Australian College of Chiropractic Paediatrics

2018

Chiropractic Evidence-Based Management of Breastfeeding Difficulty

Committee on Breastfeeding Difficulty

ACCP

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About the Australian College of Chiropractic Paediatrics

The Australian College of Chiropractic Paediatrics is the professional organisation for Paediatric Chiropractors in Australia.

Our members are paediatric-trained chiropractors employed throughout the private sector. They provide health care, management, and consultancy to clients.

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The **Australian College of Chiropractic Paediatrics** is committed to providing the latest in research and education of chiropractic management of breastfeeding difficulty.

Summary of Key Action Statements in this Document

1. When managing an infant with breastfeeding difficulties, the chiropractor should be aware that despite 90% of Australian mothers initiating breastfeeding, there are factors leading to suboptimal or premature cessation of breastfeeding. Despite recommendations of exclusive breastfeeding to six months of age, only 15% of Australian mothers do so. Chiropractors should work with other healthcare professionals to support exclusive breastfeeding to six months of age.

2. Breastfeeding is beneficial to infant health, with evidence of improved cortical function, motor development, language development, intelligence, mental health and immune system function. Suboptimal or lack of breastfeeding is disadvantageous to infant and child health. Breastfeeding also confers health benefits to the mother. Chiropractors should work with other healthcare professionals to support exclusive breastfeeding to six months of age

3. The chiropractor involved in the care of the breastfeeding mother and child needs to be aware of and understand the mechanics of normal breastfeeding.

4. Chiropractors involved in the care of breastfeeding infants and children need to be aware of the range of factors which may impact successful breastfeeding. The chiropractor should understand their limited training in breastfeeding education and consider there may be factors that, either in the infant/child or the mother, may result in suboptimal breastfeeding and refer when appropriate.

5. The chiropractor should be able to identify dysfunctional breastfeeding and make appropriate referrals to support the breastfeeding dyad. Recognition and appropriate referral of those with red flag indicators or signs of failure to thrive are paramount.

6. a) Thorough assessment of the paediatric patient should be undertaken by the chiropractor in infants with breastfeeding difficulties. Intersegmental ranges of motion of all spinal regions in three axes of motion should be undertaken, as well as full motion assessment of all extremity joints. A thorough assessment is essential in ruling out underlying pathology and providing an accurate diagnosis.

   b) Regardless of the presence of neurological or musculoskeletal dysfunction in infants with breastfeeding difficulty, collaborative care and support should be sought from an International Board Certified Lactation Consultant (IBCLC) as chiropractors are not adequately trained to assess causes outside of this scope.

   c) In the presence of red flag indicators, failure to thrive, or dehydration referral to both an International Board Certified Lactation Consultant (IBCLC) and paediatrician is recommended.

7. The chiropractor should understand the impact and effect of the chiropractic adjustment, as significant changes may occur within the nervous and musculoskeletal systems. Improvement in afferentation by restoring proper spinal joint function facilitates appropriate neurological development and function, which may present as improved breastfeeding.

8. Low-level evidence of chiropractic management has demonstrated improvement in 78-100% of those with breastfeeding difficulties; infants with breastfeeding difficulty may benefit from chiropractic management.

9. The chiropractor should routinely measure an infant's growth and development. Weight, head circumference, length and neurodevelopment in the infant with breastfeeding difficulties should be regularly measured and documented. Appropriate referral to an International Board Certified Lactation Consultant (IBCLC) or paediatrician may be necessary in cases of atypical development, cases that do not improve with chiropractic management, or worsening cases.

10. The chiropractor should recognise when referral to other health care providers is indicated, and refer when appropriate. In the event of uncertainty, the paediatrician should be the primary referral. In the absence of indications of infant illness, referral to an International Board Certified Lactation Consultant (IBCLC) should occur, as chiropractors have limited education in breastfeeding management.

1. Introduction

The benefits of breastfeeding are well documented with the World Health Organisation (WHO), the American Academy of Pediatrics (AAP), and the National Health and Medical Research Council (NHMRC) recommending exclusive breastfeeding for the first six months of life, followed by breastfeeding with the introduction of nutritious complementary foods, until at least one to two years or beyond (World Health Organization 2011; American Academy of Pediatrics 2012; National Health and Medical Research Council 2013). Exclusive breastfeeding has several benefits including improved infant survival rates, health, growth and developmental outcomes for the infant (World Health Organization 2011). In addition to the benefits for the infant, breastfeeding also provides physical and psychological benefits for the mother.

The Australian Government has strongly supported the practice of breastfeeding, with frequent surveys, inquiries, and strategies culminating into the "Best Start Report" (House of Representatives, Standing Committee on Health and Ageing2007; Australian Institute of Health and Welfare 2011. 2010). A major factor behind these breastfeeding initiatives and reports is the low rate of exclusive breastfeeding at 4- and 6-months of age. In Australia, the initiation rate of exclusive breastfeeding may be at 90%, but this reduces to 46% at 4-months of age and 14% by 6-months of age (National Health and Medical Research Council 2013).

There are several contributing factors towards a parent's decision to cease breastfeeding, with "difficulties of attachment and suck" the a commonly cited reason (Odom et al. 2013). Research has shown an association with breastfeeding difficulty and the presence of cervical spine joint dysfunction (Stewart 2012; Fludder & Keil 2018b). Low-level evidence shows infants with breastfeeding difficulty of a musculoskeletal nature to improve with chiropractic care (Holtrop 2000; Vallone 2004; Miller et al. 2009; Holleman et al. 2011; Drobbin & Stallman 2015; Miller et al. 2016; Ferranti et al. 2016).

In Australia there remains a poor rate of exclusive breastfeeding to six months of age, despite ample evidence to support the many benefits of breastfeeding, in addition to effective methods to improve rates.

The chiropractor plays an important role in improving breastfeeding rates by providing: maternal education of the benefits of breastfeeding, nutritional advice, appropriate collaborative care, and with appropriate treatment where indicated. The current evidence demonstrates improvement in breastfeeding after chiropractic treatment; it is important to note, however, that there is currently only low-level evidence supporting chiropractic treatment for infants with breastfeeding difficulty, with further research in this field required. It is important for the chiropractor to recognise and appropriately refer those with breastfeeding difficulties that are not neuromusculoskeletal in nature, or when the health of the infant is urgently at risk. As breastfeeding training is considered inadequate in most Australian health care professions, including chiropractic (Rollins et al. 2016; Australian Health Ministers' Conference, 2017; Hull et al. 2018),co-management with an IBCLC is strongly encouraged.

Key Action Statement – Scope of the Problem

When managing an infant with breastfeeding difficulties, the chiropractor should be aware that despite 90% of Australian mothers initiating breastfeeding, there are factors leading to suboptimal or premature cessation of breastfeeding. Despite recommendations of exclusive breastfeeding to six months of age, only 15% of Australian mothers do so. Chiropractors should work alongside other healthcare professionals to support exclusive breastfeeding to six months of age.

2. The Scope of the Problem

The National Health and Medical Research Council (National Health and Medical Research Council 2013), the Royal Australasian College of Physicians (Royal Australasian College of Physicians 2007), the Australian Breastfeeding Association (Australian Breastfeeding Association 2013), and the Australian College of Chiropractic Paediatrics all recognise a problem with the high rate of premature cessation of breastfeeding in Australia. According to recent surveys on exclusive breastfeeding rates, initiation in Australia is 90%, reducing to 46% by four months of age, with 15% of mothers exclusively breastfeeding at six months of age (Australian Institute of Health and Welfare 2011. 2010; National Health and Medical Research Council 2013; Australian Health Ministers' Conference 2017). This has prompted the development of the Australian National Breastfeeding Strategy 2010-2015 (Australian Health Ministers' Conference 2009).

