CASE REPORT

Positive Health Outcomes Following Chiropractic Care in an Infant with Birth Trauma, Clavicular Fracture, Subluxation, and Breastfeeding Dysfunction: A Case Report & Review of the Literature

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Abstract

Objective: To describe the chiropractic care of a 16-day-old female infant suffering from multiple symptom complex as a result of birth trauma.

Clinical Features: The infant was presented by her mother with fracture to the right clavicle attributed to birth trauma and associated chief complaints of breastfeeding difficulties, excessive crying and disturbed sleep. Physical examination revealed the infant as preferring to turn their head to the right and fixated in a right lateral flexion posture. The patient demonstrated restriction in motion in the cervical spine and at the right temporomandibular joint (TMJ) resulting in decreased and asymmetrical opening of the jaw, particularly on the right side.

Intervention and Outcomes: The chiropractic care provided was Diversified Technique (i.e., "touch and hold"), Home care instructions were also given to the infant's mother to apply a cool, moist washcloth compress to the infant's cervical spine and right clavicle on a daily basis until the patient's spinal and clavicular swelling was reduced appreciably. Over a 1½ month period and ten chiropractic visits, the infant showed significant improvements, including increased cervical spine range of motion, better feeding, easier bowel movements, and improved sleep quality and the mother no longer experienced mastitis. Thereafter, continued chiropractic care was recommended to maximize the patient's nervous system function and spinal growth and development.

Conclusion: This case report described the successful chiropractic care of an infant presenting with multiple symptom complex (i.e., clavicle fracture, breastfeeding difficulties, subluxations of cervico-cranio-mandibular complex) associated with birth trauma. We encourage continued documentation in the care of similar patients to inform higher level research designs (i.e., prospective cohort studies or randomized controlled clinical trials).

Keywords: *birth trauma, vertebral subluxation, infant, clavicular fracture subluxation, TMJ, breastfeeding dysfunction, chiropractic, adjustment, spinal manipulation*

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Introduction

Birth trauma has been defined as an event occurring during labor and delivery that results in threatened or actual serious injury or death to the mother and/ or infant.[1] Since the inclusion of childbirth as a potentially traumatic event in the Diagnostic Statistical Manual in 1994,[2] research into birth trauma emerged globally and particularly in countries such as the Scandinavian countries, the United Kingdom, and Australia.[1]

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Real as well as perceived birth trauma experienced by the mother during labor or birth can result in lasting consequences. For example, posttraumatic stress disorder (PTSD) may result in the mother feeling abandoned, guilt and helplessness. These feelings have direct impact on mother-child interactions and negatively affect a couple's relationship.[3] For the newborn, birth trauma can result in abrasions and lacerations, torticollis, intrathoracic injury (i.e., hemothorax, pneumothorax, chylothorax), intra-abdominal injury (i.e., hemoperitoneum, hepatic and adrenal injury), peripheral nerve injury (i.e., brachial plexus and phrenic nerve palsy) and fractures and dislocations.[4]

A number of articles have been published in scientific literature on the care of infants and children suffering from birth trauma.[5-10] To further document the clinical expertise and care provided by chiropractors in the care of similar patients, we present this case report of a newborn presenting with clavicular fracture, breastfeeding dysfunction and spinal and extraspinal subluxations in the cervico-cranio-mandibular complex.

Case Report

History

A female infant aged 16 days was presented by her mother for chiropractic evaluation of the spine and cranium as the infant suffered a right clavicle fracture attributed to birth trauma. In addition to the mother's concern about her baby's right clavicular fracture, she also reported that her infant had a poor shallow latch to her left breast resulting in nipple pain. The patient's mastitis (i.e., swelling and redness of breast tissue) was rated with a pain rating of 5/10 (i.e., 0=no pain; 10=maximum pain) and characterized as "pinching" and "chomping" type pain during her infant's breastfeeding dysfunction.

According to the infant's mother, the infant's clavicular fracture occurred as a result of birth trauma. Further history revealed the mother's labor lasted 35 hours and it was during the second stage of labor during the pushing phase that the fracture occurred. The infant's mother reported pushing for approximately 45 minutes with the use of "a lot of Pitocin". The infant was delivered vaginally with the use of epidural anesthesia for pain management due to prolonged and painful labor contractions. The infant's mother indicated that touch or contact to the infant's neck and shoulder ipsilateral to the fractured clavicle was provocative for pain and discomfort. Certain movements such as when buckling the infant into her car seat or laying the infant on her right side to feed on her mother's left breast also elicited pain resulting in the infant crying.

The infant's breastfeeding difficulties had been noticeably getting worse over time according to her mother. The infant's clinical presentations have affected the infant and mother's quality of life deleteriously. On the part of the mother, she suffered from mastitis and stress due to the uncertainty of "what to do" with her infant's present disposition. On the part of the infant, pain associated with the clavicular fracture and inability to feed properly resulted in excessive crying and sleep disturbance.

According to the infant's mother, no follow-up care (i.e., direct care, home care instructions) was provided by the hospital where the infant was born or the infant's pediatrician. The infant's mother denied that her infant was attended to by any other non-allopathic providers or that she has instituted any "self-care" options for her child.

