world class gymnasts demonstrate the advantages of hard work and long hours of training, but what about the young child who wants to become a gymnast and does not have the joint hypermobility endowed upon so many of her fellow competitors? As one patient (low on the Beighton scale) complained to me, "I was a gymnast as a child and I worked longer and harder than most of the others that I trained with, but I was never able to perform the moves that just seemed to come naturally to the others in my team." Some of the characteristic traits that one sees frequently in world class gymnasts are hypermobility of the lumbar spine and hyperextension of the elbows demonstrating that they would likely score high on Beighton's scoring system.

Ballet
Ballet dancers who are not inherently lax jointed need to acquire hypermobility in certain joints to perform their art. The question we should ponder here is "are ballet dancers born or are they made"? How much of the joint laxity is the result of regular training and how much is due to inherited joint hypermobility? Certainly, joint flexibility is a great advantage to ballet dancers in performing the impressive movements required of their craft. Controlled studies have demonstrated that ballet dancers show a significantly higher Beighton score than non-dancers.[40] A study conducted of the most prestigious ballet companies in the U.K. noted that joint hypermobility was prevalent in 95% of female and 82% of male dancers, which suggests that to some extent, inherited JH was a selection factor in recruiting.[41] The downside of increased flexibility in dancers is that joints such as the elbows tend to hyperextend past the neutral position "spoiling" the graceful lines that professional dancers strive so hard to achieve. This problem however, can be compensated for to a degree by developing the supporting musculature of the hypermobile joints or by voluntary muscular control, thus helping to correct the less acceptable appearance of such alignment. A question one might ponder is "does the flexibility that is so common in ballet dancers cause long term damage to their joints?"

Studies of dancers would suggest that they are more likely to develop premature osteoarthritis of the hip.[44] Radiographic studies of early joint degeneration in professional ballet dancers show thinning and irregularity of the medial knee joint with bone marrow changes in the lateral femoral condyle, loss of joint space and degenerative changes in the hip. Miller conducted a study of injuries to classical ballet dancers and identified a range of problems that included osteochondral fractures, fatigue fractures, sprains, chronic ligamentous instability of the knee, degenerative arthritis of multiple joints and low back pain.[43] One might ponder if the high incidence of stress fractures in the legs and feet of ballet dancers could be contributed to by defective collagen in the effected bones associated with their joint hypermobility.

Swimming
Swimming is a sport that requires muscular strength, good aerobic capacity and endurance. Elite swimmers however are often endowed with an additional quality: hypermobility, which in swimming is an undeniable asset. Flexibility in the shoulder joints makes it possible not only to swim faster but also to swim less slowly (a subtle difference). Increased shoulder mobility helps the swimmer to lift their shoulders out of the water more easily, increasing the am-

plitude of their stroke. In some swimming strokes, such as butterfly, shoulder hypermobility allows the joint to subluxate the humerus from the glenoid fossa, permitting a wide range of shoulder movement and resulting in a greater power stroke. Finally, ankle flexibility is a key asset when swimming. A striking example can be seen watching US Olympic champion, Michael Phelps swim. In addition to his size 14 feet, his ankles can bend 15 degrees further into dorsiflexion than typical. Swimming may be a sport chosen by people with joint hypermobility because of the distinct advantages it provides. Recognizing this, clinicians should be in a better position to advise their hypermobile patients regarding appropriate sports participation.

Athletics

In athletic competition, individuals with small physiques are more suited to long distance running whereas taller individuals have an advantage in long jumping. Hurdlers require a wide range of hip joint flexibility to allow for increased hip abduction, permitting smooth transition over the obstacles in their path. Joint flexibility is an advantage for high jumpers, while javelin throwers need shoulder flexibility. These are just some examples to indicate the advantages conferred by joint flexibility. This is by no means an extensive list of sports but awareness in the mind of the clinician helps identify the causes of some sport-based patient complaints. However, hypermobility is not necessarily an advantage in every sport. In sports such as soccer, football, wrestling, basketball and volleyball, hypermobility is not seen as an advantage, but it may influence the pattern of sporting injuries sustained. Hypermobility studies have demonstrated that joint proprioception in the lower limb is reduced.[46] This may be a contributing factor to ankle sprains in basketball players.

Link Between Joint Hypermobility and Attention Deficit Hyperactivity Disorder

Attention-deficit/hyperactivity disorder (ADHD) and BJHS are two separated conditions, assessed and managed by different specialists without overlapping interests. Recently, some research has highlighted an unexpected association between these two clinical entities: A controlled study by Shiari identified joint hypermobility in 74.4% of children with attention deficit hyperactivity disorder compared with 12.8% of healthy controls.[49] A study of the research literature by Baeza-Velasco highlighted potential symptomatic links between ADHD and joint hypermobility as involving impaired coordination, impaired proprioception, fatigue, chronic pain, and dysautonomia.[47]

Hypothesis: Link Between ADHD and Joint Hypermobility

Here is an untested hypothesis derived from many years of clinical observation by the author. After specializing in pediatrics for many years, the incidence of children presenting with joint hypermobility and ADHD became an expected finding. As we have previously discussed, patients with joint hypermobility frequently suffer with tight paraspinal muscles. Movement and stretching of the body joints and limbs has been shown to help, with adult patients reporting improvement after stretching classes, such as yoga. In school, children often are required to sit still for extended periods of time. Children with joint hypermobility may have difficulty with this request, because they innately feel that movement helps their condition. As a result, they may jump up or squirm and fidget around in their seat, perhaps because moving their muscles and joints around feels good. Is this then why they are labeled hyperactive?

Spinal Hypermobility - Patient Characteristics

A frequently encountered characteristic in any chiropractor's patient population is the patient who can "self-adjust." One example is the school-aged child who, while sitting in class, twists the torso around in both directions to make the spinal joints "pop." Another is the patient who twists the head in both directions far enough to induce cavitation. Both these patient types report deriving some "ease" of the tightness they feel in the spine and associated tissues.

Clinical Considerations for Spinal Adjusting and the Hypermobile Patient

Infant joints are naturally more mobile than older children and adults. Evaluating an infant for hypermobility should include the family history, particularly as it relates to hypermobility. Testing the mother and father, according to the Beighton criteria, may identify a familial propensity to hypermobility which can affect the infant. Additionally, evaluating an infant's motor skills may identify developmental delay.

Manual adjustment of the spine requires a technique to move the intervertebral joints to the point of ligament tension, which is just short of the point at which joint cavitation will occur. This is followed by a light thrust to release the vacuum within the joint, which increases the facet joint space dimension, thus reducing pressure on the intracapsular structures. The difficulty encountered in adjusting hypermobile patients is associated with their increased range of motion. To reach the point of ligament tension a greater range of movement is required.

This requirement creates difficulty in successfully performing manual spinal adjustments on this patient type. To compensate for this excess joint mobility, some doctors will utilize an Activator-type adjusting instrument that delivers the impulse thrust with the spine in the neutral position. Others may use a "drop-technique," "cervical stair-step" or "press and hold" type of adjustment, using an appropriate line of drive. Manual adjusting techniques for the spine are

most commonly the Diversified or Gonstead type adjustments with Activator Methods being the most frequently used instrument adjusting technique.[48] It is the author's opinion that for patients identified with joint hypermobility, the Gonstead seated-type adjustment for the cervical spine is more appropriate than the Diversified adjustment, because it uses a reduced rotational component to reach the point of joint pre-stress. Doctors may find that the hypermobile patient whose cervical spine is difficult to adjust in the supine position responds better to a Gonstead-type seated adjustment as an alternative.

Considering the greater recognition that is being given to the clinical effects of joint hypermobility and the significant advances that have been delineated, chiropractors may well want to modify their standard approach to spinal adjusting. Studying each patient to identify their level of joint hypermobility may help achieve the successful clinical outcomes that all patients deserve.

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Portable pad or pen and paper? Preference of mothers completing an outcomes instrument: a cross-sectional survey

By Mandy Hiew, MSc[1], Derek Shawn Lo Tiap Kwong, MSc[1], Zicheng Mok, MSc[1], Yun Han Tee, MSc[1] and Joyce Miller, BS, DC, PhD[1]

1. AECC University College, Bournemouth, United Kingdom

Corresponding author: Joyce Miller, BS, DC, PhD. Email: jmiller@aecc.ac.uk

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ABSTRACT

Background: The objective of this study was to investigate the preferred method of data collection, paper or electronic, for mothers completing a validated infant outcomes instrument, the United Kingdom Infant Questionnaire. **Methods:** Mothers of children aged 0-12months were asked to complete the questionnaire in both paper and electronic formats. The mother was then given another form to select her preferred type of survey. **Results:** In all, 51 mothers participated; 35 (69%) preferred the electronic questionnaire, 11 (21%) preferred the paper version and 5 (10%) felt neither one was better. Comments included that electronic form was easier and it was better to save the trees. **Conclusion:** Although the number was small, this study showed that electronic-based questionnaires were preferred by mothers of infants. With the progression of technology, electronic questionnaires could be considered a more efficient method for collecting important data, without loss due to patient or parent preferences.

Introduction

Within the medical profession, the earliest found written records of a patient's history, prescription and depiction of diseases were from the fourteenth century by Greek medical doctors. However, in current age of informatics, it could be debated whether pen and paper are still the best tools to be used when portable computers, electronic storage devices and the internet are making their way into every aspect of our life.

Paper records may be slowing down progress. For example, Tim Kelsey, NHS England's national director for patient and information in 2015, said, "every day, care is held up and patients are kept waiting while an army of people transport and store huge quantities of paper around the healthcare system" stating an obvious waste of both natural and human resources.[1] There are many issues with paper-based records, time consumption, handwriting, redundant data keeping or data stored at different locations.[1,2] In 2015, the NHS spent an estimate of £125-250 million ($162-325 million) for paper storage.[3] Chiropractors based in Canada researched the feasibility of online software to collect information from their patient and 80% showed a preference for the online option.[4]

Complete transition from pen and paper to an electronic substitute in the healthcare scene would be a big leap for progress resulting in not only lesser consumption of non-renewable resources, but a more effective relay of information.[7] No studies have been done to compare paper or electronic preference on the specific population of parents reporting outcomes for their infant's care. Starting with newborns would be a major step toward electronic informatization, given that data collected over the course of an individual's entire life might be more beneficial in the long term.

Methods

This study was conducted in a chiropractic teaching clinic, located on the south coast of England. All infants between the age of 0 to 12 months who presented to the clinic between January 2017 and April 2017 were eligible for inclusion. The English-speaking mothers were asked to complete both a paper version and an electronic format of the same United Kingdom Infant Questionnaire (UKIQ) either at the intake or discharge. No other exclusion criteria were used.

The UKIQ is a validated questionnaire used by the teaching clinic for infants aged between 0 to 12 months. The questionnaire was used to monitor infant's progress over the course of treatment. The intake UKIQ is given to every infant's mother at presentation to the clinic. The follow-up form was given at the 4th visit or discharge of the patient, whichever came first. The collection of data was procured either at infant's intake or discharge. All questionnaires were handed out and completed in the presence of our research members exclusively to ensure all potential enquiries by the mothers were clarified. Verbal permission from the mothers was acquired prior to administrating both questionnaires. The paper questionnaire was handed in followed by electronic questionnaire on a tablet specifically dedicated for this study. All mothers who enter the clinic

signed a form that agreed for their infant's anonymous data be used for research purposes. This study was approved by the AECC ethics research subcommittee.

Mothers were asked to answer all the questions. As for the electronic questionnaire, all questions had to be answered before the form could be submitted. The preference of each mother towards paper or electronic questionnaires was noted following their completion of both questionnaires in a paper survey. Additionally, mothers were given an opportunity to comment regarding the reason for their chosen preference. They could also make a comment to the research staff, if they chose.

The responses were collected and combined by the research team. Data from this study were analysed using descriptive statistics in Excel. The results were tabulated into percentage for comparison and collected comments were collated.

Results

In total, 51 mothers participated in this study. Overall, 69% of the mothers preferred the electronic forms over the paper version. Five participants were neutral on both data collection methods, eleven mothers were supportive of the paper version and the others displayed the complete opposite in favour of the electronic format. Some mothers also added comments.

Questionnaire preference	Total (n= 51)
Electronic form	35 (69%)
Paper form	11 (21%)
Neither	5 (10%)

Table 1. Mothers' preference of paper versus electronic form.

Why electronic form preferred?	Why paper form preferred?
Fast and fluent with electronic devices	The tablet is heavy with fonts that are too small and the possibility of accidentally changing the answers/options while fiddling with the touch screen interface.
Lesser use of paper	Input of any information on a paper format is possible without the limitation of options provided by the electronic format.

Table 2. Mothers' comments on preference towards outcome instruments.

Discussion

This was a study of whether mothers presenting their infant to a chiropractic clinic preferred to complete an outcome instrument on paper or with a portable tablet. Most mothers in our study preferred the electronic questionnaire. This finding was corroborated by a Canadian study of 45 patients who were given options of questionnaires in either paper or electronic format and showed preferences for the software version.[4]

However, in contrast, a Dutch research group worked with 136 breast cancer patients within a hospital setting and had them fill in questionnaires in either paper or electronic format. Two-thirds of their patients chose to fill out the paper version while just over a third preferred the electronic option. The patients who chose the electronic questionnaire were reportedly much younger and higher educated than the rest of the population.[5] It is likely that a population of young mothers presenting to chiropractors may well be similar to the population that preferred the electronic survey.

Another Dutch study consisting of 277 female childhood cancer survivors from around the nation were randomized into two groups and sent invitations to participate by paper and electronic means. The paper-based group were also given the option to switch to electronic format through the invitation sent to them. The gathered data showed no differences in filling the questionnaires between both groups but also showed more respondent filling the paper-based questionnaire rather than the electronic format.[6]

Kania-Richmond et al, studied the use of online software for questionnaire administration and recorded that the patients found the electronic system better.[4] They reported lower error rate with better attention to the patient's privacy and ease to fill in the forms in their own free time. From the patient's perspective, an important factor impacting the accuracy of information provided was linked to the restricted fields in the questionnaires and inability to customise their answers. It is important to note that a study in Scandinavia compared the response rates from four different modes of data collection. Their result showed no loss of data regardless of the method.[8] Accuracy of data is the most important factor in any process of data collection.

Limitations

There are, of course, limitations to this study. The participant group for this study was small and limited to a specific region in England. Potential participants may have been missed during their first visit when no research members were available to conduct the survey or when the tablets were occupied/unavailable. There also could be circumstances whereby the mother would refuse to complete both questionnaires due to a multitude of factors: infant being unsettled, too lengthy a questionnaire to do twice or the lack of time.