The declining rate of breastfeeding practice over the first six months of life, however, either suggests the benefits and recommendations regarding exclusive breastfeeding practices are not adequately known or expressed by health care providers, are not widely known or understood (World Health Organization 2009b), and/or there is inadequate assistance available for sustaining breastfeeding practices. The decision to encourage breastfeeding for the first 6 months of life is consistent with the positions of the AAP and WHO, who have based their statements from findings and outcomes by systematic reviews on optimal breastfeeding duration (Horta et al. 2007; Kramer & Kakuma 2012). Beyond six months, it is recommended to continue breastfeeding alongside the introduction of complementary food until 12 months of age and beyond, depending on maternal and child preferences (National Health and Medical Research Council 2013; Australian Health Ministers' Conference 2017). The World Health Organization recommends continued breastfeeding until at least 2 years of age (Brodribb 2012c).

2.1. Optimal Breastfeeding

There are inconsistencies regarding the definition of breastfeeding, with variation ranging from whether the infant has ever fed at the breast, exclusively breastfed, exclusively fed expressed breastmilk, or been breastfed by a wet-nurse; whether they receive a supplementary expressed milk, supplementary formula feeds, or whether

lactation aids have been required (Victora et al. 2016; Brodribb 2012a; American Academy of Pediatrics 2012).There is a continuum of ways in which an infant can be nourished, with the optimal being unaided breastfeeding. Ultimately, breastfeeding should be a comfortable and satisfying nurturing experience for both mother and baby; one that optimises infant growth and development, provides innate immune protection, and, facilitates mutually beneficial physical, cognitive and emotional interaction for mother and baby (Entwistle 2013).

2.2. Duration of Breastfeeding

The current international breastfeeding recommendations are exclusive breastfeeding until 6 months of age, with continued breastfeeding complemented by the introduction of solids from six months of age until 2 years and beyond, or as long as both mother and child wish (World Health Organization 2009b). The AAP and NHMRC recommend exclusive breastfeeding for the first six months, with continued breastfeeding until at least 12 months of age, without indicating an upper limit on age (American Academy of Pediatrics 2012; NHMRC 2012). Non-human primate data has suggested human children are designed to receive breastmilk until at least 2.5 years of age, with an estimated upper limit of 7 years of age (Brodribb 2012a; Dettwyler 1995).Genetic research studies have determined that even in lactase non-persistent phenotype, the lactase enzyme is active until 2-3 years of age; lactase-persistent phenotypes demonstrate lactase activity until much older ages (Wang et al. 1998; Swallow 2003; Troelsen 2005). Anthropological and non-human primate studies have demonstrated the natural weaning age should be much older than current practices (Dettwyler 1995). Observation of more traditional cultures has concurred with this finding, with natural weaning occurring between 2 and up to 7 years of age (Dettwyler 1995; Brodribb 2012a). The most recent NHMRC guidelines do not discuss the process of ceasing to breastfeed, nor the ideal age at which the process should occur (NHMRC 2012). This evidence suggests that the Guidelines are incomplete; the term "extended breastfeeding" may be a misnomer, where rather cessation of breastfeeding before 2-3 years of age based on this current evidence should be considered "premature cessation" of breastfeeding.

2.3. Comfort of Breastfeeding

The normal, healthy infant demonstrating optimal feeding should feed comfortably from both breasts. While nipple sensitivity increases post-partum and attachment pain peaks with engorgement at day 3-5 (Ziemer et al. 1990), breastfeeding difficulty consisting of pain persisting in to the second week of breastfeeding, or that is associated with damage or a change in nipple shape after the feed, is not normal, and likely due to poor attachment (Dennis et al. 2014; Brodribb 2012d). Nipple pain is a leading cause of discontinuation of breastfeeding (Dennis et al. 2014), and a large proportion of cases can be improved with correction of attachment (Brodribb 2012d; Blair et al. 2003), usually facilitated by a lactation consultant.

2.4. Milk Supply

In women with no underlying medical impediments (such as insufficient glandular tissue) feeding according to the infant's need is encouraged and expected to help establish and maintain milk supply (Great Britain. Panel on Child Nutrition 1988; Kent et al. 2006; Holmes et al. 2013). Storage capacity of the breast varies among mothers, and between breasts (Kent et al. 2006; World Health Organization 2009b), as does each individual infant's gastric emptying time and stomach capacity(Kent et al. 2012). There is great variability in the frequency of feeds and volume of milk ingested in normal, healthy breastfed infants. Kent et al reported the frequency of feeds in healthy, exclusively breastfed infants varies between 6-18 times per day, with mothers producing an average of 788mL (range 478-1356mL) of breastmilk per 24-hour period (Kent et al. 2006). This production volume remained quite stable throughout the first 6 months of life (Kent et al. 2006).

2.5. Feeding Patterns

The right breast tends to produce more milk than the left in most mothers (76%), and boys tend to have a higher volume consumption than girls. Night feeds are normal and an important part of breastfeeding the infant, with 63% of infants feeding 1-3 times in the night first 6 months of life (Kent et al. 2006). There is currently inconsistency regarding normal ages for the cessation of overnight breastfeeding, with some authors suggesting infants not requiring overnight feeds from 6 months of age(Thiedke 2001; Kliegman et al. 2015)however, the ABA acknowledges that in some circumstances infants may still require overnight feeds(Australian Breastfeeding Association 2016).

Duration of a breastfeed should not be restricted (Holmes et al. 2013), so long as nipple damage is not occurring (World Health Organization 2009b), which will likely require assistance from an International Board Certified Lactation Consultant (IBCLC). Breastfeeding of over 30 minutes in duration may be a by-product of poor attachment, resulting in inefficient milk transfer and prolonging feeds (World Health Organization 2009b) or the result of "comfort feeding" where the infant is using the act of feeding to reduce pain levels (Peng et al. 2018; Liaw et al.2011; Thakkar et al. 2016; Boyle et al. 2006).Both the ingestion of breastmilk and the action of breastfeeding have been demonstrably used as effective analgesics in infants (Mathai et al. 2006; Thakkar et al. 2016), and therefore continuation of frequent and/or long duration feeds after attachment correction and in the presence of nipple pain-free feeding should raise clinical suspicion of infant pain (Peng et al. 2018; Thakkar et al. 2016; Boyle et al. 2006; Liaw et al. 2011). (Please see Section 7 on abnormal breastfeeding behaviours).

2.6. Low Milk Supply

Perception of low milk supply is the most common reason given for premature weaning (Li et al. 2008; Brodribb 2012c; Gatti 2008), despite research demonstrating that only a very small percentage of women are truly not able to produce enough milk (Neifert et al. 1990). Mothers may inappropriately confuse behaviours of

an irritable baby, such as fussiness and inability to settle after a feed, with those of inadequate milk supply (Hillervik-Lindquist et al. 1991). Other factors mothers incorrectly use as a determinant of milk supply include: how much they can express, test-weighing of a single feed, feed duration, less full breasts and low weight gains over a short period of time (Brodribb 2012c).