Examination

Given the infant's history and clinical presentation, a physical examination was performed. On inspection, the infant presented with a preference to turning their head to the right with fixation in a right lateral flexion posture. A deep red skin crease on the right anterior lateral portion of the infant's neck was noticeable. The infant's ears were asymmetrical in positioning (i.e., vertical positioning) when visualized anterior to posterior and inferior to superior direction from the infant's chin. The infant's jaw was also unlevelled. The attending chiropractor (AD) created a visual analysis to examine asymmetry of an infant's face and the relationship of the cranium relative to the cervical spine and shoulders from the anterior to posterior and inferior to superior direction while the infant is in the supine position (see Figures 1 and 2).

We refer to this visual analysis as the "Triangle of Dorough." In this view, the chiropractor is able to appreciate any distortions (i.e., rotational and lateral flexion distortions) between the cranium and cervical spine that may cause underlying functional issues in this region such as feeding dysfunction or tummy time dysfunction or challenges lifting the head against gravity by the infant. If one is able to view abnormal ear alignment or shoulder alignment in relation to the nasion while looking up from the chin, or directly face-on, while the infant is in a recumbent and supinated anatomical position, one is able to visualize any distortions that may be present. This distortion is indicative of vertebral subluxation at the cranio-vertebral junction. Photogrammetric analysis using the Triangle of Dorough as shown in Figures 1 and 2 demonstrated distortions.

On palpation of the patient's cervical spine, the infant demonstrated facial wincing, pupillary constriction, and a swatting response. Light digital palpation of the right clavicle revealed a palpable osseous knot over the fracture site. Palpable bands and taught muscle fibers were noticeable on the right side of the infant's cervical spine paraspinal muscles along with swollen and palpable deep and superficial cervical lymph nodes, ipsilaterally. Palpable bands and taught muscle fibers were also noted at the right anterior triangle of the cervical spine. Palpable swelling or notable small non-mobile, pea sized nodules (not lymphatic tissue) were detected at the postero-lateral portion of the cervical trough which are in the exact location of the facet joints of the cervical spine. These swollen facet joints were noticeable at the C_1-C_2, C_2-C_3, C_3-C_4, C_4-C_5 and C_5-C_6 functional spinal units (FSUs) on the right side.

On motion palpation, restrictions on moving the patient's head to the left were restricted while a right rotational preference was notable on the patient's right side of the cervical spine FSUs from C_1 to C_6. Time was taken to appreciate the patient's natural favorable ROM during the exam. It was noticed that the patient preferred to have their head turned to

their right. The patient also demonstrated restriction in motion at the right temporomandibular joint (TMJ) resulting in decreased and asymmetrical opening of the jaw, particularly on the right side. Passive ROM demonstrated limited ROM on left lateral flexion and left rotation. Cervical spine compression testing was positive on the right side. No abnormalities were detected on deep tendon reflex testing in the upper and lower extremities. Babinski, suckling, rooting, and Moro reflex testing were all within normal limits.

Based on the physical examination findings, the infant suffered from strain/sprain injury of the soft tissues of the cervical spine along with subluxations in the cranium, the TMJ (bilaterally), the cervical spine and a fracture-subluxation[11] of the right clavicle.

Intervention & Outcomes

The patient's mother was made aware of the history and examination findings and consented to a trial of chiropractic care. The infant was scheduled for chiropractic care at a frequency of two times per week for 4 weeks for the initial phase of the infant's care. This was followed by a reduction in treatment frequency to one time a week for two weeks followed by a re-evaluation.

The chiropractic care provided was Diversified Technique characterized as "touch and hold" consisting of a gentle and held pressure applied to correct each site of vertebral subluxation. This hands-on technique was applied at each visit to each site of spinal subluxation for approximately 2-3 minutes while the patient was allowed to move at her own free will. Each and every visit lasted for a total duration of approximately 30 minutes. Sufficient time was allowed for the infant to rest, relax, or feed during each visit to avoid overstimulating the infant.

Home care instructions were provided to the infant's mother in the care of her infant to facilitate the healing process. The infant's mother was instructed to provide a cool, moist washcloth compress to the cervical spine and right clavicle, every day. The cloth was to be applied for 1-2 minutes or until the cloth reached body temperature and was to be repeated 2-3 times a day, every day, until swelling in the affected areas reduced to no appreciable swelling. Instructions also included that the used washcloth was washed and dried before each use. Recommendations were also to allow for chest-to-chest tummy time for 30 minutes a day, throughout the day to establish strength and stability at the craniovertebral junction and along with the entire extensor spinae group of musculatures.

A total of ten in-office visits had been completed over a 1½ month period. The infant's mother reported a significant increase in her daughter's ROM in the cervical spine after the first three chiropractic visits and further reported as no longer experiencing latching pain to her left breast during breastfeeding. The infant was described by her mother as more comfortable when left to sleep on her own and was more comfortable in her car seat.