While results showed 69% of preference towards the elec-

tronic format, it should also be noted that there would be a number of confounding factors to be accounted for:

1. Bias of the individual administrating the study.
2. The order in which the paper or electronic questionnaires were given to the mother.
3. Financial class of our patient
4. Discrepancy within the data collection team in keeping the protocol exact

Advances in technology leap forward on a daily basis, the healthcare system around the world is bound to scrap out paper and pen for portable electronic devices in an attempt of saving both the environment and monetary resources. More research should be done in respect to not only the administration of the questionnaire, to investigate the change in behavior, cognitive and pattern recognition aspect but also to look deeper into what it entails to apply this to a large-scale system such as the NHS. Safe storage of the electronic data would be of prime importance with maybe the use of governmental/military software protections and trying to better manage the classification/traceability of the documents themselves.

Conclusion

In this study, mothers who presented their infant to a chiropractic teaching clinic showed an inclination toward electronic-based questionnaires as easier and faster to complete. It is not surprising that a young adult population has ease in manipulating an electronic device and prefers it to paper. Additional research should be carried out to confirm our assumption with consideration of other factors such as geographical location, intellectual level and financial status of the patient population.

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Early intervention: Improvement in motor developmental speech delay in a 2-year-old male following chiropractic care: a case report

By Andrew Dorough DC[1]

1. Private Practice, O'Fallon, Missouri
Email: dr.dorough1031@gmail.com

ABSTRACT

Objective: To chronical the improvements in a non-verbal 2-year-old male presenting without the age appropriate receptive language. At the time he presented, he was unable to pronounce simple vowel sounds. **Methods:** Online review of the literature on motor development delay, speech delay and chiropractic were performed using the index to chiropractic literature, PubMed and Google Scholar. Search terms "motor developmental delay", "speech delay", "child apraxia", "speech delay and chiropractic", "speech and language delay" and "spinal manipulation" were used. **Clinical Features:** A 2-year-old male with apparent motor speech delay reported to the office for chiropractic care. This child was almost completely non-verbal and unable and or unwilling to articulate simple vowel sounds, simple words or word sounds. His expressive vocabulary consisted of 5-8 words that were poorly pronounced. His main form of communication was crying or using bodily gestures. The child had seen no other professional for this complaint nor had he received any treatment by another professional for this complaint. **Intervention and outcome:** The child received cervical and cranial chiropractic care for 7 visits over 8 weeks using digital vibration with hands (Gonstead technique) and Sigma-Instrument (instrument assisted) technique to correct cervical vertebral and atlanto-occipital segmental dysfunction. Throughout chiropractic care, the child showed steady progress in articulating vowel sounds, word sounds and simple words including pronunciation attempts upon reading words. Parents also report, subjectively, that child has become more "affectionate" and "loving". **Conclusion:** An early intervening course of chiropractic care using modified Gonstead Technique and Sigma Instrument assisted adjusting technique for the correction of cervical vertebral and atlanto-occipital bone subluxation were associated with improvement in the child's presenting motor developmental speech delay.

Keywords: motor developmental delay, speech delay, child apraxia, speech delay and chiropractic, speech and language delay.

Introduction

The World Health Organization defines developmental delay as a child who is not meeting a range of milestones at the expected rate of development.[1] Developmental delay includes a variety of areas including but not limited to cognitive skills, fine and gross motor skills, speech and language skills and social and emotional skills.[2] This paper will investigate the speech component of child development and the effects and treatment options if delay is present.

Speech is the oral expression of thought. Apraxia is a motor speech disorder that makes it difficult for children to speak requiring significant effort to articulate sounds and words. To speak, neuronal messages need to travel from the brain expressed through appropriate oral motor function. If your child has apraxia of speech (Childhood Apraxia of speech, aka: CAS), there is a "glitch" or fault in the transmission of the message to the appropriate muscles. A child might not be able to organize the required muscular movements of his lips or tongue to produce sounds, even though his muscles are not weak resulting in a small or simple vocabulary (expressive language). A child with CAS knows what he or she wants to say, but cannot say it. CAS is a problem with the communicating with the muscles of the mouth to move appropriately, not a reflection of their cognitive ability.[3] CAS is often called verbal dyspraxia or developmental apraxia. Even if the term "developmental," is used, CAS is not a problem that children simply outgrow.[3] A child with a developmental speech disorder learns sounds in a typical order, just at a slower pace. If a child has CAS, he will not follow typical patterns and will not make progress without treatment. With intense treatment and continued effort, a child's speech can improve. The cause is unknown.[3] According to ASHA, if a child is younger than 3 years of age and does not coo or babble as an infant, says her first words later than expected, makes only a few different sounds, has problems putting sounds together, has long pauses between sounds, does not always say a word the same way or has some problems eating, there is likely to be CAS present.[3] In addition, the University of Michigan Health System produced an information chart that articulates milestone norms in speech development (see figure 1).[4]

Current intervention includes multi-sensory cueing, in-

Age	Language Level
Birth	Cries
2-3 months	Cries differently in different circumstances; coos in response to you
3-4 months	Babbles randomly
5-6 months	Babbles rhythmically
6-11 months	Babbles in imitation of real speech, with expression
12 months	Says 1-2 words; recognizes name; imitates familiar sounds; understands simple instructions
18 months	Uses 5-20 words, including names
1 to 2 years	Says 2-word sentences; vocabulary is growing; waves goodbye; makes "sounds" of familiar animals; uses words (like "more") to make wants known; understands "no"
2 to 3 years	Identifies body parts; calls self "me" instead of name; combines nouns and verbs; has a 450 word vocabulary; uses short sentences; matches 3-4 colors, knows big and little; likes to hear same story repeated; forms some plurals
3 to 4 years	Can tell a story; sentence length of 4-5 words; vocabulary of about 1000 words; knows last name, name of street, several nursery rhymes
4 to 5 years	Sentence length of 4-5 words; uses past tense; vocabulary of about 1500 words; identifies colors, shapes; asks many questions like "why?" and "who?"
5 to 6 years	Sentence length of 5-6 words; vocabulary of about 2000 words; can tell you what objects are made of; knows spatial relations (like "on top" and "far"); knows address; understands same and different; identifies a penny, nickel and dime; counts ten things; knows right and left hand; uses all types of sentences

Figure 1. Speech and Language Delay Disorder. University of Michigan Health System.

tegral stimulation, progressive approximation, phonetic placement, tactile facilitation, prosodic facilitation and gestural cueing.[5] Treatment selection depends on several factors, including the severity of the disorder and the communication needs of the child. Because symptoms typically vary both from child to child and for the same child. Multiple approaches may be appropriate at a given time or over time.[6] Diagnosis of CAS is age sensitive and evaluation begins at age three. Diagnosis of CAS in children under 3 is challenging for a variety of reasons, including but not limited to:

1. The potential presence of developmental disabilities and/or comorbid conditions;

2. The lack of a single validated list of diagnostic features that differentiates CAS from other types of childhood speech sound disorders (e.g., those due to phonological-level deficits or neuromuscular disorder);

3. The fact that some primary characteristics of CAS (e.g., word inconsistency, a predominant error pattern of omission, etc.) are characteristic of emerging speech in typically developing children under the age of 3 years;

4. The lack of a sufficient speech sample size for making a more definitive diagnosis;

5. The challenge of sorting out inability versus unwillingness to provide a speech sample or to attempt a speech target;

6. The possibility that changes occurring prior to age 3 (e.g., developmental maturation, social and linguistic peer exposure, and beneficial effects of therapy) may alter the diagnostic label.[7,8]

Preliminary research using retrospective analyses of home videos suggests some early indicators of CAS below the age of three.[7,8] However, given the preliminary nature of this data and the need for more research (e.g., longitudinal studies from infancy), diagnosis below age 3 is best categorized under a provisional diagnostic classification, such as "CAS cannot be ruled out," "signs are consistent with problems

in planning the movements required for speech," or "suspected to have CAS."[9]

Chiropractic care for the pediatric population is growing in acceptance.[10,11] Chiropractic care intends to remove nerve interference caused by vertebral subluxation.[12] A vertebral subluxation represents an altered state of afferent input which can lead to maladaptive changes in central neural plasticity resulting in dysfunction.[12] Current literature regarding the chiropractic management of infants and children with developmental delays is limited.[13-16] The evidence to date suggests that chiropractic care may be beneficial for this population.[13-16] The purpose of this case report is to demonstrate the improvements in speech delay found in a 2-year-old male following early intervention utilizing age appropriately modified Gonstead Technique and Sigma Instrument assisted adjusting technique for the correction of cervical vertebral and atlanto-occipital bone subluxation.

Methods

To review the definition of childhood Speech Apraxia and its relevance to chiropractic, an online review of the literature on motor development delay, speech delay and chiropractic were performed using the index to chiropractic literature, PubMed and Google Scholar. Search terms included: "motor developmental delay", "speech delay", "child apraxia", "speech delay and chiropractic", "speech and language delay" and "spinal manipulation" were used. Databases were searched from inception through February 2018, with utilized studies, case reports and research based standards, all of which are peer-reviewed.

Case Report

History: A 2.5 - year-old male with speech delay presented for chiropractic care. The mother and father report that labor was chemically induced (Pitocin) and lasted approx. 22 hours. The mother reported that she pushed for 1.5 hours until her child was delivered vaginally. Both parents reported that there is a family history of Asperger's and autism, however, the child did not appear to demonstrate these developmental issues.

The mother reported that the child had no breastfeeding challenges however, both parents noted that this child had trouble lying prone and was not able to lift his head up well (did not extend at C01) while prone between months 4-8. He was able to do perform pushups (extending from the waist recruiting his trapezii and levator scapulae), however would cry while doing this activity. The child had no other apparent development motor delays.

Before treatment, the child had an expressive vocabulary that consisted of 5-8 words, he was not retaining newly learned words, he would not try to mimic or attempt to say unfamiliar words when asked to, he would not try to sound words or syllables out. Parents reported that he started to make minimal vowel sounds and speech sounds at 2 years of age.

Examination: Upon visual chiropractic examination, there was evident restriction in the oral pharyngeal complex which was assessed by observing the TMJ which deviated to the left, head was in flexion. Upon command, the patient had trouble opening his mouth widely and extending his tongue beyond the teeth and lower lip. Excessive salivation was also noted.

Orthopedic and neurologic examination, revealed the following: Cervical Distraction Test was within normal limits bilaterally, Flexion Compression was positive. Jackson's Compression Test was within normal limits on left-side and was positive on right-side. Maximal Foraminal Compression Test was within normal limits on left-side and was positive on right-side. The last three tests elicited facial wincing, pupillary constriction and withdrawal reflex which presented throughout test thus indicating tension pain and soreness. Reflexes: Biceps reflex, Triceps reflex, and Brachioradialis reflex were within normal limits bilaterally.

Range of Motion (Passive): Cervical ROM: Flexion was within normal limits. Extension is 40° (66% of normal), limited by: Spasm, Guarding; Left Lateral Flexion was within normal limits; Right Lateral Flexion was within normal limits; Left Rotation was within normal limits; Right Rotation was within normal limits. Spinal Fixation/Malposition/Palpatory findings: Occiput restricted on the right; C1 facet capsular swelling on the right; C2 facet capsular swelling on the right; C3 facet capsular swelling on the right. All the aforementioned restrictions were associated with patient irritability upon palpation.

Patient was fussy and cried when light touch (approx 1-2 pounds of pressure) was applied to right cervical paraspinal tissue.

Hypertonicity was found in the following areas: Left-Cervical paraspinal musculature and Right-Cervical paraspinal musculature.

Trigger points were found in the following areas: Left-Cervical-Spine (mild), Right-Cervical-Spine (moderate).

Edema was found in the following areas: Left-Cervical-Spine (moderate), Right-Cervical-Spine (moderate), (posterior) Left-TMJ (mild), (posterior) Right-TMJ (mild-moderate), (posterior) Left-Cervical-Spine (mild-moderate), (posterior).

Tenderness was found in the following areas: Left-Cervical-Spine (mild-moderate), Right-Cervical-Spine (moderate to severe), (posterior) Right-Cervical-Spine (moderate-severe).

Intervention: Cervical spine chiropractic care was administered over a period of 8 weeks where the child was seen 7 times, approximately one time per week. Vertebral subluxation was assessed using commonly used, and reliable, clinical indicators of restricted inter-segmental range of motion, asymmetric intervertebral muscle tension and abnormal spinal joint play.[17-19]

After the appropriate information regarding treatment for the patient was delivered to the parents and consent was obtained, chiropractic adjustments were made using age appropriately modified Gonstead Technique and instrument assisted Sigma-Instrument. Most chiropractic techniques are modifiable for use in the pediatric population based on their developmental stage anatomically and physiologically.

Outcomes: Over the course of chiropractic care, the child made considerable progress in speech and ability to make sounds and no adverse reactions to treatment were reported. Following the first 2 visits, he began making more letter sounds without solicitation from parents, he also began babbling differently and more clearly. After the third treatment, he began to pronounce more syllables and more words. A the sixth visit, the parents noticed that he was beginning to read syllables off of signs at the stores they went to and would attempt to say complicated words from these signs. After the seventh visit, the parents noticed that their child was more engaged with other children at the parks during play time and they also noticed that their son was becoming more affectionate. For example, after treatment he is now saying "hi" and "bye", blows kisses and gives hugs whereas this was not happening before treatment. Before treatment began, the parents reported that their child seemed unaffectionate and not playful with others. The parents reported that they have observed him performing more focused play and his general wellbeing has seemed to improve greatly.

Discussion

Gonstead technique is a widely utilized technique with a report of 58.5% of chiropractors using this technique (although not exclusively), with 28% of their patients receiving Gonstead care.[20] This is a procedure that utilizes digital palpation, motion palpation and visual analysis. This technique was utilized, singularly, for the first three treatments. The Sigma-Instrument adjustment was utilized to assist with the modified Gonstead technique. Sigma-Instrument is an oscillating percussion technique similar to the adjustment tool mechanics of the Activator Technique. Sigma-Instrument delivers an impulse that ranges from 1 Hz to 12Hz per impact. Mechanical vibration was introduced in the 1950's by Fulford.[21] Later on, Carnigan et al. demonstrated, in his works on Parkinson's, that specific frequencies have specific effects on the musculature, namely: 0-4 Hz creates inhibition of voluntary muscles, 4-8 Hz creates stimulation of the voluntary muscles and 8-12 Hz creates stimulation of the involuntary muscles.[22] For the purpose of this case, the instrument was set at 8 Hz to invoke an effect in the stimulation of voluntary muscles of the cervical spine and occipital region. The Sigma-Instrument was set on a delivery force of 10 pounds or 44.48 newtons per impact and an adjustment limit was set to 10 impulses per vertebral motion segment. Home care advice consisted of gentle massage of the cervical spine 2 times daily for 5-minute increments.