Sufficient milk supply should be based on a few factors; weight and growth, urine output, 24-hour milk production, bowel motions and demeanour (Brodribb 2012c). A neonate should regain birth weight by 2 weeks of age, having lost no more than 10% of delivery weight (Powers 2001; Hill & Johnson 2007; Macdonald et al. 2003). Large volumes of intravenous (IV) fluids given during labour can artificially lead to concerns regarding regaining birth weight (Chantry et al. 2011). After birth weight has been regained, the infants typically gain an average of 15-30g/day; infants should have 6-8 pale, very wet cloth nappies in a 24-hour period, or 4-5 heavy, wet nappies if using highly absorbable disposable nappies (Brodribb 2012c).

Normal bowel motions are poorly defined in infants (Bekkali 2010; den Hertog, 2012; Camurdan, 2014).It is rare for a healthy, full-term newborn infant to pass their first meconium beyond 48 hours after birth (Camurdan et al. 2015; Hertog et al. 2012). Breastfed infants defecate more frequently than formula-fed infants until between 2 weeks (Bekkali et al, 2010) and 6 months of age (Camurdan et al. 2015; Hertog et al. 2012).

Typical bowel motion frequency was described by Bekkali as at least one per day from two weeks of age until 24 months of age (Bekkali, 2010), with up to every other day reported by Camurdan (Camurdan et al. 2015); Camurdan also reported a seemingly normal variant of stooling twice or less per week with no other indicators of constipation. However, this study was of healthy, thriving infants. A breastfed infant stooling only 1-2 times per week, with no other signs of constipation or failure to thrive, may be normal (Camurdan et al. 2015).Camurdan also reported that the pattern of stooling frequency tended to remain stable from after 1 month of age until 6 months of age presumably changing with complementary feeding/introduction of solids. Unlike formula and mixed-fed infants, breastfed infants tend to decrease bowel motion frequency significantly, particularly over the first 1-3 months of life (Bekkali et al. 2010; Camurdan et al. 2015; Hertog et al. 2012). Feeding frequency has not been well correlated with bowel movements, but these studies were performed on healthy infants (Bekkali et al. 2010; Hertog et al. 2012).Hard stool should not be considered normal at any age, nor for any feeding type (Bekkali et al. 2010; Hertog et al. 2012),though especially in an exclusively breastfed infant less than 6 months old. Softer stool is to be expected in the breastfed infant compared to the formula-fed infant (Bekkali et al. 2010; Hertog et al. 2012).

A 24-hour milk production measurement can be used to determine accurate milk supply (Gatti 2008), which may be reassuring to a worried mother. Underfeeding is likely to affect weight first, followed by linear height, and least likely to affect head circumference (Brodribb 2012c).

Optimal breastfeeding should be viewed as a continuum, where the role of the chiropractor is to advance breastfeeding dyads towards the optimal, and should be a comfortable and satisfying experience for both the mother and baby. An appropriate understanding of the common causes of premature breastfeeding cessation, as well as an accurate understanding of optimal breastfeeding, are important components of the chiropractic management of breastfeeding difficulties. Chiropractors play an important role in supporting exclusive breastfeeding to 6 months of age.

Key Action Statement – Benefits of Breastfeeding

Breastfeeding is beneficial to infant health, with evidence of improved cortical function, motor development, language development, intelligence, mental health and immune system function. Suboptimal or lack of breastfeeding is disadvantageous to infant and child health. Breastfeeding also confers health benefits to the mother. Chiropractors should work with other healthcare professionals to support exclusive breastfeeding to six months of age

3. Benefits of Breastfeeding

3.1. Nutritional Benefits of Breastfeeding

There are specific nutritional components of breast milk that heavily influence later health outcomes, detailed by Kliegman *et al*(Kliegman et al. 2015).

3.2. Evidence of the Infant Benefits of Breastfeeding

A 2017 study by Grace *et al.* demonstrated an influence of breastfeeding on cortical function by assessing motor development (Grace et al. 2017). The infants who had breastfed for greater than six months showed better results compared to those breastfed less than six months. A higher incidence of suboptimal motor development was found in those who breastfed for less than six months. The mechanism behind this was proposed in two parts; firstly, the role of long-chain polyunsaturated fatty acids present in breastmilk and secondly, a neurological mechanism involving sensory processing and motor programming specifically in the cerebellar cortex.

In a 2015 literature review, Smith also found that prolonged breastfeeding promoted improved cortical function, including improved language development (J. M. Smith 2015). This has been supported by two additional studies that illustrate similar findings of improved language outcomes (J. W. Anderson et al. 1999; Tofail & Hamadani 2015). A 2013 systematic review by Horta *et al.* illustrated further global neurodevelopmental benefits stating in its conclusion "that breastfeeding is associated with increased performance in intelligence tests in childhood and adolescence, of 3.5 [IQ] points on average" (Horta et al. 2007). These findings were supported in 2016 by Luby *et al* (Luby et al. 2016).

There is a growing body of evidence that supports the importance of breastmilk in promoting development of the intestinal microbiome, which is a significant contributor to immune system function (Kaplan et al. 2011; Walker 2013; Donovan 2016; World Health Organization 2009b). In breastfed infants there is a decreased risk in the development of necrotising enterocolitis (Victora et al. 2016; Kaplan et al. 2011; American Academy of Pediatrics 2012) and respiratory symptoms, including lower respiratory tract infections (American Academy of Pediatrics 2012; Gorlanova et al. 2016; World Health Organization 2009b; Brodribb 2012c). Additional child

benefits of breastfeeding include a decreased risk of Diabetes Mellitus Types 1 and 2 (Victora et al. 2016; American Academy of Pediatrics 2012; Binns et al. 2016; Amir 2014), obesity (Victora et al. 2016; American Academy of Pediatrics 2012; Binns et al. 2016), indicators for cardiovascular disease (Victora et al. 2016; American Academy of Pediatrics 2012; Binns et al. 2016), various childhood cancers (American Academy of Pediatrics 2012; Amitay & Keinan-Boker 2015; Binns et al. 2016; Gertosio et al. 2016; Kutty 2016; World Health Organization 2009b), gastrointestinal tract infections (American Academy of Pediatrics 2012; World Health Organization 2009b), inflammatory bowel disease (Victora et al. 2016; American Academy of Pediatrics 2012; Binns et al. 2016), urinary tract infections (Victora et al. 2016; American Academy of Pediatrics 2012; Binns et al. 2016), acute otitis media (World Health Organization 2009b; Brodribb 2012c), Sudden Infant Death Syndrome (SIDS) (American Academy of Pediatrics 2012; World Health Organization 2009b; Brodribb 2012c)and infant mortality (Gertosio et al. 2016; Victora et al. 2016; Hennet & Borsig 2016; Debes et al. 2013). Breastfeeding may protect mental health, as non-breastfed infants have an increased likelihood of developing mental health problems, including: hyperactivity, anxiety associated with parental separation, schizophrenia in adulthood (Brodribb 2012c). There is reduced risk of experiencing neglect and abuse (Brodribb 2012c). Further benefits of breastfeeding have been well documented, and summarised in the review by Kramer and Kakuma (Kramer & Kakuma 2012).

3.3. Evidence of the Maternal Benefits of Breastfeeding

The benefits of breastfeeding also extend to the mother, with evidence demonstrating a decreased risk of osteoporosis, ovarian and breast cancer (Victora et al. 2016; Kramer & Kakuma 2012), along with a reduced rate of maternal depression (Victora et al. 2016; World Health Organization 2009a; Sauve 2005) and postpartum blood loss (World Health Organization 2009b). Additionally, the risk of Type II Diabetes Mellitus, rheumatoid arthritis and adult cardiovascular disease (including hypertension and hyperlipidaemia) are all decreased with an increased duration of breastfeeding (American Academy of Pediatrics 2012). Mothers who are exclusively breastfeeding to 6 months of age and have not resumed menstruating have a less than 2% chance of becoming pregnant (Brodribb 2012c). Increased child spacing resultant from lactational amenorrhea aids maternal physical recovery (American Academy of Pediatrics 2012).