Overall, the infant's feeding had improved significantly, her bowel movements were more with ease and having a higher quality of sleep (i.e., with less waking cycles during the night). After eight chiropractic visits, continued improvements were reported with the infant's feeding (i.e., approximately 20% improvement), overall decreased fussiness, improved cervical spinal ROM, and better-quality sleep. During this time, the infant's mother opted for her baby to undergo a frenectomy to address a "posterior-ankyloglossia" as diagnosed by an oral surgeon and based on the recommendation of her lactation consultant. The surgery was performed in the hope of preventing future feeding dysfunction in the infant and mastitis in the infant's mother. Following the frenectomy, the infant's mother ceased to experience recurring mastitis, and the infant's breastfeeding was reported to continue to improve steadily.

Chiropractic care continued following the infant's frenectomy to maximize the patient's nervous system function and spinal growth and development. With continued chiropractic visits, the infant exhibited considerably less fussiness and crying during the care sessions, particularly when the right side of her neck was touched. Recommendation was made to the infant's mother to have her daughter attend care one time a month for the remainder of her first year of life to ensure normal spinal development due to mild residual joint irritation and misalignment concomitant with the infant's injuries from birth trauma. No adverse events were noted by the infant's parents or the attending clinician.

Discussion

We review the chiropractic care of an infant presented by her mother for chiropractic care suffering from several symptoms and health challenges as a consequence of birth trauma. In the interest of brevity, our discussions will focus on birth trauma and clavicular fractures in particular as well as breastfeeding difficulties that the infant experienced from a subluxation-based chiropractic care perspective.

Birth Trauma Sustained by the Newborn

Birth trauma experienced by the newborn during labor and delivery is wide ranging from minor and self-limiting injuries such as injuries to the scalp to more severe injuries such as neonatal morbidity or mortality due to, for example, intracerebral hemorrhage.[12-13] The most common types of injuries resulting from birth trauma are injuries to the scalp and fractures of the clavicle.[13-14]

In 1993, Schullinger[4] stated that significant birth injury accounts for fewer than 2% of the neonatal deaths and stillbirths in the United States, occurring at an average of 6 to 8 injuries per 1000 live births. In a more recent analysis of neonatal birth trauma, Gupta and Cabacungan[15] found an increase in prevalence rate of 23% from 25.3 to 31.1 per 1000 hospital births based on a total of 982 033 weighted records.

Eighty percent of all birth traumas involved scalp injuries and increased yearly from 19.87 to 26.46 per 1000 hospital births while major birth traumas (i.e., clavicular fractures, brachial plexus injuries, and intracranial hemorrhage) decreased from 5.44 to 4.67 per 1000 hospital births. From a chiropractic

perspective, the prevalence of injuries due to birth trauma may be greater than that documented in the literature due to soft tissue injuries concomitant with cranial, spinal and extraspinal subluxations.

Clavicular Fracture-Subluxation

Linder et al.[13] found that birth trauma resulting in clavicular fractures occurred 7.7 times per 1000 live births based on a retrospective cohort case–control study involving full-term (37.0 to 41.6 weeks) singleton neonates delivered between 1986 and 2009 in a university-affiliated tertiary hospital in Petach Tikva, Israel. Linder et al.[13] also found the following independent risk factors for instrumental delivery (Odds Ratio (OR) =7.5; 95% Confidence Interval (CI) = 6.3–8.9): birth weight, delivery during risk hours, parity, maternal age and neonatal head circumference. Cesarean delivery was the only factor protective of birth trauma (OR = 0.2, 95% CI = 0.2–0.3).

In a retrospective file review performed of all births with clavicular fractures from January 2003 to December 2012, Ahn et al.[16] found 319 cases of clavicular fractures or 0.41% of total live births (n = 77 543). Ahn et al.[16] found that vacuum delivery was associated with a significantly higher incidence of clavicular fracture, as were mothers of advanced age with relatively shorter height. High birthweight, low head to chest circumference ratio and low Apgar score were other variables that was significantly associated with clavicular fracture. Logistic regression analysis found that vacuum delivery and birthweight were significant risk factors.

According to Ahn et al.[16] clavicular fractures generally have a benign outcome, without requiring treatment[17-22] as exemplified in their retrospective file review findings that all infants with clavicular fractures recovered without any specific treatment. The case presented resonates with the no treatment approach with her clavicular fracture. A "watch and wait" approach was the standard in medical care for this condition. We would disagree with this medical policy, particularly when there is concomitant brachial plexus injury[23] or when soft-tissue injuries and spinal and extra-spinal subluxations are present in the cervico-cranio-mandibular complex. This case report highlights the role of the chiropractor to address these soft-tissue injuries and the spinal and extra-spinal subluxations in cervico-cranio-mandibular complex and the fracture-subluxation of the scapula.

Systematic Review of Literature

To further inform these discussions, we performed a systematic review of the literature on the chiropractic care of children presenting with clavicular fractures. We consulted the following databases: PubMed (1966-2024), Allied and Complementary Medicine (AMED) (1978-2024), Cumulative Index to Nursing and Allied Health Literature (CINAHL) (1978-2024), and Index to Chiropractic Literature (1978-2024).