Speech and sound propagation improvements were reported in a 2.5 year old male over the course of 8 weeks of chiropractic care. The child had initially presented with motor speech and sound propagation delay with an inability to sound out words, pronounces syllables and say more than 5-10 words. Typical interventions for developmental delay involve a multi-disciplinary approach that includes physical therapy, occupational therapy, speech therapy, psychological therapy and early special education.[23]

It is important for early speech patterns to develop to support the development of higher brain functions later in life. Language and speech proper emerges in late infancy; and yet during a short three years the child should have a highly developed system of linguistic habits that he uses for the expression of his every need and desire, both physical and intellectual. In addition, he should be able to use complex forms of sentences with appropriate inflections, and his expressive vocabulary should consist of several thousand words later on in childhood.[24] Therefore, it is very important to identify speech pathology early on, before, three years of age. Moreover, it is important to investigate the role of chiropractic care in the treatment of cervical spine dysfunction in a child who has apparent motor developmental speech and language delay. Collaboration with speech and language pathologists holds the promise of providing comprehensive evaluation and treatment for children with these issues.

Limitations

There are inherent limitations of one case study. This includes a lack of a control group, the inability to include spontaneous remission or self-limiting clinical presentation. In this case the assessment of motor developmental speech delay was not made through a formal assessment or professional instrument or method due to the child's age, rather through subjective parental observations, objective clinical observations and reports of the parents and doctor of chiropractic. Additionally, it is unknown whether

the parents followed the homecare advice given, and if followed whether this resulted in the improved in speech changes observed.

Conclusion

Chiropractic care, using modified Gonstead technique and Sigma-Instrument technique for the correction of vertebral subluxation, was associated with improvements in the child's presenting speech and language delay. More research is needed to investigate the role chiropractic may play in collaboration with speech and language pathologists in supporting children who present with similar conditions.

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Chiropractic management of musculoskeletal disorders associated with a neonatal clavicle fracture: a case report

By Amelie Bourque, DC [1]

1. Private practice, Montreal, Quebec, Canada
Email: bourque.amelie@hotmail.com

ABSTRACT

Objective: To present chiropractic management of a 5-month-old patient with multiple complaints related to a neonatal clavicle fracture and the resolution of all symptoms after 4 treatments. **Case presentation:** A 5-month-old male presenting with history of a fractured left clavicle, fussing, irritability, crying, grunting, rigidity, abnormal positioning of his left arm at rest, breastfeeding difficulties on the right side and apparent discomfort lying on his stomach. He presented to a chiropractic office after consulting various health professionals without improvement. **Interventions, and outcomes:** Various techniques, including touch and hold, sacro-occipital, light vibration and mobilization were used to treat the 5-month-old male infant during the 4 visits complimented by home exercises. Objective findings of subluxations of the left clavicle, left 1st rib, T2, T5, occiput, left scapula and left gleno-humeral joint were confirmed with static palpation, motion palpation of the spine and the upper limb. Following 4 visits, grunting and crying ceased, the left arm was in normal position at rest with complete active and passive range of motion, breastfeeding successfully bilaterally without nipple pain for the mother. The child also demonstrated improvement in motor development. **Conclusion:** Chiropractic management should be considered collaboratively with medical follow-up in cases of birth trauma such as clavicle fracture. Further research is warranted to asses the long-term musculoskeletal sequelae with similar cases of neonatal birth trauma.

Key Words: case report, chiropractic, subluxation, neonatal clavicle fracture, footling breech presentation, birth trauma, Caesarean section, breastfeeding difficulties, irritability, sleep disorder.

Introduction

Neonatal clavicle fracture is defined as a trauma directly related to vaginal delivery or caesarean section.[1] It is considered as the most commonly fractured bone in obstetrics, occurring in 0.2% to 3.5% of all births.[1-3] Usually seen during vaginal deliveries, clavicle fractures in newborns are associated with shoulder dystocia, birth weight, vacuum deliveries, prolonged second stage of labor, gestational age, instrumental vaginal delivery, maternal age, height and obesity.[2,3] Generally associated with a lower risk of birth trauma, clavicle fractures can also occur during caesareans.[4] A retrospective review of caesarean deliveries with neonatal clavicle fracture identified an incidence of 0.05% for this birth trauma.[2] In both, vaginal or caesarean deliveries, pathophysiology of the clavicle fracture is still unclear. Some authors associated this trauma with the pressure of the fetal shoulder on the mother's symphysis during the contractions associated with a vaginal delivery and the baby's birth weight with a Caesarean delivery.[2,3] Considering previous studies, prognosis of clavicle fractures is benign without sequelae and without requiring treatment.[2,3] Neurological injuries associated with clavicle fracture, such as brachial plexus palsy, are well documented as possible outcomes. But there is no current study presenting the possibility of musculoskeletal sequelae associated with birth trauma.

Diagnosis is usually confirmed with physical examination and radiography. Principle signs of a clavicle fracture in a newborn patient included swelling, asymmetric Moro reflex, tenderness, crepitation in the affected shoulder and crying when the affected upper arm is moved.[3,5] Neonatal clavicle fractures can be undiagnosed at birth and only confirmed during the days following childbirth. A retrospective review demonstrated an incidence of 86.2% confirmed diagnosis before discharge from the hospital with a physical examination or radiography.[3]

The aim of this current case report is to present the association of neonatal clavicle fracture with musculoskeletal disorders and related effects on the physical development of the baby and his well-being.

Methods

The following electronic databases were used to identify previously published studies: Pubmed, Google Scholar, Mantis, Index to Chiropractic Literature, ICPA Research. Search keywords included: birth trauma, neonatal clavicle fracture, cesarean delivery, pediatric, chiropractic, manipulation and treatment. Supporting publications used in this paper: Case study, systematic review and retrospective review. Other books and articles were used to provide supporting information.

Case report

A 5-month-old male infant was presented by his mother for a chiropractic evaluation. Chief complaints included fussing, irritability, crying, grunting, rigidity, abnormal position of his left arm, 2 weeks of constipation, breastfeeding difficulties on the right side and apparent discomfort lying on his stomach. The mother associated all these complaints to the fracture of his left clavicle he had sustained during his birth.

The multiparous mother described her second pregnancy with some complications. At 11 week of gestation, she received a diagnosis of one healthy embryo, one non-viable embryo and a subchorionic hematoma of 5 cm located near the cervix with a recommendation of rest. At 13 week of gestation, bleeding and cramps starts related to an hypertrophy of the hematoma. At 15 week of gestation, they confirmed the presence of a second hematoma, she was put on bed rest for the remainder of her pregnancy and prescribed a prometrium treatment to avoid miscarriage risk. At 21 week of gestation, the subchorionic hematoma has resorbed but an amniotic fluid sludge was diagnosed increasing the risk of cervix inflammation and preterm labor. An antibiotic was prescribed for the mother preemptively to manage any risk of infection. At 23 week of gestation, preterm labor was no longer a risk, but the ultrasound showed a low fetal weight (in the 12th percentile). Her obstetrician recommended ultrasound every two weeks to evaluate the risk of intrauterine growth restriction. Fetal weight varied between the 5th and the 10th percentile. The baby was born at 40 week with a birth weight of 2,925g, in the 5th percentile, without any associated complication.

The baby was delivered with an emergency Caesarean section because of a footling breech presentation. At 39 weeks and 5 days of gestation, the obstetrician detected that the fetus was in a breech position. The next day, they attempted an external cephalic version to try to turn the fetus to a vertex position. At the end of the procedure, with fetal ultrasound, they confirmed the fetus was vertex with his feet close to his head. The mother chose to postpone the planned Ceasarean until 41 weeks of gestation allow for the baby to complete his version. At 40 weeks and 1 day of gestation the mother underwent a fetal ultrasound to confirm the fetal position. The fetus was in a footling breech position so they decided to schedule an emergency Caesarean the same night. Upon going home to prepare, 30 minutes after leaving the hospital, the mother had a spontaneous rupture of her membranes without any detectable uterine contractions. The contractions started naturally when she came back to the hospital 30 minutes later. Upon performing a vaginal examination, they discovered that she was dilated to 10 cm and a fetal foot had passed through the cervix. The Caesarean section immediately performed and completed in 5 minutes.

APGAR scores were 7 at 1 minute and 9 at 5th minutes, because the neonate did not cry during the first minute. The mother reported a rapid and stressful birth, 3 hours from onset to delivery. The first pediatrician did a physical exam on the neonate after 2 hours of life without noticing any abnormality. On the 4th day, a second pediatrician did a physical evaluation and detected a left clavicle fracture. The pediatrician proposed an x-ray to confirm the fracture, but parents declined it. The parents did not receive any specific recommendations for care or precautions around the clavicle fracture. The pediatrician told the parents that the fracture was benign, the prognosis was good, and that healing should occur without any risk of complication or sequelae.

The mother observed a change in her infant's behavior after his second week of life starting with breastfeeding difficulties on the ride side, rigidity in his global tonus with a tendency to arch his back and an abnormal positioning of his left arm in extension when she was breastfeeding him. At 3 months, the mother noticed persistent grunting accentuated during tummy time and lying on the bed. The mother visited multiple health care professionals without seeing any improvements in her child

The mother noted a decrease in grunts and a stronger latch while her baby was taking acetaminophen. Medical physical assessments were normal and showed no disorders related to the clavicle fracture. However, convinced that her son was suffering because of his clavicle, the mother decided to consult a chiropractor.

Physical Exam

The infant was agitated, grunting and crying upon physical examination with evidence of rigidity in his global tonus. General posture in extension was observed. Head rotation was slightly limited to the left during passive rotation. Upon evaluating left shoulder mobility the infant was distressed and reacted by contracting the musculature around the shoulder girdle. The mother mentioned the infant always medially rotated and extended his left arm backward when she was breastfeeding him and he did not want to rest on his left arm during tummy time. Neurological examination revealed intact Galant, Babinski and Landau reflexes.

Objective findings of subluxations of the left clavicle, left 1st rib, T2, T5, occiput, left scapula and left gleno-humeral joint were confirmed with static palpation and motion palpation of the spine and the upper limb. Left clavicle was restricted in depression (supero-inferior) and protraction (postero-anterior) associated with left trapezius and scalene hypertonicity. Palpating the left first rib in sitting and su-

Date	Health professional	Complaints (C)/results (R)
21/06/2017	Osteopathy	**C:** discomfort of the left arm, difficulty turning his head to the left side, breastfeeding difficulties on the right side, reflux **R:** improved head rotation to the left side and breastfeeding for only a few days
27/06/2017	Osteopathy	**C:** same as the last visit **R:** improved head rotation to the left side and breastfeeding for only few days
10/07/2017	Acupuncture	**C:** Reflux and gas **R:** relaxation
11/07/2017	General practioner (GP)	**C:** abnormal position of his left arm, he seemed to be suffering, reflux **R:** Prevacid prescribed for the reflux, recommendation to a breastfeeding clinic
13/07/2017	Intl board-certified lactation consultants	**C:** Breastfeeding difficulties on the right side **R:** detection of a tongue-tie and recommendation for a frenectomy
14/07/2017	Dentist	**C:** Tongue-tie and breastfeeding difficulties on the right side **R:** Frenectomy without improvement in the breastfeeding
19/07/2017	GP	**C:** Routine visit, vaccination and follow-up of Prevacid effectiveness to reduce reflux **R:** Continue Prevacid (despite lack of improvement in the child's reflux), normal physical examination
21/07/2017	Osteopathy	**C:** to improve tongue and jaw muscles mobility following the frenectomy **R:** No change
28/07/2017	IBCLC and Paediatrician	**C:** Breastfeeding difficulties on the right side, abnormal position of his left arm when he is on his stomach **R:** Tongue-tie release was incomplete following the first frenectomy. IBCLC recommended a second frenectomy since breastfeeding was still difficult on the right side.
31/07/2017	Family doctor	**C:** Vaccination, evaluation of Prevacid effectiveness to reduce reflux **R:** Continue Prevacid (child still have reflux). Normal physical examination
01/08/2017	IBCLC and Doctor	**C:** Fever (in reaction to the vaccination) **R:** frenectomy follow-up
03/08/2017	Osteopathe in France	**C:** Abnormal position of his left arm when he's on his stomach, breastfeeding still difficult, better suckling with acetaminophen (Tempra) **R:** Normal physical examination
04/08/2017	Paediatrician in France	**C:** Routine visit (weight) **R:** Normal physical examination
19/09/2017	Nurse practitioner	**C:** Grunting, fussing, reflux, breastfeeding difficulties **R:** Increase the initial dose of Prevacid (ineffective at current dose), weight loss (5th to 3rd percentile)
10/10/2017	Paediatrician	**C:** breastfeeding difficulties, refusing the breast, grunting, agitated sleep **R:** The mother took fenugreek and blessed thistle to improve her milk production, Normal physical examination of the baby
11/10/2017	GP	**C:** breastfeeding difficulties, refusing the breast, grunting, agitated sleep **R:** Recommendation to start with solid food and take medication to improve milk production. The mother declines the medication due to the associated side effects.
30/10/2017	Osteopathy	**C:** Abnormal position of his left arm when he's on his stomach **R:** lots of muscles tension, performs manual therapy on his stomach and ribs without noticeable change
24/11/2017	Chiropractic	**C:** Fussing, irritability, crying, grunting, rigidity, abnormal position of his left arm, breastfeeding difficulties on the right side and hard times to stay on his stomach **R:** Improvement in breastfeeding on the right side with a stronger latch, decrease in grunting, relaxation and more easily consolable, improving the position of the left arm and maintaining the ventral position for longer without crying

Table 1. Timeline of health professional visits.

pine position confirmed the important loss of supero-inferior mobility. T2 had posterior and right rotational misalignment. T5 was found posteriorly restricted with significant contracture in paraspinal musculature. Palpation of the occiput revealed a restriction in flexion with hypertonicity in suboccipital musculature. Left scapula was restricted in both internal and external rotation associated with rotator cuff musculature contracture. Left gleno-humeral joint was found to be restricted in flexion, abduction and internal rotation combined with hypertonicity of the left pectoralis major.

Diagnosis and Treatment

A pediatrician confirmed the clavicle fracture at the time of discharge from the hospital on the 4th day of life during a physical examination. Parents declined the proposed radiography because according to the doctor, the outcome would not affect the treatment plan. The significant restrictions around the left shoulder girdle, including the clavicle, scapula, gleno-humeral joint, first rib and upper thoracic were all associated to the left clavicle fracture. The chiropractic diagnosis was a left shoulder girdle dysfunction associated with a neonatal fracture of the left clavicle and multiple subluxation complexes.