4. The Risks of Not Breastfeeding

In infants who do not breastfeed optimally there is evidence for: poor weight gain, high maternal stress levels, mastitis, increased antibiotic exposure, increased formula use, increased obesity, diminished immune system function, attachment and suck difficulties (Victora et al. 2016; Humphrey 2009; NHMRC 2012; Stuebe 2009).

There is evidence that suboptimal or lack of breastfeeding may lead to increased suboptimal craniofacial development such as malocclusion and cross bite (Boronat-Catalá et al. 2017).

Key Action Statement – Mechanics of Normal Breastfeeding

The chiropractor involved in the care of the breastfeeding mother and child needs to be aware of and understand the mechanics of normal breastfeeding.

5. Mechanics of Normal Breastfeeding

Breastfeeding is a complex motor pattern involving coordination of attaching, suck, and swallow sequences (Goldfield et al. 2006). These motor patterns are achieved by the proper functioning of six of the twelve cranial nerves, incorporating 60 sets of voluntary and involuntary skeletal muscles working across articulations of the face and skull (L. J. Smith 2007). Dysfunction of the muscles, nerves or joints involved may lead to improper motor patterning, resulting in alterations of normal breastfeeding mechanics.

5.1. Attachment

The ideal attachment includes an appropriate degree of mouth opening forming a complete seal (Elad et al. 2014). The nipple and areola are drawn into the mouth, with the tip of the nipple extending to be in close proximity to the hard-soft palate junction; the anterior portion of the tongue extends forward between the nipple/areola complex and the lower lip and moves as a rigid structure with the cycling movement of the mandible (Elad et al. 2014; Sakalidis & Geddes 2016).

5.2. Suck

Following successful attachment, the sucking pattern of a healthy newborn consists of a series of sequential sucks punctuated with pauses, swallows and breaths in an organised manner (Elad et al. 2014). There are two types of sucking: nutritive and non-nutritive, and both are thought to be important in the programming of breastfeeding (Sakalidis & Geddes 2016). The skull and palate remain stationary, and the soft palate closes off nasal passages (Elad et al. 2014; Lau 2015). The current theory for milk extraction suggests that the posterior section of the tongue moves in a wave-like or peristaltic motion; it is from this action combined with mandibular oscillations that sub atmospheric (negative) pressure is generated to remove milk from the breast (Elad et al. 2014; Sakalidis & Geddes 2016). This process requires the coordination of the muscles of the tongue, hyoid, pharynx, anterior neck and the diaphragm (Sakalidis & Geddes 2016).

5.3. Swallow

There are three phases of swallowing: oral, pharyngeal and oesophageal (Sakalidis & Geddes 2016). Each phase is heavily influenced by tongue control (Sawczuk& Mosier 2001; Svensson et al. 2003; Sakalidis & Geddes 2016). During swallowing, the tongue exerts pressure on the palate to assist in moving the milk from under the soft palate toward the pharynx (Sakalidis & Geddes 2016).

5.4. Position

A seminal study observing the effect of primitive neonatal reflexes during breastfeeding compared being in a reclined position to that of a more upright position (Colson et al. 2008). This study found that dependent on maternal position, primitive neonatal reflexes could hinder or improve breastfeeding experience. Babies feeding with their mothers in a reclined position were found to have a significantly greater number of primitive neonatal reflexes aiding breastfeeding compared to when feeding in an upright position. This conflicts a previous intervention study addressing methods of teaching breastfeeding technique stating that the mother be "upright, supported and comfortable" during feeding (Ingram et al. 2002).

There is limited evidence promoting one position over another, with the Australian Breastfeeding Association recommending the correct way being the "one that works for you and your baby"(Australian Breastfeeding Association 2017a). It remains to be investigated whether the "underarm" or "football" hold may be associated with improved breastfeeding in cases of underlying cervical spine dysfunction.

Key Action Statement – Factors Influencing Breastfeeding

Chiropractors involved in the care of breastfeeding infants and children need to be aware of the range of factors which may impact successful breastfeeding. The chiropractor should understand their limited training in breastfeeding education and consider there may be factors that, either in the infant/child or the mother, may result in suboptimal breastfeeding and refer when appropriate.

6. Factors Influencing Breastfeeding

The mother's intent to breastfeed is generally established by the third trimester, with perception of social norms and the benefits of breastfeeding being the most frequently cited reasons (Odom et al. 2013). This is reflected in Australia with over 90% of mothers initiating breastfeeding (Australian Institute of Health and Welfare, 2014). Despite the acknowledgement of suboptimal breastfeeding rates, there are substantial voids in the knowledge and skill of practitioners at all levels of health care to support successful breastfeeding (Rollins et al. 2016; Australian Health Ministers' Conference, 2017; Hull et al. 2018).

Factors that have been found to negatively impact breastfeeding rates include: advice and practices which undermine maternal confidence and self-efficacy, lower socioeconomic status, birth interventions, previous experience, family influence, age and smoking status (Rollins et al. 2016; Australian Health Ministers' Conference 2017). In an American study by Odom, 26.8% of mothers found that attaching or sucking did not meet their expectations, and this was the cited reason for cessation of breastfeeding (**Figure 1**) (Odom et al. 2013).

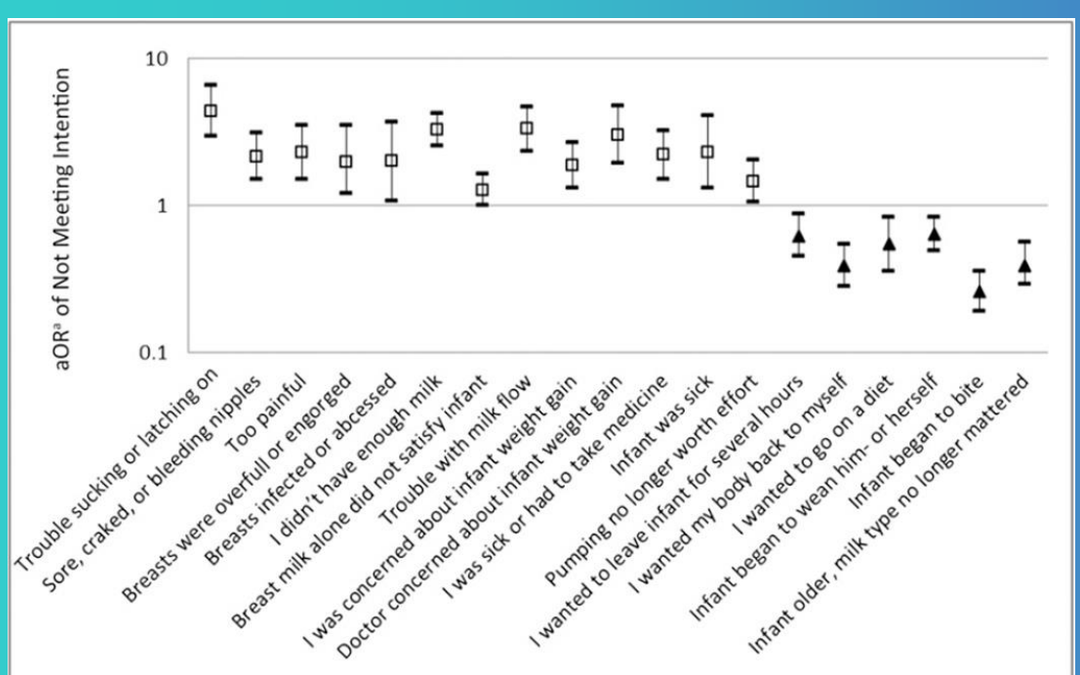


Figure 1 – from Odom et al 2013 (Figure 1).