The search terms were chiropractic, chiropractic care, chiropractic manipulation, infants, baby, newborn, neonate, pediatrics, clavicle, and clavicular fracture in various Boolean combinations and utilizing the "apply related words" function when available. Inclusion criteria for our review were manuscripts: (1) involving a pediatric patient (i.e., aged 0-17 years of age), (2) chiropractic care (i.e., spinal manipulative therapy (SMT) and/or adjunctive therapies) was provided, (3) published in a peer-reviewed journal and (4) published in the English language. Exclusion criteria were: (1) abstracts from conference proceedings, (2) dissertations for a Master or PhD degree, (3) Letters to the Editor, (4) chapters in textbooks and (5) non-English language manuscripts. The two chiropractic journals with a focus on the chiropractic care of children were also electronically searched for articles meeting the inclusion criteria from their inception to December 2024. These were the Journal of Clinical Chiropractic Pediatrics and the Journal of Pediatric, Maternal & Family Health – Chiropractic.

The authors (AD and JA) independently examined the search results with disagreements resolved by consensus. Both authors also examined the references of the reviewed manuscripts for eligible literature not previously identified. The principal author (AD) extracted the following data from the relevant studies using an Excel spreadsheet: (1) study description (i.e., study design, year of publication, country of origin); (2) aim or study purpose (3) clinical presentation, (4) clinical management information (i.e., diagnosis/assessment procedure(s), chiropractic technique and adjunctive therapies and (5) summary of findings.

The extracted data was confirmed independently by the co-author (JA) to minimize error. Disagreements were addressed by consensus between the authors. Our reporting followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[24] Quality appraisal of the reviewed manuscripts was performed independently by AD and JA using the Joanna Briggs Institute Critical Appraisal Tools (JBI CATs) for case reports[25] as these were the only type of literature found to assess their trustworthiness, relevance and overall methodological quality.

Our initial search revealed a total of five abstracts for screening with one duplicate title. Of the remaining titles (n=4), one article[26] immediately did not meet the inclusion criteria. Of the remaining three titles, further investigation revealed another article[27] involving the chiropractic care of an infant experiencing a clavicular fracture due to birth but failed to meet the inclusion criteria for review (see Figure 3). The article by Sperry and Pfalzgraf[26] did not meet our inclusion criteria but nonetheless deserves commentary given that the child received "chiropractic" manipulations by an unlicensed individual.

Sperry and Pfalzgraf[26] described a nine-month-old child that was unresponsive in his crib, five hours after his last feeding and eventually died. Autopsy revealed no external or internal signs of abuse or neglect with a few visceral pleural and epicardial petechiae consistent with sudden infant death syndrome (SIDS). However, postmortem total body radiographs revealed healing, symmetrical clavicular fractures and healing a left medial humeral epicondyle fracture. The parents had no explanation for these injuries and denied causing any harm to the child.

The location and nature of the fractures strongly suggested child abuse, and the case was reported to the authorities as

such. An investigation revealed that the child had undergone "chiropractic" manipulations by an unlicensed therapist according to the parents some three to four weeks prior to dislocation. This time interval correlated with the histologic age of the injuries, and the history explained their unusual bilateral location and appearance. The parents were exonerated of abuse charges, and the death was ascribed to SIDS. The caveat here for any chiropractor attending to the care of newborns is to perform an adequate history and physical examination to rule out possible absolute and relative contraindications to chiropractic care and for the possibility that another healthcare provider may have rendered inappropriate care.

We remind the reader the findings from the retrospective file review by Ahn et al.[16] Prior to discharge, 275 (86.2%) infants with clavicular fracture(s) were detected but in 44 (13.8%) infants, the clavicular fractures were not detected until after discharge. A simple test such as the Moro reflex where the infant is incapable or fail to throw their arms out to the side with their palms facing up or the Asymmetrical Tonic Neck Reflex (ATNR) where the infant fails to demonstrate the "fencing reflex" (i.e., the infant's head is turned to one side, the arm and leg on the ipsilateral side to rotation extend, and the arm and leg on the contralateral side flex) may indicate the need for further investigation to rule out a clavicular fracture.

The case report by Lanjopoulos and Lanjopoulos[27] also failed to meet the inclusion criteria. Despite reporting of a 2-year-old female with a history of a broken clavicle at birth, the focus of the case report by Lanjopoulos and Lanjopoulos focused on her complaints of chronic otitis media, difficulty sleeping, irritability, and skin sensitivities to clothes and being held or touched. The remaining two articles[, 28-29] remained for further review. The extracted variables are provided in Table 1.

The case report by Hanson and Linaker[28] described a sustained clavicular fracture due to a fall while in this case report and that by Bourque,[29] the clavicular fracture was attributed to birth trauma. In terms of their clinical presentations, co-morbidities to the clavicular fracture-subluxation included constipation and breastfeeding difficulties in the case report by Bourque[29] while this case reported a comorbidity of breastfeeding difficulties, excessive crying and sleep disturbance.

The toddler reported by Hanson and Linaker[28] only involved a clinical presentation of a fracture-subluxation of the right clavicle. Not surprisingly, the clinical presentation and examination findings were similar. For example, the infants presented with distress, exhibited guarding on the side of the involved fracture-subluxation. The infants suffered from sprain-strain injuries at the cervical spine and the involved shoulder. In the case report of Bourque[29] and in this case report, the breastfeeding difficulties may be attributed to a consequence of the fracture-subluxation of the clavicle. However breastfeeding difficulties may also be due to the subluxation of the TMJ or diagnosed posterior-ankyloglossia as in this case report.