The 5-month-old patient was treated by a chiropractor once a week for the first two weeks and then two more time during the next 2 months for a total of 4 visits. Chiropractic treatment was initiated following the physical examination at the first visit. Informed consent was obtained after the report of finding at the first visit. A combination of different techniques were used to treat joint restrictions. Left clavicle, 1st rib, scapula and gleno-humeral joint were adjusted with light mobilization and vibration because the area was sensitive to pressure. Sacro-occipital technic (SOT) was used to treat the occipital restriction and to release the tension in the fascia and the paraspinal musculature. Thoracic spine (T2 and T5) was treated with the "touch and hold" technique by holding a specific, light pressure on the fixated vertebrae. The left shoulder girdle musculature was treated using myofascial release and massage. The parents received home exercises recommendation to reduce tension and to improve motor development.

Outcomes

Immediately after the first treatment, the mother observed significant changes in her child's behavior and well-being. In the following days, he was more calm and relaxed, his left arm was no longer held in extension, breastfeeding on the right side was easier with a better latch and transfer, digestion was normalized (he had been constipated for the last two weeks), less grunting, more easily consoled and more comfortable in tummy time. At the 3rd visit, it was noted that there was no more grunting, no more crying during the tummy time and he was able to sit unassisted. After the 4th and last visit, he had normal range of motion of his left upper limb without hypertonicity in the musculature around the shoulder girdle, no residual breastfeeding issues, radically positive changes in his motor development, staying longer in the prone position, sitting by himself and crawling. The mother confirmed he was no longer grunting or crying for inexplicable reasons. Chiropractic care was concluded after the 4th visit because parents moved to another city but they were greatly encouraged to continue treatment in another chiropractic clinic as needed. The parents reported no adverse events related to any of the treatments given.

Discussion

In utero, the first bone to ossify is the clavicle and it is the most commonly fractured bone at birth. Usually, birth related clavicle fractures are nondisplaced greenstick type fractures and can be confirmed with "crunchiness" upon palpation of the clavicle. Complete healing of the clavicle fracture takes about 2 to 3 weeks and during this period, parents should avoid lifting the child by the arm to prevent aggravation of the injury.[6] Sometimes, pediatricians will recommend bracing to stabilize the clavicle but in most cases no treatment is needed.[7]

In this case, parents did not receive any recommendations before leaving the hospital on the specific care of a clavicle fracture. Even without serious neurological sequelae associated with the clavicle fracture, parents should be advised of the precaution they need to take with their newborn. Specific recommendations include handling their baby gently, avoid pulling the arm to lift the baby and to avoid lying baby on the affected side in his bed and also during breastfeeding.[8,9] With these recommendations, parents could have avoided positioning their baby on the affected side, which would have made breastfeeding easier and less painful for the infant and the mother. Right breastfeeding was very difficult suggesting the position was painful for the baby.

Many studies on clavicle fractures have been reported and there is no report of frequent complications. In some case, brachial plexus palsy with limited movement of the wrist and arm and phrenic nerve paralysis were associated with the fracture but the patient had no related sequelae.[3,7,8] There is limited information concerning long-term sequelae associated with neonatal clavicle fracture. Biomechanical dysfunctions such as restricted joint mobility, muscles tenderness, sensitivity and limited range of motion (ROM) are not directly associated to the clavicle fracture in the literature. However, in this case, the patient had several biomechanical constraints associated with the birth trauma. Decreased ROM of the glenohumeral, scapulothoracic and sternoclavicular joints, multiple joint restrictions mainly at

Visit 1 — 24/11/2017		
Subjective findings:	**Physical findings:**	**Treatment and recommendations:**
Left shoulder girdle feeling very tight and restricted, lots of grunting, breastfeeding difficulties on the right side and constipation	Left clavicle: decreased mobility on static palpation in depression and protraction Left scapula: decreased motion palpation on internal and external rotation, left rotator cuff hypertonic and sore Left gleno-humeral joint: decreased mobility on motion palpation in abduction, flexion and internal rotation; left pectoral hypertonic Left 1st rib: decreased inferior motion when palpated supine and sitting T2: decreased mobility on static palpation and motion palpation in extension and left rotation with tenderness in the paraspinal musculature T5: decreased mobility on motion palpation on extension Cranial bones: decreased mobility of the occiput in flexion Musculature findings: Hypertonic left rotator cuff with crying on contact, left trapezius, left pectoralis major, left scalene, bilateral paraspinal and suboccipital.	AS occiput (SOT) T2 (sustained contact) T5 (sustained contact) Left 1st rib (vibration) Scapulo-thoracic (mobilization) Left clavicle (mobilization) Soft tissue work: Muscles stretching with passive trunk flexion Muscles massage on left rotator cuff, bilateral paraspinal, left pectoralis major Recommendations: - Paraspinal muscles massage - Happy baby exercise* - Passive trunk flexion*
Visit 2 — 01/12/2017		
Subjective findings:	**Physical findings:**	**Treatment and recommendations:**
Decreased tension in the left shoulder girdle with improved mobility, decreased grunting, better time on his tummy without crying, better sucking during breastfeeding, normal bowel movement (no more constipation), more relax	Left clavicle: decreased anterior mobility of the left clavicle during a shoulder protraction. Left 1st rib: decreased superior to inferior mobility on motion palpation when supine with improvement compared to the last visit T2: decreased mobility on static palpation and motion palpation in extension and left rotation with tenderness in the paraspinal musculature T5: decreased mobility on motion palpation in extension Left gleno-humeral joint: decreased mobility on motion palpation in abduction, flexion and internal rotation Cranial bones: decreased mobility of the occiput in flexion Muscles findings: Hypertonic left rotator cuff, left trapeze, left pectoralis major, bilateral paraspinal and suboccipital.	AS occiput T2 (sustained contact) T5 (sustained contact) Left 1st rib (vibration) Left clavicle mobilization Left gleno-humeral traction Soft tissue work: Muscles stretching with passive trunk flexion Muscles massage on left rotator cuff, bilateral paraspinal, left pectoralis major Recommendations: Exercises - Happy baby - Passive body flexion - Shoulders adduction/abduction*
Visit 3 — 15/12/2017		
Subjective findings:	**Physical findings:**	**Treatment and recommendations:**
Sit without any support, cold and cough (started daycare)	Left clavicle: decreased anterior mobility of the left clavicle during a shoulder protraction. T2: decreased mobility on motion palpation in left rotation with improved mobility in extension Left 1st rib: decreased superior to inferior mobility on motion palpation when sitting and supine Cranial bones: decreased mobility of the occiput in flexion Muscles finding: Hypertonicity in paraspinal musculature, left trapeze and left pectoralis major	AS occiput T2 (sustained contact) Left 1st rib (vibration) Left clavicle mobilisation Soft tissue work: Muscles stretching with passive trunk flexion Muscles massage of paraspinal and left pectoralis major Recommendation: -Passive body flexion -Happy baby
Visit 4 — 19/01/2018		
Subjective findings:	**Physical findings:**	**Treatment and recommendations:**
Dental thrust, no more grunting and crying, wants to crawl and stays long time on his tummy. Breastfeeding is now complete without pain.	Left 1st rib: light restriction during superior to inferior mobility on motion palpation T2: decreased mobility on motion palpation in left rotation T5: decreased mobility on motion palpation in extension	T2 and T5 (sustained contact) Left 1st rib (vibration) Soft tissue work: Muscles stretching with passive trunk flexion Muscles massage of paraspinal and left pectoralis major Recommendation: - Paraspinal muscles massage - Passive body flexion

Table 2. Chiropractic management notes. * See Figure 1, 2 and 3.

the left first rib and clavicle, hypertonicity and tenderness of left shoulder girdle muscles all could potentially have been associated with the trauma that caused the original clavicle fracture. Despite orthopedic management of the bone fracture, patients who had neonatal clavicle fracture should also being seen by a chiropractor. Chiropractic analysis was essential to diagnose of a left shoulder girdle dysfunction associated with a neonatal fracture of the left clavicle and multiple subluxation complexes. Contrary to what we found in the literature, this case suggested that patients could have associated sequelae.

Spear and Alcantara[10] presented a study of a 6-week-old infant born with trauma from vacuum extraction under chiropractic care. A male infant presented with chief complaint of infantile colic, acid reflux, restlessness, inability to relax and/or lay on his back, difficulty sleeping and general irritability. The patient had 7 treatments of chiropractic care using Activator and "touch and hold" adjustments. Following these 7 treatments, the mother noticed improvement of the initial complaints and resolution of his digestive problems.

In this case report, restoration of normal ROM of the left clavicle, first rib, shoulder girdle, cranial bones and thoracic spine through chiropractic adjustments allowed an improvement in the child posture, motor development, breastfeeding and well-being. Chiropractic adjustment can be considered safe when modified or adapted for infants with the absence of adverse event following low force adjustment.[11,12]

In conclusion, this case report demonstrates the importance

Figure 1: Happy baby exercise (neutral position). Catch baby's feet and hands together and cradle baby from side to side to relax the paraspinal muscles and encourage baby to roll sideways.

Figure 2: Passive body flexion. Place baby on the forearm supporting his head with hands and by bending elbows create a passive flexion of the body and the baby's head. NOTE: The baby's head should be kept in a neutral position (unlike in the photo where the neck is rotated) to execute this exercise.

Figures 3 and 4: Shoulder adduction/abduction. Catch baby's hands to open arms and create abduction then bring arms closer to the baby's body and across the chest in adduction.

of chiropractic follow-up after a birth trauma such as neonatal clavicle fracture. Chiropractic assessment evaluates biomechanics and neuromusculoskeletal system to determine whether or not there are possible sequelae following a birth trauma. Considering the positive results following chiropractic treatment in this case, chiropractic could be considered as a gentle, safe and modifiable approach to treat infants with co-morbid conditions associated with a clavicle fracture. There is undeniably a significant lack of resources on this subject and more research is needed to support knowledge on chiropractic care of musculoskeletal sequelae associated to a clavicle fracture.

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The chiropractor's role in the interdisciplinary care of the infant with faltering growth: two case reports

By Linda Alida Bernadette Anna Overschie, BSc, MSc Chiropractic, DC[1]

1. AECC University College, Bournemouth, United Kingdom
Email: lindaoverschie@hotmail.com

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ABSTRACT

Background: this case report identifies chiropractic care as one component in the diversified approach to faltering growth in the infant. **Methods:** A literature search was conducted in October 2017 using the journal databases PubMed, Medline, Cochrane Library, Index to chiropractic literature, CINAHL and the AECC library.
Case presentations: Two infants presented separately for care, having not been able to regain their birthweight at three and eight weeks of age, respectively. **Intervention and outcomes:** The chiropractic approach was used to address the biomechanical and musculoskeletal problems in the infants. Other professionals were consulted for other aspects of their care. **Discussion:** An interdisciplinary team approach was needed to address all of the issues of the faltering growth. Chiropractic care was key to improve the baby's use of muscles of mastication and to allow for comfort in supine sleep.

Key Words: pediatrics, faltering growth, failure to thrive, chiropractic, case series.

Introduction

Faltering growth, previously termed failure to thrive, has been defined as a slower rate of weight gain in infants and young children than expected for age and sex.[1] Clinically, concern of faltering growth should be raised when infants with a birthweight below the 9th centile on the UK-WHO growth charts[2,3] fall across 1 or more centiles, when infants with a birthweight between the 9th and 91st centiles fall across 2 or more weight centiles, when infants with a birthweight above the 91st centile fall across 3 of more weight centiles, or when weight is below the 2nd centile for age regardless of the birthweight.[1]

Faltering growth may be caused by organic disease such as celiac disease, urinary tract infection, renal failure and cardiac abnormalities. Organic disease, however, only constitutes a small percentage of infants with faltering growth and is unlikely in an asymptomatic infant who appears well on examination.[1,4,5]

Previously, it was thought that faltering growth was strongly related to deprivation. This theory has recently been challenged by several studies concluding there is no association between faltering growth and social economic factors such as parental occupation, education, maternal eating restraint and alcohol consumption during pregnancy.[6,7,8]

Researchers have attempted to identify risk factors for faltering growth, but evidence is often either inconsistent or of low quality. Prematurity and neurodevelopmental concerns are likely to be related to faltering growth and infants who are small for their gestational age are at risk of persistent small stature.[9,10,11] There is inconsistent evidence for the association of postnatal maternal depression or anxiety with faltering growth.[8,9,12] Moreover, faltering growth may be related to feeding difficulties, including weak sucking, slow feeding, consumption of small quantities of milk, refusal of breastmilk and abnormal appetite.[7,10,13,14,15]

Due to the often unknown etiology, faltering growth has been perceived as a disturbing phenomenon by many clinicians concerned with the pediatric population. To provide an example of how such cases can be managed and which role the chiropractor may occupy within this management, two cases of infants with faltering growth receiving chiropractic care are presented.

Methods

A literature search was conducted in October 2017 using the electronic journal databases PubMed, Medline, Cochrane Library, Index to chiropractic literature, CINAHL and the AECC library. The keywords used in this search were infant growth, failure to thrive, weight faltering, non-organic failure to thrive individually and combined with chiropractic and breastfeeding dysfunction.

CASE PRESENTATION 1 — INFANT J

A 3-week-old male presented to a multidisciplinary midwifery and chiropractic feeding clinic as a result of difficulty breastfeeding, severe maternal breast soreness and slow

weight gain. Breastfeeding was particularly difficult on the left side. A feed would take 45 minutes or longer with a frequency of every two hours in the day and three times during the night. At night he would often stay awake for an hour after feeding. Sleeping supine was problematic and co-sleeping in side lying position occurred therefore most of the time. Moreover being in the car seat would upset him, resulting in continuous crying until arrival. At presentation, the infant had not regained birthweight yet. He had weighed 3,190 grams at birth and was at 2,900 grams at presentation. The mother was determined to continue breastfeeding due to a family history of allergy and eczema.

History and clinical findings

The infant was born by an emergency caesarean section at 38+4 weeks as a result of obstetric cholestasis. Skin-to-skin occurred within an hour and the infant successfully latched onto the breast. Post-surgery antibiotics were administered to the mother for one week. Family history consisted of maternal bicuspid aortic valve, eczema and allergy. Fenugreek and Domperidone were used to increase milk supply.

Midwifery breastfeeding examination showed severe erythema and blistering of the maternal nipples with painful latch. There was occasional clicking and the baby tired very quickly while feeding. The infant repetitively threw his head back without releasing the nipple during feeding causing maternal discomfort.