Rollins found that to promote greater duration of breastfeeding, positive factors such as individual counselling, support and lactation management were found to be beneficial (Rollins et al. 2016). The study also highlighted additional factors found to promote and encourage continued breastfeeding including: a mother's strong intention and desire to breastfeed, supportive context, positive role models, previous experience, high socioeconomic class, higher maternal education levels, prenatal education, and early intervention.

Mothers who do not successfully breastfeed are less likely to attempt breastfeeding in subsequent pregnancies (Sutherland et al. 2011). Infant crying or fussiness, perceived hunger, and the inability to settle an infant often leads to an assumption of inadequate milk supply and consequent introduction of breast milk substitutes (DiGirolamo et al. 2005; Howard et al. 2006; McCann & Bender 2006; Avery et al. 2009; DaVanzo et al. 2010; Kervin et al. 2010; Wasser et al. 2011; Lawton et al. 2012; Odom et al. 2013; C. R. L. Brown et al. 2014; Rollins et al. 2016). Introduction of breastmilk substitutes, either by advertising or within the hospital environment, has been associated with a decrease in breastfeeding practice (Sobel et al. 2011; Evans et al. 1986; Declercq et al. 2009; Parry et al. 2013; Wright et al. 1996). Additional studies support a relationship between perception of low milk supply and breastfeeding cessation (Li et al. 2008; Hauck et al. 2011; C. R. L. Brown et al. 2014). Factors influencing maternal perception of milk supply include maternal confidence in breastfeeding and infant crying (Dykes & Williams 1999; Otsuka et al. 2008).

A study published in the Lancet found that a health-care providers support and influence regarding feeding decisions at key moments was critical to the ability of the mother to breastfeed (Rollins et al. 2016). These critical periods were both before birth, and in the immediate post-natal period, when breastfeeding difficulties are most likely to occur (Rollins et al. 2016). Consequently, when evaluating a child with breastfeeding difficulty, the chiropractor should be aware of the positive influence they can exert to promote breastfeeding practices, but also be conscious of the current limitations and gaps in services available to support breastfeeding (Rollins et al. 2016), as well as their own limited training (Australian Health Ministers' Conference 2017, Hull et al. 2018).

When evaluating a mother-baby dyad with breastfeeding difficulties, the chiropractor should consider the possibility that the signs may be an indication of underlying dysfunction or pathology.

6.1. Infant Birth Trauma And Breastfeeding Difficulty

Birthing injuries are defined as "structural or functional deteriorations to the neonate's body due to a traumatic event at birth"; there are well-defined risk factors associated with birth trauma, including higher birth weight (>4,000g) and instrumental intervention (Akangire & Carter 2016).

Ashton–Miller *et al.* examined the forces placed on foetal head during labour, with the authors estimating the forces applied to range from 1.6 kilograms of compressive force (16N) at rest to 12.2 kilograms of compressive force (120N) during volitional contraction (Ashton-Miller & DeLancey 2009). A recent study by Pettersson demonstrated tractional forces with vacuum extractions exceeding the recommended safe maximum of 215N in over 30% of births (Pettersson et al. 2015). This reflects findings by Hall *et al* with vacuum-extraction being associated with a higher rate of breastfeeding cessation (Hall et al. 2002).

In a cohort study of 491,590 women the impact of delivery method was compared, with children being born via spontaneous vaginal delivery found to have fewer short- and long-term health problems when compared to those born with instrumental assistance or by Caesarean section (Peters et al. 2018). The prevalence of breastfeeding problems was 3%, with breastfeeding problems 1.31 times more likely with induced, emergency Caesarean section (1.31 aOR, 95% CI) and 2.75 times more likely in instrumental assistance, induced, vaginal delivery (2.75 aOR, 95% CI) when compared to spontaneous vaginal birth (Peters et al. 2018).

A recent retrospective study by Fludder and Keil analysed associations between method of birth and prevalence of restrictions in cervical spine range of motion (Fludder & Keil 2018a). In infants born vaginally without instrumental assistance, 76.1% of infants presented with restrictions in cervical range of motion compared to those born via Caesarean section (82.3%). There was an observable difference in prevalence in those born with vacuum assistance, with over 90% of infants born with vacuum assistance (either alone or with forceps) having a reduction in normal cervical spine range of motion, however this was not statistically significant. A retrospective analysis of infant behaviours observed that in infants with difficulty breastfeeding, 56.5% had reductions in cervical spine range of motion (Fludder & Keil 2018b).

Incidence of injury to the facial nerve has been reported at 1.8-7.5 per 1,000 live births, with nine of the 15 facial palsies within the cohort occurring from forceps-assisted delivery (Hughes et al. 1999). Injury to the facial nerve is one mechanism, among others, involved in the development of breastfeeding difficulty secondary to birthing trauma (Alcantara et al. 2015; Akangire & Carter 2016; Scheans 2016). Furthermore, impact on the function of the temporomandibular joint secondary to direct insult from forceps can result in breastfeeding difficulty (L. J. Smith 2007). The relationship between forceps-assisted deliveries and temporomandibular joint dysfunction in the infant has been demonstrated (Alcantara et al. 2015).

6.2. Ankyloglossia

Ankyloglossia is defined as a short lingual frenulum limiting the lingual mobility required for breastfeeding (Segal et al. 2007; Francis, Krishnaswami, et al. 2015; Canadian Agency for Drugs and Technologies in Health (CADTH) 2016; O'Shea et al. 2017). The generally accepted incidence is 4-11% of newborns (Segal et al. 2007; Canadian Agency for Drugs and Technologies in Health (CADTH) 2016; O'Shea et al. 2017), however lack of clear diagnostic criteria (Segal et al. 2007; Obladen 2010; Canadian Agency for Drugs and Technologies in Health (CADTH) 2016; O'Shea et al. 2017) and an unknown natural history (Francis, Krishnaswami, et al. 2015) prevents the true prevalence from being known. There is significant discrepancy between professions regarding the impact of ankyloglossia on breastfeeding difficulties (Messner & Lalakea 2000; Obladen 2010; Francis, Krishnaswami, et al. 2015).

It has been suggested that "lingual frenulum" be used for anatomical descriptions of normal anatomy, while "tongue-tie" be reserved for a lingual frenulum associated with breastfeeding difficulties (Haham et al. 2014). Some professions consider lip and buccal ties in their assessment of tissues affecting breastfeeding (Cockley 2016), however other studies have demonstrated the presence of lower frenum attachments which are normal anatomy variants that may improve with age (Boutsi & Tatakis 2011). The degree of involvement of ties in breastfeeding difficulties is quite controversial (Messner & Lalakea 2000; Segal et al. 2007; Obladen 2010; Kumar & Kalke 2012; Canadian Agency for Drugs and Technologies in Health (CADTH) 2016; O'Shea et al. 2017), with inadequate data to support the treatment of buccal and lip-ties in breastfeeding difficulties (Francis, Chinnadurai, et al. 2015). A possible link between ankyloglossia, overuse of muscles of mastication and restriction in neck movement has been suggested (Vallone 2012). True ankyloglossia can have a significant impact on breastfeeding success; the chiropractor should therefore evaluate and consider tongue-tie, or other oral tethers, as a potential contributing factor to breastfeeding difficulties and refer appropriately. Further information regarding ankyloglossia can be found in Appendix C.