In terms of the care provided, Hanson and Linaker[28] described a high velocity, low amplitude light thrusts to the site of spinal subluxation (i.e., C_2) along with home instructions to the use of sling on the side of the involved clavicle to restrict shoulder movement, and to avoid dangling the patient's legs. Bourque applied light mobilization and vibration to the left clavicle, the 1st rib, scapula and glenohumeral joint.[29] Sacro-Occipital Technique (SOT) was applied to address occipital restrictions and to release the tension in the fascia and the cervical paraspinal musculature. The T_2 and T_5 subluxations were addressed with a "touch and hold" technique. Myofascial release and massage were applied to the left shoulder girdle musculature. In the case reported, sites of spinal subluxations were also addressed with "touch and hold" technique as in the Bourque case report[29] with the addition of home care instructions for the infant's mother to provide a cool, moist washcloth compress daily to the cervical spine and right clavicle of the patient to decrease the inflammation.

This case report describes the clinical expertise and capability of chiropractors to care for infants and toddlers presenting with complaints associated with birth trauma (i.e., clavicular fracture-subluxation and comorbidities such as breastfeeding).

The results of the quality appraisal of the reviewed manuscripts are summarized in Table 2. Overall, the reviewed case reports were of good methodological quality as assessed by the JBI CATs. In both case reports, the objectives of the study were clearly stated, the patients' demographic characteristics clearly described along with their histories and presented as a timeline. The patients' current clinical conditions were clearly presented with a number of diagnostic tests or assessment methods clearly described. The chiropractic care (i.e., spinal adjustments and adjunctive therapies) were clearly described along with long-term follow-up. In terms of adverse event reporting, Hanson and Linaker failed to address if the child suffered from adverse events due to chirtopractic or not while Bourque clearly stated that "No adverse reactions to care were observed by the chiropractor or reported by the parents during or after the course of care."

Breastfeeding Dysfunction – TMJ subluxation

Breastfeeding is essential for the survival, nutrition, and development of infants and young children. Globally, the prevalence of breastfeeding at 12 months is highest in sub-Saharan Africa, south Asia, and parts of Latin America. In most high-income countries, the prevalence is lower than 20%. Differences are also noted between countries such as the UK (<1%) and the USA (27%), and between Norway (35%) and Sweden (16%).[30]

Although not discussed here in detail, traumatic childbirth can impact breast feeding.[31] A stressful labor and delivery, emergency Caesarean, psychosocial stress or pain of childbirth have been documented as risk factors for delayed lactogenesis, defined as the initiation of plentiful milk secretion.[31-33]

According to Vallone,[34] when evaluating an infant with breastfeeding difficulties, a "whole child" approach should be adopted as there are many factors that could interfere with a successful latch and milk transfer such as injured muscles, hip dysplasia, neurologic interference, certain medications and fractured clavicles. Even a misaligned clavicle can cause tension in the anterior muscles of the neck as the infant flexes to prevent traction on the clavicle while breastfeeding and thus

interfering with their ability to nurse properly.[35]

According to Alcantara et al.[36] the chiropractic perspective of birth trauma resulting in breastfeeding difficulties can be attributed to abnormal anatomical, physiological, or biomechanical dynamics of the cervico-cranio-mandibular complex and referred to by some as cervicocraniomandibular syndrome.[37] In 2018, Hawk et al.[38] performed a scoping review of the manual interventions for musculoskeletal (MSK) factors in infants with suboptimal breastfeeding. Keep in mind that their review addressed "manual therapies" and not necessarily confined to chiropractic. Their scoping review found 27 articles meeting inclusion criteria. These were: 7 expert commentaries,[39-45] 1 RCT,[46] 1 pilot study,[47] 1 cohort study,[48] 2 cross-sectional studies (surveys),[49-50] 5 narrative reviews[36-51, 54] and 10 case reports/ series.[55-64]

The following year, Edwards and Miller[65] published their review of the evidence that chiropractic care helps infants with sub-optimal breastfeeding. The authors reviewed 10 articles and were assessed as demonstrating a low to moderate level of evidence with 9 articles being case series or case reports[48, 66-73] in addition to the systematic review by Hawk et al.[36]

Since the review of Hawk et al.[36] we are aware of an additional four articles on the topic of chiropractic care of infants with breastfeeding difficulties. Three were case reports. Fludder and Bourgeois[74] described a 4-week-old infant with breastfeeding difficulty not associated with tongue-tie, lip-tie, or other oral tether based on the assessment of an International Board Certified Lactation Consultant (IBCLC). The infant was born via Caesarean section at 39+3 weeks gestation with the use of forceps which the mother reported as being "very forceful." The infant was cared for with of low-force spinal and extremity manual therapy, combining mobilization and the use of portable drop piece to regions of the spine demonstrating articular restriction. After her initial visit, the infant's mother reported improvements in her child's ability to suck and swallow, with elicitation of both Galant Reflex and Perez Reflex.

After her second visit, there was a marked reduction in unsettled behavior, and improvements in both her ability to attach and suck at the breast. In terms of outcomes of care, the infant was described as gaining weight (i.e., after six patient visits, weight gain was approximately 70 g per week). By the 8th visit, the infant's cervical spine demonstrated full and normal ROM along with a substantial increased rate of weight gain of 140 g within one week. After the 9th visit, her weight increased to 200 g within one week.