Hypertonicity of the masseter, temporalis, and suprahyoid muscles and musculoskeletal tension of the upper cervical spine and mid-thoracic spine were found. Digastric activation was insufficient and reduced during breastfeeding compared to during the suck reflex. The palate appeared narrow. A diagnosis of mild musculoskeletal imbalances of the spine and jaw was made.

A tongue tie was detected and was sent for frenotomy within the same week.

On examination the infant was alert, with more than six wet and dirty nappies and no signs of dehydration. Vital signs and primitive reflexes were age appropriate and within normal limits. The remainder of the examination was unremarkable and included posture, cranial nerves, deep tendon reflexes, and muscle tone.

Interventions and outcomes

A few days after presentation, the infant's mother appeared to have breast candidiasis and was treated with anti-fungal medication for one week. Within the same week, congenital heart conditions were excluded by performing an ultrasound scan of the infant's heart.

After breastfeeding examination at presentation, it was advised to see a lactation consultant for additional advice. The lactation consultant suggested the use of the flipple technique (also known as the extended or exaggerated latch technique, where the mother basically indents her thumb into the top of her breast to flick the nipple up before latching baby on) and saddle positioning (also known as straddle or koala hold).[16]

Informed consent was provided by the parents before chiropractic treatment was started. The chiropractic treatment given consisted of low force, low speed pediatric manual therapy (touch and hold) of the first rib and various regions of the spine, in particular the cervical spine. Gentle soft tissue therapy was used to release the suprahyoid, paraspinal and upper trapezius muscles. The occiput was treated using gentle pediatric occipital cranial techniques. No adverse reactions to care were observed by the chiropractor or reported by the parents during or after the course of care.

In the first four weeks of care, breastfeeding and night sleep were slightly improving. Maternal nipple pain reduced and became more manageable. The initial promising weight gain, however reduced and when the infant started to lose weight it was decided to advise on a 24 hours addition of a high calorie formula supplementation (150 ml a day) at 7 weeks of age, which was continued afterwards. Donor breast milk was considered, but was not available.

Weight gain slowly started to improve. The lactation consultant advised to reduce supplementation to 75 ml, while the infant dietician advised to increase supplementation to 200 ml a day. The infant's mother decided to implement the latter at 9 weeks of age.

By 13 weeks of age, fist sucking was noted in between feeds. Moreover, it was always the mother who would end a feed and if she would not, a feed could take up to 2.5 hours. It was therefore decided a further top up of formula (240 ml) was appropriate. Soon after the formula top up, a change of the infant's defecation was noted. Its normal mustard colour changed in to a green/grey colour. The consistency became more viscous and the infant was getting significantly more wind. Both GP and mother were concerned about the disturbance of the infant's digestion by the high calorie formula, which was therefore exchanged for a typical formula and temporarily reduced to 180 ml twice a day. Defecation colour and consistency went back to normal and wind resolved. At 20 weeks it was suggested the mother would use her own judgment regarding any increase of formula depending on the infant's hunger. At discharge at 22 weeks of age, he was having 200 to 240 ml three or four times a day post breastfeeding without digestive upset.

Later we found out the infant's father, his brother and other

males in the paternal family were all slow to put on weight as children. It was suggested this might be an underlying reason for the infant's slow weight gain.

In addition to weight gain improvement, night and daytime sleeping, breastfeeding difficulties and positional comfort were improving progressively and continuously over the course of care. At discharge at 22 weeks, a feed would take 20 to 30 minutes and breastfeeding in cradle position could be resumed without any maternal discomfort or feeding difficulty. The infant was sleeping more hours in the day as well as being able to sleep supine through the night. Being in the car seat was no longer a problem The infant was developing well and could roll over, crawl, and bring his feet to his mouth at discharge. The health care team had felt confident about the baby's slow but steady weight gain from 14 weeks of age, but the mother had preferred to continue with weekly consultations until 22 weeks.

At 9 weeks of age a cyst was found on the infant's head. A referral for a check-up with a pediatrician was made. The pediatrician was seen at the age of 23 weeks and it was concluded the infant was healthy and thriving. No further review of the cyst was needed.

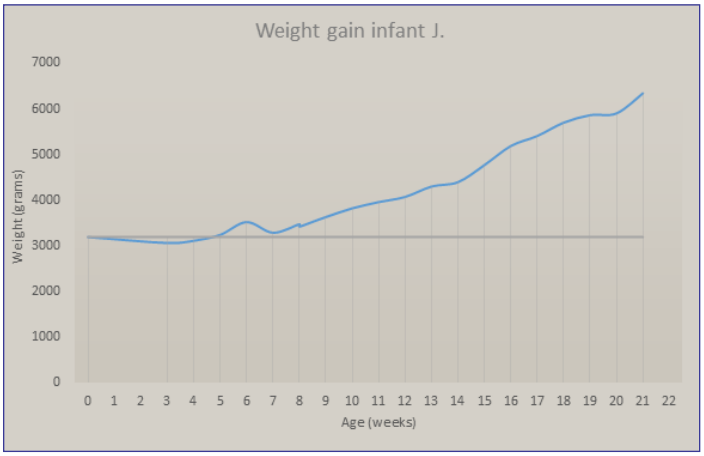

Figure 1. Weight gain of infant J. in grams over time (weeks). The grey line indicates the birth weight.

When the infant was 16 months of age, the mother was contacted for an update. The child was growing and developing well. The last time he was weighed, at 12 months of age, he was between the 75th and 91st centile of weight. At the moment of contact, the infant could walk and could say his first words. Breastfeeding was stopped at the age of 9.5 months due to maternal medical reasons.

CASE PRESENTATION 2- INFANT O

An eight-week-old, full-term female presented to a chiropractic clinic with irregular feeding habits, slow weight gain and discomfort lying supine. At presentation she had not returned to birth weight yet. During the day she would feed nearly continuously, with each feeding session taking between 40 and 90 minutes. Feeding was on the infant's demand. Breaks between feeding were very short and only rarely taking as long as 30 minutes. At night she would sleep, apart from a 60 to 90 minutes feeding session around 1am and 5 am.

History and clinical findings

Infant O. was born at 40+3 weeks with an emergency caesarean section after three failed rounds of prostin gel and a failed balloon pump intervention. There was direct skin-to-skin for a few minutes and the first feed was within an hour. At day three in hospital a loss of 8% of birth weight was noted and it was decided to supplement her breastfeeding with formula. Three days after initiating supplemental feeding, she started to have diarrhea and regurgitation. It was therefore suggested to change to a different formula supplement. The diarrhea and regurgitation, however, did not subside. At five weeks of age, the general practitioner was contacted, who prescribed a hydrolysed formula for milk intolerance. This formula, however, resulted in constipation and gagging and the parents therefore decided to return to exclusive breastfeeding.

The infant's mother was not extremely concerned about the slow weight gain, as the infant's older brother also gained weight very slowly in the first weeks of life. At the infant's brother's birth, a 2 liter maternal blood loss was suggested to explain his above 10% weight loss in his first days. His weight gain improved after supplementing breastfeeding with formula. He is now 5 years old and on the 75th centile for length.

The infant's 44 year-old mother presented with infection of the uterus after birth and was prescribed antibiotics (metronidazole) at week seven for one week. The medical history of her direct relatives included asthma and plaster rashes.

On examination of the infant, a heart shaped tongue, a tongue tie and a tight upper lip frenulum were found. The infant's suck was slightly disorganised with an early gag reflex. Both neck extension and mouth opening were insufficient during feeding. The pre-feeding and post-feeding weights were taken and showed a gain of 20 grams in the first 20 minutes and 35 grams in the 45 minute session. The mylohyoid muscle appeared to be inhibited and moderate musculoskeletal tension of the occiput, upper cervical spine, upper thoracic spine and sacroiliac joint was noted. The infant was therefore diagnosed with musculoskeletal imbalances due to inefficient and/or faulty feeding behavior. The infant was alert, active, with plenty of wet and dirty nappies and did not show any signs of dehydration. Vital signs, primitive reflexes,

and developmental screen were within normal limits for an eight-week-old infant. No abnormalities were found on the remainder of examination including posture, cranial nerves, deep tendon reflexes, muscle tone, and hip screen.

Interventions and outcomes

Over the course of 3 weeks, 4 treatments were given. These included visits in both the chiropractic clinic and a related multidisciplinary midwifery and chiropractic clinic. Informed consent was given by the parents before treatment was started. The upper cervical spine, upper thoracic spine and sacroiliac joints were treated with low force, low speed pediatric manual therapy (touch and hold). The muscles of mastication, in particular the palatoglossus and mylohyoid muscles, were treated with gentle intraoral soft tissue therapy in an effort to improve the infant's efficiency at the breast. The mother was advised to consider pumping after each breastfeed to make sure the infant's inefficient feeding would not lead to a decrease in the mother's milk supply. It was also suggested to discuss the use of galactagogue, Domperidone, with her general practitioner.

Midwifery examination of breastfeeding confirmed findings of insufficient mouth opening and cervical extension. Difficulty achieving a good latch was worse on the left breast. Advice was given on feeding positons such as rugby ball position[17] and biological nurturing.[18]

Domperidone was prescribed by the general practitioner and the mother began to take it when the infant was 9 weeks of age. Moreover, a referral was made to the pediatrician. At 10 weeks of age, the infant presented to the pediatrician who concluded she was healthy and thriving well.

Retained placental remnants were found to be the cause of the mother's infection of the uterus. The midwife suggested these placental remnants could have an effect on milk supply by inhibiting prolactin production. Shortly after discharge the mother underwent a procedure to eliminate these placental remnants.

During the 4-week course of chiropractic care of the infant, improvement was progressive and continuous. Musculoskeletal tension in the spinal areas and muscles of mastication was gradually released and the suck improved. The infant's mother reported breastfeeding to be much more comfortable and efficient. Towards the end of the course of care, there were longer gaps in between feeding sessions during the day, which enabled the infant's mother to do other activities besides feeding her daughter. Moreover, daytime sleep improved, from nearly none to approximately 7 hours a day. At night, the infant would also sleep longer, now only waking up once a night. The initial discomfort lying supine was completely resolved at discharge. The infant's mother also reported that the infant appeared more settled, although 'being unsettled' was not one of the initial reasons for seeking help. Weight gain slowly but steadily improved and birthweight was reached at nine weeks of age. No adverse reaction to chiropractic care was reported by the parents during the course of care. (FIG 2)

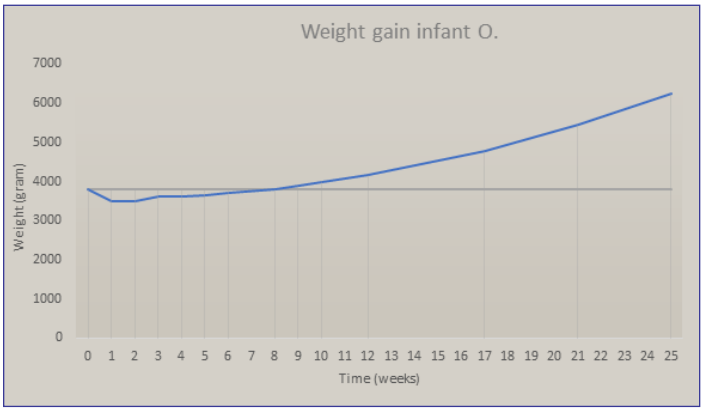

Figure 2. Weight gain of infant O. in grams over time (weeks). The grey line indicates the birth weight.

Fifteen weeks after discharge, the infant's mother was contacted and she wanted to return to the clinic for an update. In this period the infant has been exclusively breastfed without problems. Feeding was still on demand, however, on a much lower frequency then before. In the past eight weeks, an ascent from between the 0.4th and 2nd centile to being between the 9th and 25 centile of weight was seen. The infant was developing well and is now rolling from side to side, front to back and started putting her feet in her mouth.

Discussion

An interdisciplinary approach was used for these infants with faltering growth. Depending on the specific case, it may be helpful to involve a specialist such as a midwife, pediatric dietician, infant feeding specialist, pediatrician, social worker, or clinical psychologist.[5] Moreover, the infant's GP should be informed. A pediatrician should only be contacted if the infant presents with signs and symptoms suggesting organic pathology or in case of severe weight faltering.[1,5] (In the UK, a GP is part of the primary health care services directly accessible by the local community. A pediatrician is a secondary health care professional to who the GP will refer patients if more specialized healthcare is needed.)

If concerns present about faltering growth in an infant, a feeding assessment should be performed. Every effort should be made to continue breastfeeding for the health of the infant and mother. Clinicians should be aware that formula supplementation often leads to the cessation of breastfeeding. In case of supplementation, it is therefore important

to encourage continuation of breastfeeding. Mothers should be advised to feed the infant with the available breastmilk before providing any supplements and to express breastmilk to maintain and promote sufficient milk supply.[1]

Weight should be monitored and measurements should be taken at appropriate intervals depending on age and severity (Table 1). The clinician should be aware that weighing infants too frequently could increase parental anxiety regarding the faltering weight.[1]

Age	Frequency
<1 month	daily
1 to 6 months	weekly
6 to 12 months	fortnightly
>12 months	monthly

Table 1. NICE guidelines on weighing frequency in infants with faltering growth.

Both of the described cases met the criteria of faltering growth produced by the National Institute for Health and Clinical Excellence.[1] Infant J. was between the 75th and 91st centile at birth and dropped down five centiles, whereas infant O. was between the 9th and 25th centile and dropped 3 centiles. The specialists involved in the management of these cases include the chiropractor, midwife, GP, lactation consultant, pediatric dietician, tongue tie practitioner (a midwife and lactation consultant in the above case) and pediatrician. Etiological factors which may have played a role were hereditary slow weight gain and breastfeeding dysfunction for infant J. and hereditary slow weight gain, breastfeeding dysfunction and hormonal influence from placental remnants for infant O.

Although high quality evidence is sparse, chiropractic care may be helpful in breastfeeding difficulties, by resolving musculoskeletal tension and imbalances, particularly in the cervical spine and jaw.[19,20,21,22,23] Feeding difficulties may be an etiological factor causing faltering growth and this therefore creates a potential role for the chiropractor in the care of infants with faltering growth.[7,10,13,14,15]

Both cases show an improved weight gain and resolution of breastfeeding difficulty through multidisciplinary efforts and persistent, motivated mothers. These cases are an example of how chiropractic care can be part of an interdisciplinary approach to infants with faltering growth. Further observation and collection of data in a more rigorous study design may be warranted.

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JOURNAL ABSTRACTS

Cervical Proprioception in a Young Population Who Spend Long Periods on Mobile Devices: A 2-Group Comparative Observational Study.