6.3. Factors That May Influence Infant Breastfeeding

There are many factors that may influence an infant's ability to breastfeed successfully. Below is a list of conditions frequently encountered by chiropractors, however this list is not exhaustive. The chiropractor should be aware of the limitations in both their scope of practice and breastfeeding education, and refer appropriately.

Spinal joint dysfunction (subluxation) – A restriction in normal intersegmental range of motion frequently observed in the cervical spine (Holleman et al. 2011; Stewart 2012; Alcantara et al. 2015; Fludder & Keil 2018b). Chiropractors are able to accurately identify and correct spinal joint dysfunctions (Davies & Fallon 2010; Anrig & Plaugher 2011).

Extremity joint dysfunction –Typically involving the glenohumeral joint, chiropractors are able to accurately identify and correct extremity joint dysfunctions (Davies & Fallon 2010; Stewart 2012; Fludder & Keil 2017).

Food allergies, hypersensitivities and/or intolerances – The most common food-protein allergies and intolerances are to cow's milk, soy, eggs, wheat, peanuts, tree nuts and seafood (Hodge et al. 2009). Food proteins can affect exclusively breastfeeding infants, passing through breastmilk (Järvinen & Suomalainen 2001).Symptoms of food allergy, hypersensitivity and/or intolerance can include vomiting, positing, signs of atopy (including eczema), blood in stool, and colic-like symptoms of gastric pain/discomfort(Brodribb 2012b), with Cow's Milk Protein Allergy usually involving multiple systems (respiratory and digestive) (Järvinen & Suomalainen 2001; Gibbons et al. 2011).

Gastro-oesophageal Reflux (GOR)/Gastro-oesophageal Reflux Disease (GORD) – Physiological reflux may be considered a normal part of the first year of life, with incidence peaking at approximately 4 months of age and significantly improving by 6-7 months of age (Hill et al. 2000; Brodribb 2012b). An infant with GOR/GORD will usually be irritable around feeds, with or without vomiting (Brodribb 2012b). Cow's milk protein allergy has been implicated in GOR/GORD, as well as eosinophilic oesophagitis, with elimination of dairy from the mother's diet trialled after the failure of medication to improve symptoms (Brodribb 2012b). The use of PPI's for the treatment of reflux has not been shown to be efficacious at best (Gieruszczak-Białek et al. 2015), and harmful at worst (Bavishi & DuPont 2011; Eom et al. 2011).

Congenital Muscular Torticollis (CMT) – Present in 0.3%-2% of live births (Angoules 2013). Its aetiology may include intrauterine position, prolonged labour and malposition such as breech presentation (Lee et al. 2011; Cheng & Au 1994; Han et al. 2017). CMT may negatively influence breastfeeding practices (Genna 2015). A survey of 2457 International Board Certified Lactation Consultants (IBCLCs) found the most commonly recognised musculoskeletal dysfunctions impeding breastfeeding were CMT and neck tension (Lavigne 2016). Breastfeeding difficulties associated with CMT may include unilateral refusal (Wall & Glass 2006), weak suck, depressed primitive reflexes and possible negative effect on sensory integration and processing (Genna 2015). A chiropractor needs to be aware of unique needs of infants with CMT and adaptation used during breastfeeding practices.

Structural Conditions – Such as deformational plagiocephaly or craniosynostosis, or other conditions affecting the face, oral cavity, or the breastfeeding system (Wall & Glass 2006; Alcantara & R. Anderson 2008).

Infection – Such as thrush (Candida albicans) involving oral or oesophageal structures of the infant (Chetwynd et al. 2002; Brent 2001; A. Brown & Jordan 2012).

Congenital conditions – Such as laryngomalacia (a softening of the tissues of the larynx that can cause obstruction), ankyloglossia (tongue-tie), oesophageal fistula or constriction, or cleft palate (Brodribb 2012b).

Neuromuscular conditions– Ranging from conditions such as cerebral palsy (Sleigh 2005), to conditions affecting tone, gag reflex, diaphragmatic function, oesophageal function and tongue function.

Trauma - Including fracture (most often cranial or clavicular), avulsion (brachial plexus), or Traumatic Brain Injury (TBI)

Genetic syndromes – Such as Down syndrome (Oliveira et al. 2010; Pisacane et al. 2003; Weijerman et al. 2008), galactosaemia (a condition which affects the breakdown of galactose), and Pierre Robin Syndrome (a condition involving facial developmental abnormalities).

6.4. Maternal factors influencing breastfeeding

Nipple pain (C. R. L. Brown et al. 2014; Odom et al. 2013)

Vasospasm – Spasm of the blood vessels to the nipple restricting blood supply (often associated with trauma). While this condition itself may not interfere with breastfeeding, the pain associated with it may prompt premature cessation (L. Lawlor-Smith & C. Lawlor-Smith 1997; J. E. Anderson et al. 2004).

Mastitis – Often caused by inflammation blocking a milk duct. This is not always associated with infection, but does risk progression to forming a breast abscess. While in some cases this can lead to premature cessation of breastfeeding (Spencer 2008), breastfeeding is recommended to continue (NHMRC 2012; Amir 2014).

Breast Abscess – A localised collection of infected fluid within breast tissue that may require immediate medical attention. It is recommended to maintain breastfeeding from the affected breast, as long as any medication taken is safe for the infant (Irusen et al. 2015).

Infection – Including but not limited to Human Immunodeficiency Virus (HIV), Tuberculosis, Varicella-Zoster (active lesions), Herpes Simplex Virus (HSV – active lesions), Cytomegalovirus (CMV), Hepatitis B and Hepatitis C.

Polycystic Ovarian Syndrome (PCOS) – This endocrine disorder can cause under or over supply (Marasco et al. 2001,Australian Breastfeeding Association 2015).This population is shown to be at increased risk of early breastfeeding cessation (Vanky et al. 2008). Poor breastfeeding outcomes may be associated with higher BMI commonly associated with PCOS rather than the condition itself (Joham et al. 2016).

Insufficient Glandular Tissue (IGT) – Some physical signs increase the risk of the mother not having sufficient glandular milk-producing tissues (Huggins et al. 2000). This includes breasts that are widely-spaced, tubular-shaped, and/or asymmetrical; and an absence of breast changes during pregnancy and/or post-partum. While still able to breastfeed, mothers with IGT may require a feeding supplement or medication to aid this process (Sultana et al. 2013, Australian Breastfeeding Association 2017b).

Chemotherapy –Most breastfeeding women are advised to cease breastfeeding during chemotherapy as commonly used medications may transfer to the feeding infant, risking serious adverse event (Pistilli et al. 2012).

Partner/family/culture discouraging breastfeeding

Self-preservation/vanity/personal reasons of mother

Breast Augmentation (Schiff et al. 2014; Cruz & Korchin 2010) **or Reduction** (Souto et al. 2003)

Abuse/neglect (Kendall-Tackett 2007)

Prescription or recreational drug use (American Academy of Pediatrics 2012)

This list is not exhaustive; other conditions may be associated with breastfeeding difficulty.

Key Action Statement – Clinical Identification of Biomechanically Dysfunctional Breastfeeding

The chiropractor should be able to identify dysfunctional breastfeeding and make appropriate referrals to support the breastfeeding dyad.

Recognition and appropriate referral of those with red flag indicators or signs of failure to thrive are paramount.