At her 11th visit, her mother reported normal breastfeeding. McNamara[75] described the care of a 3-week-old newborn struggling to attach and latch consistently to the breast. She was referred for chiropractic care by a lactation consultant due to concerns that her breastfeeding dysfunction may or may not be due to tongue tie. The infant was under weight (i.e., 3210g) and sleepy. The infant was diagnosed with restrictions at the C_0/ C_1 FSU, right TMJ and glenohumeral joint restrictions which was possibly linked to a long labor and the use of forceps at birth. At the patient's 3rd visit, the infant's mother reported a more comfortable, deeper latch and less fussiness when placed at the breast. Feeding was taking about 30 minutes, and the infant had also increased her weight by 350g. The infant had improved in suck strength and function but Moro Reflex testing on the right was still diminished. By the patient's 6th visit, the infant was at a weight of 6107g, a head circumference of 39cm and good functional head control on tummy time. Pull to sit was assessed as good with no head lag. Dysfunction was noted in her right TMJ and glenohumeral joint with some mild functional asymmetry still present.

Bunge[76] described the care of a newborn 32 days of age with a chief complaint of breastfeeding difficulties and inability to latch. The infant was presented to a lactation consultant at 12 days of age with the infant's mother presenting with sore nipples and her infant as having no latch, suck, or milk transfer from the breast. The infant was being fed with expressed milk via finger feeds or a nasogastric tube as a home-made supplemental nursing system. The mother trialed a nipple shield, but it did not improve, and the infant continued to have breastfeeding difficulties. The lactation consultation referred the infant for a frenectomy due to a posterior tongue tie at 13 days old. Despite the frenectomy, the infant continued to experience breastfeeding difficulties.

At 4 weeks 4 days (32 days) of age, the infant's parents presented the infant for chiropractic care. Previous therapy at this point included craniosacral therapy by a physiotherapist with no improvement according to the infant's parents. Chiropractic care included chiropractic adjustments modified to the age and size of the patient to the cranium, TMJ, and hyoid along with a bilateral occipital release. Soft tissue therapy was applied to the anterior neck musculature, including a stretch to release muscle restrictions.

The home exercise program included massage therapy to the anterior neck, face and chest, the guppy stretches (i.e., the infant lies supine and allowing the head to tilt gently into a slight extension), side to play (i.e., the infant is side lying and looking at parents) and different options of tummy time. With chiropractic care and at four months of age, the infant experienced no feeding difficulties at this stage. She weighed 6640g with a gain of 232g per week in the last 10 weeks. This was within normal ranges for her current age. No adverse effects were reported by the parents post chiropractic care.

Finally, a commentary advocating chiropractic care for infants with breastfeeding difficulties was published by Miller.[77] The author described some of the key skills and techniques used by chiropractors to assist the breastfeeding dyad (i.e., mother and child). In terms of the evidence for chiropractic care to improve suboptimal breastfeeding based, Miller offered the systematic reviews by Edwards and Miller[65] and the systematic review by Hawk et al.[38] as moderate positive evidence in assisting infants with suboptimal breastfeeding with manual therapy (i.e., chiropractic and osteopathic care).

Miller then highlighted that forces applied by chiropractors to address MSK dysfunction in infants with breastfeeding difficulties are low (i.e., 2N or 0.22 lbs. of force), that chiropractors embrace a collaborative approach to patient care (particularly with IBCLCs), the clinical signs in an infant that a referral to chiropractor may be appropriate, the chiropractor's general approach to patient care, and the biological plausibility for MSK care and safety.

Lastly, Dorough[78] describes the importance of chiropractic physician-clinical evaluation of the infant experiencing feeding difficulties. The author explains how biomechanically induced stress, strain, and traumatic injuries during the birth process can often create confusion for non-physicians speculating a posterior-tongue tie.

Dorough illustrates how potential injuries can hinder the correct diagnosis which may be causing the feeding dysfunction and how it can be potentially confused with a diagnosis of posterior-tongue tie. According to Dorough,[78] clinical understanding of both presentations in and of themselves is required when considering oral surgery for infants to correct the cause of feeding dysfunction.

Limitations of Case Report

In closing, we must caution the reader about the lack of generalizability of case reports. Several confounding variables exist based on a post-positivist research paradigm. These confounders include the lack of a control group, possible spontaneous resolution of the child's symptoms, etc. However, the success of this case report forms the basis for our generalization in the care for patients with clinical presentations.

Conclusion

This case report described the successful chiropractic care (i.e., spinal adjustments and adjunctive therapies) of an infant presenting with multiple symptom complex associated with birth trauma (i.e., clavicle fracture, breastfeeding difficulties, subluxations of cervico-cranio-mandibular complex). We encourage continued documentation in the care of similar patients to inform higher level research designs (i.e., prospective cohort studies or randomized controlled clinical trials).

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Figure 1. The photogrammetric analysis of the Triangle of Dorough. The triangle is created by connecting the triangular edges from the nasal apex to the center of the lobulus auriculae or ear lobe. The based of the triangle is drawn from the superior aspect of each ear. As demonstrated in this figure, the base of the Triangle of Dorough demonstrates the unrevealing of the ears in this infant.