Journal of Manipulative and Physiologic Therapeutics February 2018 Volume 41, Issue 2, Pages 123—128
Andrew Portelli, BPhysiotherapy(Hons); Susan A. Reid, PhD, MMedSc(Phty), GradDip(Manip.Phty)
School of Physiotherapy, Australian Catholic University, North Sydney, New South Wales, Australia
DOI: https://doi.org/10.1016/j.jmpt.2017.10.004

ABSTRACT

Objectives: The purpose of this study was to evaluate if young people with insidious-onset neck pain who spend long periods on mobile electronic devices (known as "text neck") have impaired cervical proprioception and if this is related to time on devices. **Methods:** A 2-group comparative observational study was conducted at an Australian university. Twenty-two participants with text neck and 22 asymptomatic controls, all of whom were 18 to 35 years old and spent ≥4 hours per day on unsupported electronic devices, were assessed using the head repositioning accuracy (HRA) test. Differences between groups were calculated using independent sample t-tests, and correlations between neck pain intensity, time on devices, and HRA test were performed using Pearson's bivariate analysis. **Results:** During cervical flexion, those with text neck (n = 22, mean age ± standard deviation [SD]: 21 ± 4 years, 59% female) had a 3.9° (SD: 1.4°) repositioning error, and the control group (n = 22, 20 ± 1 years, 68% female) had a 2.9° (SD: 1.2°) error. The mean difference was 1° (95% confidence interval: 0—2, P = .02). For other cervical movements, there was no difference between groups. There was a moderately significant correlation (P ≤ .05) between time spent on electronic devices and cervical pain intensity and between cervical pain intensity and HRA during flexion. Conclusion: The participants with text neck had a greater proprioceptive error during cervical flexion compared with controls. This could be related to neck pain and time spent on electronic devices.

Key Indexing Terms: Neck Pain, Proprioception, Cervical Vertebrae

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Breastfeeding and early white matter development: A cross-sectional study.

Neurolmage Volume 82-Novv 12, 2013
Sean C, Deoni, Douglas Dean III, Irene Piryatinsky, Jonathan O'Muircheartaigh, et al.
https://doi.org/10.1016/j.neuroimage.2013.05.090

ABSTRACT

Does breastfeeding alter early brain development? The prevailing consensus from large epidemiological studies posits that early exclusive breastfeeding is associated with improved measures of IQ and cognitive functioning in later childhood and adolescence. Prior morphometric brain imaging studies support these findings, revealing increased white matter and sub-cortical gray matter volume, and parietal lobe cortical thickness, associated with IQ, in adolescents who were breastfed as infants compared to those who were exclusively formula-fed. Yet it remains unknown when these structural differences first manifest and when developmental differences that predict later performance improvements can be detected. In this study, we used quiet magnetic resonance imaging (MRI) scans to compare measures of white matter microstructure (mcDESPOT measures of myelin water fraction) in 133 healthy children from 10 months through 4 years of age, who were either exclusively breastfed a minimum of 3 months; exclusively formula-fed; or received a mixture of breast milk and formula. We also examined the relationship between breastfeeding duration and white matter microstructure. Breastfed children exhibited increased white matter development in later maturing frontal and association brain regions. Positive relationships between white matter microstructure and breastfeeding duration are also exhibited in several brain regions, that are anatomically consistent with observed improvements in cognitive and behavioral performance measures. While the mechanisms underlying these structural differences remains unclear, our findings provide new insight into the earliest developmental advantages associated with breastfeeding, and support the hypothesis that breast milk constituents promote healthy neural growth and white matter development.

Keywords: Brain development, breastfeeding, Myelin maturation, White matter development; Infant imaging, Myelin, Myelin water fraction; Magnetic resonance imaging.

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Association of Combined Patterns of Tobacco and Cannabis Use in Adolescence with Psychotic Experiences.

JAMA Psychiatry 2018;75(3):240-246.
https://jamanetwork.com/journals/jamapsychiatry/fullarticle/2669772
Hannah J. Jones, PhD; Suzanne H. Gage, PhD; Jon Heron, PhD; et al.

Key Points – Question: Are patterns of adolescent cigarette and cannabis use differentially associated with subsequent onset of psychotic experiences? Findings: In this longitudinal cohort study of 3328 adolescents, there is evidence that both cannabis and cigarette use are associated with subsequent psychotic experiences prior to adjusting for confounders. However, after adjusting, the associations for cigarette-only use attenuated substantially, whereas those for cannabis use remained consistent. Meaning: While individuals who use either cannabis or cigarettes during adolescence appear to be at increased risk of psychotic experiences, the association of psychotic experiences is greater with cannabis than with tobacco smoking.

ABSTRACT

Importance: There is concern about potentially causal effects of tobacco use on psychosis, but epidemiological studies have been less robust in attempts to minimize effects of confounding than studies of cannabis use have been. **Objectives:** To examine the association of patterns of cigarette and cannabis use with preceding and subsequent psychotic experiences, and to compare effects of confounding across these patterns. **Design, Setting, and Participants:** This cohort study used data from the Avon Longitudinal Study of Parents and Children, which initially consisted of 14,062 children. Data were collected periodically from September 6, 1990, with collection ongoing, and analyzed from August 8, 2016, through June 14, 2017. Cigarette and cannabis use data were summarized using longitudinal latent class analysis to identify longitudinal classes of substance use. Associations between classes and psychotic experiences at age 18 years were assessed. **Exposures:** Depending on the analysis model, exposures were longitudinal classes of substance use or psychotic experiences at age 12 years. **Main Outcomes and Measures:** Logistic regression was used to examine the associations between substance use longitudinal classes and subsequent onset of psychotic experiences. **Results:** Longitudinal classes were derived using 5,300 participants (56.1% female) who had at least 3 measures of cigarette and cannabis use from ages 14 to 19 years. Prior to adjusting for a range of potential confounders, there was strong evdience that early-onset cigarette-only use (4.3%), early-onset cannabis use (3.2%), and late-onset cannabis use (11.9%) (but not later-onset cigarette-only use [14.8%]) latent classes were associated with increased psychotic experiences compared with nonusers (65.9%) (omnibus $P < .001$). After adjusting for confounders, the association for early-onset cigarette-only use attenuated substantially (unadjusted odds ratio [OR], 3.03; 95% CI, 1.13-8.14; adjusted OR, 1.78; 95% CI, 0.54-5.88), whereas those for early-onset cannabis use (adjusted OR, 3.70; 95% CI, 1.66-8.25) and late-onset cannabis use (adjusted OR, 2.97; 95% CI, 1.63-5.40) remained consistent. **Conclusions and Relevance:** In this study, our findings indicate that while individuals who use cannabis or cigarettes during adolescence have an increased risk of subsequent psychotic experiences, epidemiological evidence is substantively more robust for cannabis use than it is for tobacco use.

Rebellious Behaviors in Adolescents with Epilepsy.

J Pediatr Psychol 2018;43(1):52-60.
Aimee W. Smith, PhD; Constance Mara, PhD; Shannon Ollier, Psy.D; et al.

ABSTRACT

Objectives: The study aims are to (1) examine the prevalence of risk-taking (i.e., behaviors that can be categorized as rebellious or reckless) and (2) determine the influence of risk-taking on adherence, seizures, and health-related quality of life (HRQOL) in adolescents with epilepsy. An exploratory aim was to identify predictors of risk-taking. **Methods:** Fifty-four adolescents with epilepsy (M = 15.33 ± 1.46 years) and caregivers completed questionnaires on demographics, risk-taking, parent—child relations, adolescent inattention/hyperactivity, and HRQOL at four time points across 1 year. Seizure occurrence and electronically monitored adherence were also collected. **Results:** Rebellious behaviors were normative and stable over 1 year in adolescents with epilepsy. Higher rebelliousness was related to poorer adolescent-reported memory HRQOL. The only significant positive predictor of rebellious behaviors was adolescent age. **Conclusions:** Adolescents with epilepsy endorsed normative levels of rebelliousness, which is negatively related to HRQOL. Older adolescents may warrant clinical attention.

Association of Sex with Recurrence of Autism Spectrum Disorder Among Siblings.

JAMA Pediatr 2017;171(11):1107-1112.

Nathan Palmer, PhD; Andrew Beam, PhD; Denis Agniel, PhD; et al

Key Points – Question: What are the sex-specific recurrence rates of autism spectrum disorder among siblings? **Findings:** In this population analysis of 1 583 271 families with 2 children, a significantly increased risk of recurrence of autism spectrum disorder was found among males than among females. **Meaning:** An older female sibling diagnosed with autism spectrum disorder is associated with greater risk of recurrence in the younger sibling compared with an older diagnosed male sibling, and male siblings are more likely to experience recurrence than female siblings regardless of the sex of the diagnosed sibling.

ABSTRACT

Importance: Autism spectrum disorder (ASD) is known to be more prevalent among males than females in the general population. Although overall risk of recurrence of ASD among siblings has been estimated to be between 6.1% and 24.7%, information on sex-specific recurrence patterns is lacking. **Objective:** To estimate high-confidence sex-specific recurrence rates of ASD among siblings. **Design, Setting, and Participants:** This observational study used an administrative database to measure the incidence of ASD among children in 1 583 271 families (37 507 with at least 1 diagnosis of ASD) enrolled in commercial health care insurance plans at a large US managed health care company from January 1, 2008, through February 29, 2016. Families in the study had 2 children who were observed for at least 12 months between 4 and 18 years of age. **Main Outcomes and Measures:** The primary measure of ASD recurrence was defined as the diagnosis of ASD in a younger sibling of an older sibling with an ASD diagnosis. **Results:** Among the 3,166,542 children (1,547,266 females and 1,619,174 males; mean [SD] age, 11.2 [4.7] years) in the study, the prevalence of ASD was 1.96% (95% CI, 1.94%-1.98%) among males and 0.50% (95% CI, 0.49%-0.51%) among females. When a male was associated with risk in the family, ASD was diagnosed in 4.2% (95% CI, 3.8%-4.7%) of female siblings and 12.9% (95% CI, 12.2%-13.6%) of male siblings. When a female was associated with risk in the family, ASD was diagnosed in 7.6% (95% CI, 6.5%-8.9%) of female siblings and 16.7% (95% CI, 15.2%-18.4%) of male siblings. **Conclusions and Relevance:** These findings are in agreement with the higher rates of ASD observed among males than among females in the general population. Our study provides more specific guidance for the screening and counseling of families and may help inform future investigations into the environmental and genetic factors that confer risk of ASD.

Chiropractic management of dominating one-sided pelvic girdle pain in pregnant women; a randomized controlled trial.

BMC Pregnancy Childbirth. 2017 Sep 29;17(1):331.
https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-017-1528-9

Gausel AM, Kjærmann I, Malmqvist S, Andersen K, Dalen I, Larsen JP, Økland I.

ABSTRACT

Background: The aim of this study was to investigate the outcome of chiropractic management for a subgroup of pregnant women with dominating one-sided pelvic girdle pain (PGP). **Methods:** The study population was recruited from a prospective longitudinal cohort study of pregnant women. Women reporting pelvic pain (PP), and who were diagnosed with dominating one-sided PGP after a clinical examination, were invited to participate in the intervention study. Recruitment took place either at 18 weeks, or after an SMS-tracking up to week 29. The women were randomized into a treatment group or a control group. The treatment group received chiropractic treatment individualized to each woman with regards to treatment modality and number of treatments. The control group was asked to return to conventional primary health care. The primary outcome measure was new occurrence of full time and/or graded sick leave due to PP and/or low back pain. Secondary outcome measures were self-reported PP, physical disability and general health status. Proportion of women reporting new occurrence of sick leave were compared using Chi squared tests. Differences in secondary outcome measures were estimated using linear regression analyses. **Results:** Fifty-Six women were recruited, and 28 of them were randomized into the treatment group, and 28 into the control group. There was no statistically significant difference in sick leave, PP, disability or general health status between the two groups during pregnancy or after delivery. Conclusion: The study did not demonstrate superiority of chiropractic management over conventional care for dominating one-sided PGP during pregnancy. However, the analyses revealed wide confidence intervals containing both positive and negative clinically relevant effects.

TRIAL REGISTRATION: The study was registered in ClinicalTrials.gov (NCT01098136 ; 22/03/2010).

Keywords: Manual therapy; Pregnancy; SMS track; Sick leave; Subgroups

Free download PDF: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5622492/pdf/12884_2017_Article_1528.pdf

Association Between Use of Acid-Suppressive Medications and Antibiotics During Infancy and Allergic Diseases in Early Childhood.

JAMA Pediatr Published online April 2, 2018. doi:10.1001/jamapediatrics.2018.0315

Edward Mitre, MD; Apryl Susi, MS; Laura E. Kropp, MPH; et al

Key Points – Question: Does use of medications that disturb the microbiome in infancy increase subsequent risk of developing allergic diseases? **Findings:** In this cohort study of 792 130 children, the hazard of developing an allergic disease was significantly increased in those who had received acid-suppressive medications or antibiotics during the first 6 months of life. **Meaning:** Exposure to acid-suppressive medications or antibiotics in the first 6 months of life may increase risk of allergic disease development.

ABSTRACT

Importance: Allergic diseases are prevalent in childhood. Early exposure to medications that can alter the microbiome, including acid-suppressive medications and antibiotics, may influence the likelihood of allergy. **Objective:** To determine whether there is an association between the use of acid-suppressive medications or antibiotics in the first 6 months of infancy and development of allergic diseases in early childhood. **Design, Setting and Participants:** A retrospective cohort study was conducted in 792 130 children who were Department of Defense TRICARE beneficiaries with a birth medical record in the Military Health System database between October 1, 2001, and September 30, 2013, with continued enrollment from within 35 days of birth until at least age 1 year. Children who had an initial birth stay of greater than 7 days or were diagnosed with any of the outcome allergic conditions within the first 6 months of life were excluded from the study. Data analysis was performed from April 15, 2015, to January 4, 2018. **Exposures:** Exposures were defined as having any dispensed prescription for a histamine-2 receptor antagonist (H2RA), proton pump inhibitor (PPI), or antibiotic. **Main Outcomes and Measures:** The main outcome was allergic disease, defined as the presence of food allergy, anaphylaxis, asthma, atopic dermatitis, allergic rhinitis, allergic conjunctivitis, urticaria, contact dermatitis, medication allergy, or other allergy. **Results:** Of 792 130 children (395 215 [49.9%] girls) included for analysis, 60 209 (7.6%) were prescribed an H2RA, 13 687 (1.7%) were prescribed a PPI, and 131 708 (16.6%) were prescribed an antibiotic during the first 6 months of life. Data for each child were available for a median of 4.6 years. Adjusted hazard ratios (aHRs) in children prescribed H2RAs and PPIs, respectively, were 2.18 (95% CI, 2.04-2.33) and 2.59 (95% CI, 2.25-3.00) for food allergy, 1.70 (95% CI, 1.60-1.80) and 1.84 (95% CI, 1.56-2.17) for medication allergy, 1.51 (95% CI, 1.38-1.66) and 1.45 (95% CI, 1.22-1.73) for anaphylaxis, 1.50 (95% CI, 1.46-1.54) and 1.44 (95% CI, 1.36-1.52) for allergic rhinitis, and 1.25 (95% CI, 1.21-1.29) and 1.41 (95% CI, 1.31-1.52) for asthma. The aHRs after antibiotic prescription in the first 6 months of life were 2.09 (95% CI, 2.05-2.13) for asthma, 1.75 (95% CI, 1.72-1.78) for allergic rhinitis, 1.51 (95% CI, 1.38-1.66) for anaphylaxis, and 1.42 (95% CI, 1.34-1.50) for allergic conjunctivitis. **Conclusions and Relevance:** This study found associations between the use of acid-suppressive medications and antibiotics during the first 6 months of infancy and subsequent development of allergic disease. Acid-suppressive medications and antibiotics should be used during infancy only in situations of clear clinical benefit.