7. Clinical Identification of Biomechanically Dysfunctional Breastfeeding

7.1. Indicators of Dysfunctional Breastfeeding

Multiple studies have come to observe similar behaviours in infants with breastfeeding difficulties (Holtrop 2000; Vallone 2004; Miller et al. 2009; Holleman et al. 2011; Stewart 2012; Drobbin & Stallman 2015; Vallone & Carnegie-Hargreaves 2016; Fludder & Keil 2018b). Behavioural indicators of biomechanical dysfunction leading to breastfeeding difficulties include: head positional preference, arching or pulling off the breast, difficulty attaching, poor seal or dribbling, difficulty swallowing, and refusal to feed (World Health Organization 2009b; Vallone & Carnegie-Hargreaves 2016). Frequent feeding or prolonged feeding time may also indicate ineffective suckling (World Health Organization 2009b). There is low-level evidence indicating the presence of spinal and extremity joint dysfunction associated with previously mentioned behavioural findings (Stewart 2012; Fludder & Keil 2018b). Recent evidence (Goksan et al. 2015) has corroborated prior research (Slater et al. 2006; Slater et al. 2008) suggesting that infantile pain is inadequately considered and managed. Based on this low-level evidence, there is a biologically plausible mechanism suggesting that behavioural patterns frequently associated with spinal and extremity biomechanical dysfunctional breastfeeding may be pain-type behaviours; more robust research testing this hypothesis is required.

7.2. Referral Indicators

Indicators of breastfeeding dysfunction that are more likely to have serious adverse events include slow weight gain, breastfeeding lethargy or fussiness, requiring a prompt referral to an International Board Certified Lactation Consultant (IBCLC) for co-management. Red flag indicators, indicators of dehydration, and indicators of Failure to Thrive (Appendix B) will require immediate referral to both an International Board Certified Lactation Consultant (IBCLC) and a paediatrician (Krugman & Dubowitz 2003; Kliegman et al. 2015; Homan 2016). Refer to Appendix B for a more complete, but not exhaustive, description of Failure to Thrive as well as Red Flag indicators.

Key Action Statement – Assessment of Neurological and Musculoskeletal Dysfunction in Infants

a) Thorough assessment of the paediatric patient should be undertaken by the chiropractor in infants with breastfeeding difficulties. Intersegmental ranges of motion of all spinal regions in three axes of motion should be undertaken, as well as full motion assessment of all extremity joints. A thorough assessment is essential in ruling out underlying pathology and providing an accurate diagnosis.

b) Regardless of the presence of neurological or musculoskeletal dysfunction in infants with breastfeeding difficulty, collaborative care and support should be sought from an International Board Certified Lactation Consultant (IBCLC) as chiropractors are not adequately trained to assess causes outside of this scope.

c) In the presence of red flag indicators, failure to thrive, or dehydration referral to both an International Board Certified Lactation Consultant (IBCLC) and paediatrician is recommended.

8. Assessment of Neurological and Musculoskeletal Dysfunction in Infants

Chiropractors are able to accurately identify and correct spinal and extremity joint dysfunction, using age and development appropriate techniques (Davies & Fallon 2010; Anrig & Plaugher 2011).

8.1. Cervical Spine

Cervical spine gross active and passive range of motion (ROM), as well as intersegmental ROM, should be assessed in all infants (Persing et al. 2003; Ohman & Beckung 2008). Assessment of passive and active ranges of neck motion in all three planes is necessary to detect restricted cervical spine function. Many less severe cases

will remain undetected by examination unless cervical spine intersegmental motion is assessed at each level of the cervical spine by a suitably trained practitioner.

Normal newborns can laterally rotate the head well past the shoulder, 100–110 degrees from the midline, and laterally flex their head 50–60 degrees towards the ear (Ohman & Beckung 2008). Many newborns with limited neck ROM are missed because of an incomplete examination (Stellwagen et al. 2008).

In a pilot study of 19 cases of dysfunctional breastfeeding, Stewart reported on the relationship between joint dysfunction and breastfeeding difficulty (Stewart 2012). The most commonly observed regions of dysfunction were the occipito-atlantal joint and the atlanto-axial joint. A significant subjective improvement of breastfeeding was observed upon correction of spinal and extremity joint dysfunction. In a retrospective analysis of 195 infants, Fludder and Keil observed 48.7% present with breastfeeding difficulty, and the majority of these cases presenting with restriction in upper cervical range of motion (Fludder & Keil 2018b). The findings of both studies have been supported by other low-level studies demonstrating altered infant behaviour associated with spinal joint dysfunctions (Holtrop 2000; Vallone 2004; Miller et al. 2009; Holleman et al. 2011; Drobbin & Stallman 2015; Vallone & Carnegie-Hargreaves 2016).

One attributable mechanism to breastfeeding difficulty are changes in cranial nerve function, particularly the Vagus nerve. This may be a consequence of a biomechanically dysfunctional cervical spine. Studies have demonstrated improved Vagal nerve function after correction of upper cervical spine dysfunction (Zhang et al. 2006; Shafiq et al. 2014). The impact of upper cervical spine dysfunction on cranial nerve function should be considered in all infants demonstrating breastfeeding issues.

Current medical education does not adequately train medical practitioners to assess, nor treat cervical spine dysfunction in infants and children. A cross-sectional survey indicated a low level of confidence of IBCLC in recognizing musculoskeletal dysfunction in infants, with 41% admitting to not being comfortable at all(Lavigne 2016). It is also suggested that the training of IBCLC in the recognition and management of breastfeeding difficulty with a musculoskeletal aetiology may be lacking(Lavigne 2016).

Chiropractors are trained in performing thorough musculoskeletal examination to detect the presence of biomechanical joint dysfunction and should assess all infants with a history of breastfeeding difficulty.

8.2. Extremity Dysfunction

In a retrospective analysis of infant behaviours, Fludder and Keil identified difficulty with breastfeeding associated with articular dysfunction of spinal segments, extremities, or a combination of both (Fludder & Keil 2018b). Of the infants with extremity dysfunction, 50% presented with breastfeeding difficulty behaviours. A pilot study by Stewart identified 19 instances of extremity dysfunction in 19 cases of infants with breastfeeding difficulty, but did not isolate extremity from spinal dysfunction (Stewart 2012). Shoulder dysfunction was recently reported to be of a high prevalence (71.8%) in a paediatric chiropractic clinic (Fludder & Keil 2017). Further research in this area is required.

8.3. Temporomandibular Joint (TMJ)

It is important for chiropractors to assess the temporomandibular joint and all the components of the masticatory system, due to the joint's significant involvement in breastfeeding (Elad et al. 2014). Temporomandibular joint dysfunction may impair the attachment of the infant, resulting in poor milk transfer and nipple pain (Wall & Glass 2006). Asymmetry in the TMJ in infants with breastfeeding issues has also been linked with torticollis (Wall & Glass 2006).

Chiropractors are able to assess the function of the TMJ and provide suitable treatment to improve TMJ function (Anrig & Plaugher 2011).

8.4. Cranial Dysfunction

Successful breastfeeding relies on a series of complex movements facilitated by the craniofacial musculoskeletal anatomy (Bu'Lock et al. 1990; Tamura et al. 1998). There has been limited data to support the hypothesis that imbalances or asymmetries in function of the cranial and craniospinal systems have the potential to alter an infant's suck, potentially leading to breastfeeding difficulties (Vallone 2004; Biedermann 2005; Cornall 2011; Holleman et al. 2011; Alcantara et al. 2015; Vallone & Carnegie-Hargreaves 2016). Further research is this area is required.