Figure 2. In this Triangle of Dorough, the base of the triangle bisects the superior aspects of the shoulders while the lateral triangular edges are made from the nasal apex to the center of the lobulus auriculae or ear lobe. Again, as demonstrated in the photogrammetry, the lines from the superior aspect of the ears are unlevelled based on the trapezoid shape (i.e., a rectangle with unequal sides and non-parallel top and bottom.

Figure 3. Flow diagram of the systematic review of the literature on the chiropractic care of children (0-17 years of age) presenting with a clavicular fracture.

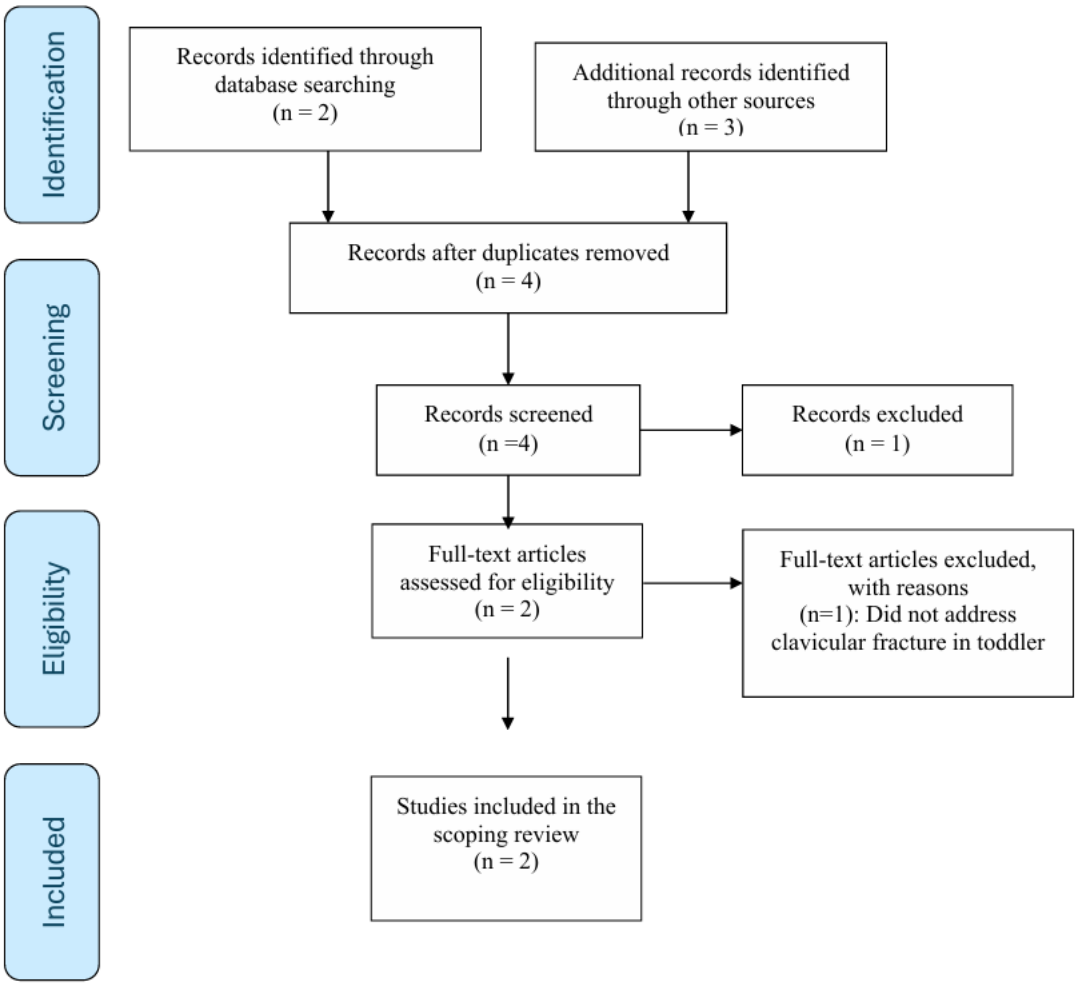

Table 1. Summary findings of case reports and case series involving the chiropractic care of infants with clavicular fractures.				
Reference/yr/ Country	Study aim(s) or purpose	Clinical Presentation or Study of Interest	Management Protocol	Summary of Findings
Hanson and Linaker /2009/[28]/USA	To present the case of an 18-month-old female that was cared for in a collaborative approach (i.e., chiropractor and orthopedist) after suffering from a clavicular fracture due to a fall.	At clinical presentation, the toddler appeared to be in physical distress, and was unable to actively or passively move her head without distress. Severe muscle spasms were noted in the cervical spine, in the sternocleidomastoid, upper trapezius, levator scapulae and both anterior and posterior scalene muscles. There was mild swelling between the proximal and distal clavicle. Held in the vertical posture with legs hanging down exacerbated her symptoms. Radiographic examination confirmed a clean break in the "S" curve, dividing the proximal and distal portions of the clavicle. An orthopedic referral was obtained. The child demonstrated restricted ROM in the cervical and thoracic spine, restricted	At her initial visit, the toddler was adjusted with a light thrust to the articular pillars of the C2 VB. She responded well and was sent home for rest and support. Home care instructions to the parent included the use of a simple sling, restrictions of movement, avoid dangling her legs when holding her under the arms and keep her body supported during the acute phase of healing. The toddler returned the following day, and the C_2 VB was again adjusted along with light lymph pumping to stimulate draining of deep and superficial lymph nodes in the SCM due to swollen cervical lymph nodes and swelling over the right clavicle. In addition to previous home care instructions, the parents were instructed to including	The child clavicular fracture healed without a palpable mass and without alteration to postural positioning of her shoulders. The toddler was evaluated at 6 months and at 12 months after her 4th visit. The fractured site was revealed as reunited without overlap between the medial and lateral components of the clavicle. There was no palpable mass upon visual inspection and palpation.