Revision Lingual Frenotomy Improves Patient-Reported Breastfeeding Outcomes: A Prospective Cohort Study.

Journal of Human Lactation, May 2018

Bobak A. Ghaheri, MD, Melissa Cole, IBCLC, Jess C. Mace, MPH, CCRP

First Published May 22, 2018 Research Article

ABSTRACT

Background: Lingual frenotomy improves patient-reported outcome measures, including infant reflux and maternal nipple pain, and prolongs the nursing relationship; however, many mother—infant dyads continue to experience breastfeeding difficulty despite having had a frenotomy. **Research aim:** The aim of this study was to determine how incomplete release of the tethered lingual frenulum may result in persistent breastfeeding difficulties. **Methods:** A one-group, observational, prospective cohort study was conducted. The sample consisted of breastfeeding mother—infant (0-9 months of age) dyads (N = 54) after the mothers self-elected completion lingual frenotomy and/or maxillary labial frenectomy following prior lingual frenotomy performed elsewhere. Participants completed surveys preoperatively, 1-week postoperatively, and 1-month postoperatively consisting of the Breastfeeding Self-Efficacy Scale—Short-Form (BSES-SF), Visual Analog Scale (VAS) for nipple pain severity, and the Revised Infant Gastroesophageal Reflux Questionnaire (I-GERQ-R). **Results:** Significant postoperative improvements were reported between mean preoperative scores compared with 1-week and 1-month scores of the BSES-SF, $F(2) = 41.2$, $p < .001$; the I-GERQ-R, $F(2) = 22.7$, $p < .001$; and VAS pain scale, $F(2) = 46.1$, $p < .001$. **Conclusion:** We demonstrated that besides nipple pain, measures of infant reflux symptoms and maternal breastfeeding self-confidence can improve following full release of the lingual frenulum. Additionally, a patient population was identified that could benefit from increased scrutiny of infant tongue function when initial frenotomy fails to improve breastfeeding symptoms.

Keywords: ankyloglossia, breastfeeding, breastfeeding assessment, health services research, tongue-tie

Schroth physiotherapeutic scoliosis-specific exercises for adolescent idiopathic scoliosis: how many patients require treatment to prevent one deterioration? - results from a randomized controlled trial - "SOSORT 2017 Award Winner."

Scoliosis Spinal Disord. 2017 Nov 14;12:26.
https://scoliosisjournal.biomedcentral.com/articles/10.1186/s13013-017-0137-8
Schreiber S, Parent EC, Hill DL, Hedden DM, Moreau MJ, Southon SC.

ABSTRACT

Background: Recent randomized controlled trials (RCTs) support using physiotherapeutic scoliosis-specific exercises (PSSE) for adolescents with idiopathic scoliosis (AIS). All RCTs reported statistically significant results favouring PSSE but none reported on clinical significance. The number needed to treat (NNT) helps determine if RCT results are clinically meaningful. The NNT is the number of patients that need to be treated to prevent one bad outcome in a given period. A low NNT suggests that a therapy has positive outcomes in most patients offered the therapy. The objective was to determine how many patients require Schroth PSSE added to standard care (observation or brace treatment) to prevent one progression (NNT) of the Largest Curve (LC) or Sum of Curves (SOC) beyond 5° and 10°, respectively over a 6-month interval. **Methods:** This was a secondary analysis of a RCT. Fifty consecutive participants from a scoliosis clinic were randomized to the Schroth PSSE + standard of care group (n = 25) or the standard of care group (n = 25). We included males and females with AIS, age 10-18 years, all curve types, with curves 10°- 45°, with or without brace, and all maturity levels. We excluded patients awaiting surgery, having had surgery, having completed brace treatment and with other scoliosis diagnoses. The local ethics review board approved the study (Pro00011552). The Schroth intervention consisted of weekly 1-h supervised Schroth PSSE sessions and a daily home program delivered over six months in addition to the standard of care. A prescription algorithm was used to determine which exercises patients were to perform. Controls received only standard of care.Cobb angles were measured using a semi-automatic system from posterior-anterior standing radiographs at baseline and 6 months.We calculated absolute risk reduction (ARR) and relative risk reduction (RRR). The NTT was calculated as: NNT = 1/ARR. Patients with missing values (PSSE group; n = 2 and controls; n = 4) were assumed to have had curve progression (worst case scenario). The RRR is calculated as RRR = ARR/CER. **Results:** For LC, NNT = 3.6 (95% CI 2.0-28.2), and for SOC, NNT = 3.1 (95% CI 1.9-14.2). The corresponding ARR was 28% for LC and 32% for the SOC. The RRR was 70% for LC and 73% for the SOC. Patients with complete follow-up attended 85% of prescribed visits and completed 82.5% of the home program. Assuming zero compliance after dropout, 76% of visits were attended and 73% of the prescribed home exercises were completed. **Conclusions:** The short term of Schroth PSSE intervention added to standard care provided a large benefit as compared to standard care alone. Four (LC and SOC) patients require treatment for the additional benefit of a 6-month long Schroth intervention to be observed beyond the standard of care in at least one patient.

Keywords: Adolescents; Clinical significance; Cobb angle; Exercise; Number needed to treat; Physiotherapeutic scoliosis specific exercises; Radiography; Schroth; Scoliosis; Spinal curvatures

Free download PDF: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5684768/pdf/13013_2017_Article_137.pdf

Breastfeeding and Maternal Hypertension.

American Journal of Hypertension, Vol 31 (13), May 2018
Article published: 30 January 2018
Sangshin Park, Nam-Kyong Choi

ABSTRACT

Background: Little is known about the relationship between breastfeeding and hypertension. We performed this study to identify whether breastfeeding itself influenced maternal hypertension and whether degree of obesity or insulin sensitivity would contribute to the relationship between breastfeeding and hypertension in postmenopausal women. **Methods:** Our study population comprised 3,119 nonsmoking postmenopausal women aged 50 years or above in the 2010—2011 Korea National Health and Nutrition Examination Survey. We performed logistic regression analyses to examine the relationship between breastfeeding and hypertension and mediation analyses to examine the contributions of obesity and insulin sensitivity to the breastfeeding-hypertension relationship. **Results:** The odds ratios, with 95% confidence intervals, for hypertension among the highest quintile of number of breastfed children (5—11) and the highest quintile of duration of breastfeeding (96—324 months) were 0.49 (0.31—0.75) and 0.55 (0.37—0.82), respectively, compared to each of lowest quintile groups. The population attributable fractions of hypertension caused by breastfeeding 3 or fewer children and breastfeeding for 56 months or less were 10.2% ($P < 0.001$) and 6.5% ($P = 0.017$), respectively. In the mediation analysis, unexpectedly, increased insulin resistance significantly attenuated the protective effect on hypertension of having breastfed more children; additionally, greater obesity and insulin resistance significantly attenuated the protective effects on hypertension of having breastfed for longer. **Conclusions:** More children breastfed and longer duration of breastfeeding were associated with lower risk of hypertension in postmenopausal women, and degree of obesity and insulin resistance moderated the breastfeeding-hypertension association.

Associations Between Brain Structure and Connectivity in Infants and Exposure to Selective Serotonin Reuptake Inhibitors During Pregnancy.

JAMA Pediatr. Published online April 9, 2018.
Claudia Lugo-Candelas, PhD1,2; Jiook Cha, PhD1,2; Susie Hong, BS1,2; et al

ABSTRACT

Importance: Selective serotonin reuptake inhibitor (SSRI) use among pregnant women is increasing, yet the association between prenatal SSRI exposure and fetal neurodevelopment is poorly understood. Animal studies show that perinatal SSRI exposure alters limbic circuitry and produces anxiety and depressive-like behaviors after adolescence, but literature on prenatal SSRI exposure in humans is limited and mixed. **Objective:** To examine associations between prenatal SSRI exposure and brain development using structural and diffusion magnetic resonance imaging (MRI). **Design, Setting, and Participants:** A cohort study conducted at Columbia University Medical Center and New York State Psychiatric Institute included 98 infants: 16 with in utero SSRI exposure, 21 with in utero untreated maternal depression exposure, and 61 healthy controls. Data were collected between January 6, 2011, and October 25, 2016. **Exposures:** Selective serotonin reuptake inhibitors and untreated maternal depression. **Main Outcomes and Measures:** Gray matter volume estimates using structural MRI with voxel-based morphometry and white matter structural connectivity (connectome) using diffusion MRI with probabilistic tractography. **Results:** The sample included 98 mother (31 [32%] white, 26 [27%] Hispanic/Latina, 26 [27%] black/African American, 15 [15%] other) and infant (46 [47%] boys, 52 [53%] girls) dyads. Mean (SD) age of the infants at the time of the scan was 3.43 (1.50) weeks. Voxel-based morphometry showed significant gray matter volume expansion in the right amygdala (Cohen d = 0.65; 95% CI, 0.06-1.23) and right insula (Cohen d = 0.86; 95% CI, 0.26-1.14) in SSRI-exposed infants compared with both healthy controls and infants exposed to untreated maternal depression ($P < .05$; whole-brain correction). In connectome-level analysis of white matter structural connectivity, the SSRI group showed a significant increase in connectivity between the right amygdala and the right insula with a large effect size (Cohen d = 0.99; 95% CI, 0.40-1.57) compared with healthy controls and untreated depression ($P < .05$; whole connectome correction). **Conclusions and Relevance:** Our findings suggest that prenatal SSRI exposure has an association with fetal brain development, particularly in brain regions critical to emotional processing. The study highlights the need for further research on the potential long-term behavioral and psychological outcomes of these neurodevelopmental changes.

Full Text Available: https://jamanetwork.com/journals/jamapediatrics/fullarticle/2676821?widget=personalizedcontent&previousarticle=2616362

Breastfeeding and motor development in term and preterm infants in a longitudinal US cohort.

Am J Clin Nutr. 2017 Dec;106(6):1456-1462. doi: 10.3945/ajcn.116.144279. Epub 2017 Nov 1.
Michels KA, Ghassabian A, Mumford SL, Sundaram R, Bell EM, et al.

ABSTRACT

Background: The relation between breastfeeding and early motor development is difficult to characterize because of the problems in existing studies such as incomplete control for confounding, retrospective assessment of infant feeding, and even the assessment of some motor skills too early. **Objective:** We sought to estimate associations between infant feeding and time to achieve major motor milestones in a US cohort. **Design:** The Upstate New York Infant Development Screening Program (Upstate KIDS Study) enrolled mothers who delivered live births in New York (2008-2010). Mothers of 4270 infants (boys: 51.7%) reported infant motor development at 4, 8, 12, 18, and 24 mo postpartum; information on infant feeding was reported at 4 mo. Accelerated failure time models were used to compare times to standing or walking across feeding categories while adjusting for parental characteristics, daycare, region, and infant plurality, sex, rapid weight gain, and baseline neurodevelopmental test results. Main models were stratified by preterm birth status. **Results:** The prevalence of exclusive breastfeeding in preterm infants was lower than in term infants at 4 mo postpartum (8% compared with 19%). After adjustment for confounders, term infants who were fed solids in addition to breast milk at 4 mo postpartum achieved both standing [acceleration factor (AF): 0.93; 95% CI: 0.87, 0.99] and walking (AF: 0.93; 95% CI: 0.88, 0.98) 7% faster than did infants who were exclusively breastfed, but these findings did not remain statistically significant after correction for multiple testing. We did not identify feeding-associated differences in motor milestone achievement in preterm infants. **Conclusion:** Our results suggest that differences in feeding likely do not translate into large changes in motor development. The Upstate KIDS Study was registered at clinicaltrials.gov as NCT03106493.

Keywords: breastfeeding; infant formula; infant nutritional physiological phenomena; longitudinal studies; motor skills; premature birth

Low back pain and causative movements in pregnancy: a prospective cohort study.

BMC Musculoskelet Disord. 2017;18: 416.
Saori Morino, Mika Ishihara, Fumiko Umezaki, Hiroko Hatanaka, et al.
Published online 2017 Oct 16. doi: 10.1186/s12891-017-1776-x
PMCID: PMC5644197 PMID: 29037184

ABSTRACT

Background: Low back pain (LBP) during pregnancy might be strongly related to posture and movements of the body, and its management is a clinically important issue. The purpose of this study was to investigate the activities related to LBP during pregnancy. **Methods:** Participants included 275 women before 12 weeks of pregnancy. The women were evaluated at 12, 24, 30, and 36 weeks of pregnancy. The intensity of LBP was assessed using the Numerical Rating Scale (NRS). Movements related to LBP were investigated by free descriptive answers. Descriptive statistics were used to compile the movements that pregnant women thought induced LBP at each evaluation. Subsequently, a linear regression analysis was performed to evaluate the degree of association of certain movements with LBP using the data of participants who had LBP. The intensity of LBP (NRS score) was specified as the dependent variable, the movements that were related to pain were specified as the independent variables at the analysis. A significance threshold was set at 0.05. **Results:** The final sample used in the analyses was 254, 249, 258, and 245 women at 12, 24, 30, and 36 weeks of pregnancy, respectively. There were 16 kinds of movements that induced LBP and all of them were daily activities rather than special movements that require extra task or effort. As pregnancy progressed, less number of participants attributed pain to a specific movement. At all evaluations, movements, especially sitting up, standing up from a chair, and tossing and turning were thought to be related to LBP. Furthermore, standing up from a chair and tossing and turning were significantly related to LBP throughout the pregnancy. In contrast, lying down and sitting up were significantly related to LBP but the relationship did not continue till late pregnancy. **Conclusions:** Daily routine activity is related to LBP during pregnancy. These results suggest that recommendations for pregnant women about basic physical movements, such as ways of standing up that reduce the load on the body might be useful in the management of LBP.

Keywords: Activity, Low back pain, Lumbopelvic pain, Motion, Pregnancy

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Osteopathic manipulative treatment for low back and pelvic girdle pain during and after pregnancy: A systematic review and meta-analysis.

J Bodyw Mov Ther 2017 Oct;21(4):752-762. doi: 10.
Franke H, Franke JD, Belz S, Fryer G.
1016/j.jbmt.2017.05.014. Epub 2017 May 31.

ABSTRACT

Background: Low back pain (LBP) is a common complaint during pregnancy. This study examined the effectiveness of osteopathic manipulative treatment (OMT) for LBP in pregnant or postpartum women. **Methods:** Randomized controlled trials unrestricted by language were reviewed. Outcomes were pain and functional status. Mean difference (MD) or standard mean difference (SMD) and overall effect size were calculated. **Results:** Of 102 studies, 5 examined OMT for LBP in pregnancy and 3 for postpartum LBP. Moderate-quality evidence suggested OMT had a significant medium-sized effect on decreasing pain (MD, -16.65) and increasing functional status (SMD, -0.50) in pregnant women with LBP. Low-quality evidence suggested OMT had a significant moderate-sized effect on decreasing pain (MD, -38.00) and increasing functional status (SMD, -2.12) in postpartum women with LBP. **Conclusions:** This review suggests OMT produces clinically relevant benefits for pregnant or postpartum women with LBP. Further research may change estimates of effect, and larger, high-quality randomized controlled trials with robust comparison groups are recommended.

Keywords: Low back pain; Osteopathic manipulative treatment; Postpartum; Pregnancy; Spinal manipulation; Systematic review

PMID: 29037623
DOI: 10.1016/j.jbmt.2017.05.014

Risk for Autism Spectrum Disorders According to Period of Prenatal Antidepressant ExposureA Systematic Review and Meta-analysis.

JAMA Pediatr 2017;171(6):555-563.
https://jamanetwork.com/journals/jamapediatrics/fullarticle/2616362

Antonia Mezzacappa, MD; Pierre-Alexandre Lasica; Francesco Gianfagna, MD, PhD; et al.

Key Points – Question: Does prenatal antidepressant exposure increase the risk for autism spectrum disorders? **Findings:** This systematic review and meta-analysis suggests an association between increased autism spectrum disorder risk and maternal use of antidepressants during pregnancy; however, it appears to be more consistent during the preconception period than during each trimester. The association was weaker when controlled for past maternal mental illness. **Meaning:** Maternal psychiatric disorders in treatment before pregnancy rather than antenatal exposure to antidepressants could have a major role in the risk for autism spectrum disorders.

ABSTRACT

Importance: Several studies have examined the links between prenatal exposure to antidepressants and autism spectrum disorders (ASDs) in children, with inconsistent results, especially regarding the impact of the trimester of exposure. **Objective:** To perform a systematic review of the literature and a meta-analysis of published studies to assess the association between ASDs and fetal exposure to antidepressants during pregnancy for each trimester of pregnancy and preconception. **Data Sources:** PubMed, EMBASE, and PsycINFO databases up to May 2016 were searched in June 2016 for observational studies. For the meta-analyses, data were analyzed on RevMan version 5.2 using a random-effect model. For the review, studies were included if they had been published and were cohort or case-control studies, and for the meta-analysis, studies were included if they were published studies and the data were not derived from the same cohorts. **Study Selection:** We included all the studies that examined the association between ASDs and antenatal exposure to antidepressants. **Data Extraction and Synthesis:** Three reviewers independently screened titles and abstracts, read full-text articles, and extracted data. The quality of the studies was also assessed. **Main Outcomes and Measures:** Primary outcome was the association between antidepressants during pregnancy and ASDs. Secondary outcomes were the associations between antidepressants in each individual trimester or before pregnancy and ASDs. **Results:** Our literature search identified 10 relevant studies with inconsistent results. For prenatal exposure, the meta-analysis on the 6 case-control studies (117,737 patients) evidenced a positive association between antidepressant exposure and ASDs (odds ratio [OR], 1.81; 95% CI, 1.49-2.20). The association was weaker when controlled for past maternal mental illness (OR, 1.52; 95% CI, 1.09-2.12). A similar pattern was found whatever the trimester of exposure considered (first trimester: OR, 2.09, 95% CI,1.66-2.64; second: OR, 2.00, 95% CI, 1.55-2.59; and third: OR, 1.90, 95% CI, 1.20-3.02. Controlled for past maternal mental illness: first trimester: OR, 1.79; 95% CI, 1.27-2.52, second: OR, 1.67, 95% CI, 1.14-2.45; and third: OR, 1.54, 95% CI, 0.82-2.90). No association was found when the 2 cohort studies were pooled (772,331 patients) for the whole pregnancy (hazard ratio, 1.26; 95% CI, 0.91-1.74) or for the first trimester. In addition, preconception exposure to antidepressants was significantly associated with an increased risk for ASDs (OR controlled for past maternal illness, 1.77; 95% CI, 1.49-2.09). **Conclusions and Relevance:** There is a significant association between increased ASD risk and maternal use of antidepressants during pregnancy; however, it appears to be more consistent during the preconception period than during each trimester. Maternal psychiatric disorders in treatment before pregnancy rather than antenatal exposure to antidepressants could have a major role in the risk for ASDs. Future studies should address the problem of this potential confounder.

Pregnancy and Pelvic Girdle Pain.

Journal of the American Podiatric Medical Association, July 2017, Vol. 107, No. 4, pp. 299-306

Floriane Kerbourc'h, Jeanne Bertuit, Véronique Feipel and Marcel Rooze

https://doi.org/10.7547/15-087

ABSTRACT

Background: A woman's body undergoes many changes during pregnancy, and it adapts by developing compensatory strategies, which can be sources of pain. We sought to analyze the effects of pregnancy and pelvic girdle pain (PGP) on center of pressure (COP) parameters during gait at different speeds. **Methods:** Sixty-one healthy pregnant women, 66 women with PGP between 18 and 27 weeks of pregnancy, and 22 healthy nonpregnant women walked at different velocities (slow, preferential, and fast) on a walkway with built-in pressure sensors. An analysis of variance was performed to determine the effects of gait speed and group on COP parameters. **Results:** In healthy pregnant women and women with PGP, COP parameters were significantly modified compared with those in nonpregnant women ($P < .01$). Support time was increased regardless of gait speed, and anteroposterior COP displacement was significantly decreased for women with PGP compared with healthy pregnant women. In addition, mediolateral COP displacement was significantly decreased in pregnant women compared with nongravid women. **Conclusions:** Gait speed influenced COP displacement and velocity parameters, and gait velocity potentiated the effect of pregnancy on the different parameters. Pelvic girdle pain had an influence on COP anteroposterior length only. With COP parameters being only slightly modified by PGP, the gait of pregnant women with PGP was similar to that of healthy pregnant women but differed from that of nonpregnant women.

Effect of Foot Manipulation on Pregnancy-Related Pelvic Girdle Pain: A Feasibility Study.

J Chiropr Med. 2017 Sep;16(3):211-219.
Melkersson C, Nasic S, Starzmann K, Bengtsson Boström K.

ABSTRACT

Objective: The objective of this study was to investigate if the research process to evaluate the effect of foot manipulation on pregnancy-related pelvic girdle pain (PPGP) is feasible. **Methods:** A randomized, single-blind (patients and evaluators) pilot trial was performed to compare foot manipulation to a comparative group at 6-weekly treatment sessions at 5 physiotherapy outpatient clinics in Skaraborg primary care (Skövde, Sweden). Women at 12 to 31 weeks of pregnancy with well-defined PPGP (n = 97) and joint dysfunction or decreased range of movement in the feet were included. Women with a twin pregnancy, low back pain, rheumatoid arthritis, or other serious diseases and those who had previous foot manipulation were excluded. Visual analog scale scores were recorded before study start, before and after each treatment session, and 3 months after delivery. **Results:** One-hundred and two women were eligible, and 97 were included (group 1: foot manipulation, n = 47; group 2: comparative treatment, n = 50); 40 and 36 in the foot manipulation and comparative treatment groups, respectively, completed the study. The foot manipulation group had a nonsignificant pain relief score compared with that of the comparative group, which had higher pain relief scores. The difference was most pronounced at the first and second treatment sessions. A power analysis showed that at least 250 individuals would be needed in each group to confirm the effect of foot manipulation. **Conclusions:** This study showed that it is feasible to assess the effect of foot manipulation on PPGP in a multicenter physical therapy outpatient clinic setting. A new larger study should choose a different comparative method and test this hypothesis in a full-scale trial.

Keywords: Ankle Joint; Osteopathic Manipulation; Physiotherapy; Pregnancy Pelvic Girdle Pain; Primary Health Care; Randomized Clinical Feasibility Study

Free download PDF: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5659811/pdf/main.pdf

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Manual therapy for unsettled, distressed and excessively crying infants: a systematic review and meta-analyses.

BMJ Journals/Open Volume 8, Issue 1
Dawn Carnes, Austin Plunkett, Julie Ellwood, Clare Miles

ABSTRACT

Objective: To conduct a systematic review and meta-analyses to assess the effect of manual therapy interventions for healthy but unsettled, distressed and excessively crying infants and to provide information to help clinicians and parents inform decisions about care. **Methods:** We reviewed published peer-reviewed primary research articles in the last 26 years from nine databases (Medline Ovid, Embase, Web of Science, Physiotherapy Evidence Database, Osteopathic Medicine Digital Repository, Cochrane (all databases), Index of Chiropractic Literature, Open Access Theses and Dissertations and Cumulative Index to Nursing and Allied Health Literature). Our inclusion criteria were: manual therapy (by regulated or registered professionals) of unsettled, distressed and excessively crying infants who were otherwise healthy and treated in a primary care setting. **Outcomes of interest were:** crying, feeding, sleep, parent—child relations, parent experience/satisfaction and parent-reported global change. **Results:** Nineteen studies were selected for full review: seven randomised controlled trials, seven case series, three cohort studies, one service evaluation study and one qualitative study. We found moderate strength evidence for the effectiveness of manual therapy on: reduction in crying time (favourable: -1.27 hours per day (95% CI -2.19 to —0.36)), sleep (inconclusive), parent—child relations (inconclusive) and global improvement (no effect). The risk of reported adverse events was low: seven non-serious events per 1,000 infants exposed to manual therapy (n=1308) and 110 per 1,000 in those not exposed. **Conclusions:** Some small benefits were found, but whether these are meaningful to parents remains unclear as does the mechanisms of action. Manual therapy appears relatively safe.

Full text FREE: http://bmjopen.bmj.com/content/8/1/e019040.long

Association of Prenatal Ultrasonography and Autism Spectrum Disorder.

JAMA Pediatr 2018;172(4):336-344.
https://jamanetwork.com/journals/jamapediatrics/article-abstract/2672728

N. Paul Rosman, MD; Rachel Vassar, MD; Gheorghe Doros, PhD; et al

Key Points – Question: Is prenatal ultrasonography frequency, timing, duration, or strength associated with later diagnosis of autism spectrum disorder? **Findings:** In this case-control study of 420 children, those with autism spectrum disorder were exposed to greater mean depth of ultrasonographic penetration during the first and second trimesters compared with typically developing children and during the first trimester compared with developmentally delayed children. No association between the number of scans or duration of ultrasound exposure and later autism spectrum disorder was found. **Meaning:** Increased depth of prenatal ultrasonographic penetration may be associated with perturbations in fetal neuronal cortical migration and later autism spectrum disorder; this correlation deserves further study.

ABSTRACT

Importance: The prevalence of autism spectrum disorder (ASD) has been increasing rapidly, with current estimates of 1 in 68 children affected. Simultaneously, use of prenatal ultrasonography has increased substantially, with limited investigation into its safety and effects on brain development. Animal studies have demonstrated that prenatal ultrasonography can adversely affect neuronal migration. **Objective:** To quantify prenatal ultrasound exposure by the frequency, timing, duration, and strength of ultrasonographic scans in children with later ASD, developmental delay, and typical development. **Design, Setting, and Participants:** This case-control study included 107 patients with ASD, 104 control individuals with developmental delay, and 209 controls with typical development. Participants were identified from medical records based on prenatal care and delivery at Boston Medical Center, a diverse, academic, safety-net medical center, from July 1, 2006, through December 31, 2014, with a gestational age at birth of at least 37 weeks. Data were analyzed from May 1, 2015, through November 30, 2017. **Exposures:** Ultrasonographic exposure was quantified by the number and timing of scans, duration of exposure, mean strength (depth, frame rate, mechanical index, and thermal index), and time of Doppler and 3- and 4-dimensional imaging. **Main Outcomes and Measures:** Among participants with ASD and controls with developmental delay and typical development, ultrasound exposure was quantified and compared per trimester and for the entire pregnancy, with adjustment for infant sex, gestational age at birth, and maternal age. **Results:** A total of 420 participants were included in the study (328 boys [78.1%] and 92 girls [21.9%]; mean age as of January 1, 2016, 6.6 years; 95% CI, 6.5-6.8 years). The ASD group received a mean of 5.9 scans (95% CI, 5.2-6.6), which was not significantly different from the 6.1 scans (95% CI, 5.4-6.8) in the developmental delay group or the 6.3 scans (95% CI, 5.8-6.8) in the typical development group. Compared with the typical development group, the ASD group had shorter duration of ultrasound exposure during the first (290.4 seconds [95% CI, 212.8-368.0 seconds] vs 406.4 seconds [95% CI, 349.5-463.3 seconds]) and second (1687.6 seconds [95% CI, 1493.8-1881.4 seconds] vs 2011.0 seconds [95% CI, 1868.9-2153.1 seconds]) trimesters but no difference in the number of scans. The ASD group had greater mean depth of ultrasonographic penetration than the developmental delay group in the first trimester (12.5 cm [95% CI, 12.0-13.0 cm] vs 11.6 cm [95% CI, 11.1-12.1 cm]). The ASD group had greater mean depth than the typical development group during the first (12.5 cm [95% CI, 12.0-13.0 cm] vs 11.6 cm [95% CI, 11.3-12.0 cm]) and the second (12.9 cm [95% CI, 12.6-13.3 cm] vs 12.5 cm [95% CI, 12.2-12.7 cm]) trimesters. **Conclusions and Relevance:** This study found significantly greater mean depth of ultrasonographic penetration in the ASD group compared with the developmental delay group in the first trimester and compared with the typical development group in the first and second trimesters. Further research is needed to determine whether other variables of ultrasound exposure also have adverse effects on the developing fetus.