Table 1. Summary findings of case reports and case series involving the chiropractic care of infants with clavicular fractures.

Reference/yr/ Country	Study aim(s) or purpose	Clinical Presentation or Study of Interest	Management Protocol	Summary of Findings
		ROM in the right glenohumeral and scapula joints, loss of segmental function at the C_2 vertebral body (VB) (i.e., decreased rotation and lateral flexion to the right) and severe muscle splinting in the involved sites.	increased vitamin C supplementation. The lymphadenopathy of the right cervical region resolved within three to four days. The child was monitored for the next six weeks after the clavicle fracture. Her full spine was examined one time a week during this six-week period. At each office visit a subluxation was found at C_2 VB and was adjusted until resolved.	
Bourque [29]/ 2018/ USA	To describe the chiropractic care of a 5-month-old male infant with multiple complaints related concomitant with a neonatal clavicle fracture.	At clinical presentation, the infant presented with chief complaints of fussiness, irritability, crying, grunting, rigidity, abnormal position of his left arm, 2 weeks of constipation, breastfeeding difficulties on the right side and discomfort lying on his stomach. The mother associated all these complaints to the left clavicular fracture her infant suffered during birth. The fracture was medically diagnosed at 4 days of age. The infant's parents did not receive any specific	The infant was scheduled for care once a week for the first two weeks and then two visits over the next 2 months for a total of 4 visits. Chiropractic care was initiated on the first visit. A combination of different techniques were applied to the left clavicle, 1st rib, scapula and glenohumeral joint were adjusted with light mobilization and vibration due to the infant's sensitivity to pressure. Sacro-Occipital Technique (SOT) was used to treat the occipital restriction and to release the tension in the fascia and the cervical	Chiropractic care was concluded after the 4th visit due to the infant's family moving to another city. The infant's parents were greatly encouraged to continue his chiropractic care. The parents reported no adverse events related to any of the treatments given.

Table 1. Summary findings of case reports and case series involving the chiropractic care of infants with clavicular fractures.

Reference/yr/ Country	Study aim(s) or purpose	Clinical Presentation or Study of Interest	Management Protocol	Summary of Findings
		recommendations for care or precautions around the clavicle fracture. Physical examination revealed the infant as agitated, grunting and crying upon physical examination with evidence of rigidity in his global tonus posture with extension. Head rotation was mildly limited to the left during passive rotation. Evaluation of his left shoulder mobility caused distressed and reacted by contracting the shoulder girdle muscles. Neurological examination revealed intact Galant, Babinski and Landau reflexes. Objective findings of subluxations were noted to the left clavicle, left 1st rib, at T_2 and T_5 VBs, at the occiput, left scapula and left gleno-humeral joint based on static palpation and motion palpation.	paraspinal musculature. The T_2 and T_5 subluxations were addressed with "touch and hold" technique. The left shoulder girdle musculature was addressed with myofascial release and massage. The infant's parents received home exercises recommendation to reduce tension and to improve motor development. Immediately after the first visit, the infant's mother observed significant changes in her child's behavior and well-being. In the following days, the infant was calmer and more 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. By the 3rd visit, the infant was described as no longer grunting, crying during	

Table 1. Summary findings of case reports and case series involving the chiropractic care of infants with clavicular fractures.				
Reference/yr/ Country	Study aim(s) or purpose	Clinical Presentation or Study of Interest	Management Protocol	Summary of Findings
			tummy time and he was able to sit unassisted. Following the 4th visit, the infant demonstrated normal ROM 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 infant's mother confirmed he was no longer grunting or crying for inexplicable reasons.	

		Response to critical appraisal checklist for case reports*** Y =Yes; N = No; U = Unclear; NA = Not Applicable							
	Reference	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
1	*Hanson and Linaker [28]*	Y	Y	Y	Y	Y	Y	N	Y
3	Bourque [29]	Y	Y	Y	Y	Y	Y	Y	Y

Table 2. Results of the JBI critical appraisal checklist for case reports

Q1. Were patient's demographic characteristics clearly described?
Q2. Was the patient's history clearly described and presented as a timeline?
Q3. Was the current clinical condition of the patient on presentation clearly described?
Q4. Were diagnostic tests or assessment methods and the results clearly described?
Q5. Was the intervention(s) or treatment procedure(s) clearly described?
Q6. Was the post-intervention clinical condition clearly described?
Q7. Were adverse events (harms) or unanticipated events identified and described?
Q8. Does the case report provide takeaway lessons?