8.5. Neurological Assessment

It is important for the chiropractor to perform a complete assessment on cranial nerve function. The breastfeeding infant utilises 6 of twelve cranial nerves (L. J. Smith 2007), and identification of asymmetry or abnormal activity may aid in proper management. These cranial nerves incorporate sensory information from the face and oral structures, as well as motor activity of facial expression, mastication, and head position.

Primitive, or neonatal, reflexes are brainstem-mediated responses that are normally present at birth (Zafeiriou 2004; Capute et al. 1984). A seminal study by Colson et al identified 20 primitive reflexes involved in breastfeeding (Colson et al. 2008). As these reflexes are highly stereotypical, asymmetry or abnormal responses may be of clinical value for the early identification of infants at risk for cerebral palsy or other developmental disorders (Zafeiriou 2004).

The recommended paediatric neurological assessment incorporating both cranial nerve and primitive reflex examination has been detailed in David *et al* (Ronald B David 2009).

Key Action Statement – Neurological Effects of Chiropractic Care

The chiropractor should understand the impact and effect of the chiropractic adjustment, as significant changes may occur within the nervous and musculoskeletal systems. Improvement in afferentation by restoring proper spinal joint function facilitates appropriate neurological development and function, which may present as improved breastfeeding.

9. Neurological Effects of Chiropractic Care

There is a growing body of evidence demonstrating the impact of chiropractic spinal manipulation on cortical function (Haavik-Taylor & Murphy 2007a; Haavik & Murphy 2012; Daligadu et al. 2013; Lelic et al. 2016; Haavik et al. 2017). Neuroplastic changes have been proposed to occur in structures such as the primary sensory cortex, primary motor cortex, prefrontal cortex, basal ganglia and cerebellum (Haavik-Taylor & Murphy 2007a; Daligadu et al. 2013). Of key importance is the function of the sensorimotor area of the cortex; dysfunction of the cervical spine has been shown to adversely impact the function of sensorimotor areas, with correction of these dysfunctions promoting normalisation (Haavik-Taylor & Murphy 2007a; Haavik-Taylor & Murphy 2007b; Haavik & Murphy 2012; Lelic et al. 2016). The sensorimotor region of the cortex is critical for the developing infant, as it provides the afferent sensory feedback of the face, lips and tongue and incorporates this with efferent control of those corresponding areas.

Research has also documented the impact of chiropractic spinal adjustment on the function of the cerebellum (Daligadu et al. 2013). The cerebellum is a plastic structure involved in motor learning and modulation of motor circuitry (Doyon et al. 2003; Bellebaum & Daum 2007; Thach 2007). The cerebellum plays a major role in processing proprioceptive input and has a strong influence on higher cortical function. Impaired proprioceptive function due to cervical spine joint dysfunction may have an impact on the central nervous system processing and its ability to transform afferent information into motor commands (Haavik & Murphy 2012). Improvement in the cervical spinal function facilitates more accurate processing and integration of this proprioceptive input (Haavik & Murphy 2011; Haavik et al. 2017). Earlier studies have also demonstrated increased accuracy of head repositioning after spinal manipulation (Palmgren et al. 2009).

Dysfunction of the cervical spine has been shown to influence sensory feedback to the midbrain region that may result in imprecise function of the lips, tongue and jaw (Rodine & Aker 2010).

Alterations of autonomic control secondary to changes in the cervical spine have been observed, with the Vagus nerve (CN X) frequently implicated (Zhang et al. 2006; Shafiq et al. 2014; Win et al. 2015). Due to its widespread action throughout the body, dysfunction of the Vagus nerve may result in widespread symptomology.

Chiropractic treatment of cervical spine joint dysfunction is important for the restoration of normal afferentation from the cervical spinal musculature, joints and other soft tissues. It may result in improved action

of the cranial nerves involved in the mechanics of breastfeeding; improved sensory feedback and proprioceptive information regarding head, lip, tongue and jaw position; and improved sensorimotor integration.

Key Action Statement – Evidence of Chiropractic Management of Breastfeeding Difficulties

Low-level evidence of chiropractic management has demonstrated improvement in 78-100% of those with breastfeeding difficulties; infants with breastfeeding difficulty may benefit from chiropractic management.

10. Chiropractic Management

10.1. Evidence of Chiropractic Management of Breastfeeding Difficulties

A 2016 study by Miller *et al.* investigated the effect of chiropractic on suboptimal breastfeeding (Miller et al. 2016).This study utilised questionnaires as an outcome measure and had an 85% response rate with 93% of mothers reporting improvement and satisfaction with care. The percentage of exclusive breastfeeding raised from 26% at the beginning of the study to 86% at the follow up survey. Mothers were almost 4 times more likely to exclusively breastfeed after attending the clinic than before the intervention.

A 2012 study by Miller *et al.* involved a case series of 114 infants with suboptimal breastfeeding presenting to a chiropractic teaching clinic (Miller et al. 2012). All infants were under 12 weeks of age. The main physical findings in the study population were cervical posterior joint restrictions (88.7%) and temporomandibular joint imbalance (35.7%). After excluding pathology, receiving extensive lactation training, and four chiropractic treatments, 78% were exclusively breastfeeding. This study also highlighted the importance of collaborative practices during management of breastfeeding difficulties.

In 2012, Stewart conducted a pilot study of 19 breastfeeding mothers and their infants investigating the effects of chiropractic on breastfeeding difficulties (Stewart 2012). The commonly found areas of dysfunction included the occiput, atlas, glenohumeral joint, and sacrum, and upon correction, a 100% improvement in breastfeeding post-therapy was observed.

Vallone conducted a clinical trial involving 35 infants, assessing the craniofacial and spinal biomechanical function of 25 infants with breastfeeding difficulties and comparing them to 10 infants without breastfeeding difficulty. The results illustrated unique musculoskeletal dysfunctions in the 25 infants with breastfeeding difficulties; improvement was reported following chiropractic care in 23 out of the 25 treated dyads (Vallone 2004).

A survey of 2457 International Board Certified Lactation Consultants (IBCLCs) reported referring 73% of infants with breastfeeding difficulties for musculoskeletal treatment. Fourteen percent were referred for chiropractic treatment; 91% noticed improvement after the musculoskeletal treatment, but this does not delineate between modalities, nor is it representative of the whole group with only 18% responding (Lavigne 2016).

Current evidence indicates benefit for infants with breastfeeding difficulties from chiropractic intervention, utilising appropriately modified treatment taking in to consideration factors such as the patient's size, age, and presentation. This evidence is of low-level with further research in this field required. Research promoting multi-disciplinary collaboration is especially indicated.

Key Action Statement - Monitoring

The chiropractor should routinely measure an infant's growth and development. Weight, head circumference, length and neurodevelopment in the infant with breastfeeding difficulties should be regularly measured and documented. Appropriate referral to an International Board Certified Lactation Consultant (IBCLC) or paediatrician may be necessary in cases of atypical development, cases that do not improve with chiropractic management, or worsening cases.

11. Monitoring

11.1. Physical Growth Monitoring

Chiropractors should routinely weigh children with breastfeeding difficulties and record all measurements during management using appropriate charts from WHO, or recorded on WHO Anthro, as WHO standards have been established using breastfed infant data as the normative data for growth. Deviations below expected growth could be indicative of low milk intake, which may lead to Failure to Thrive (Appendix B).

11.2. Neurodevelopmental Monitoring

Chiropractors should monitor the neurodevelopment of infants with breastfeeding difficulties using appropriate monitoring devices such as Parent's Evaluation of Developmental Status (PEDS) and/or Ages and Stages Questionnaire (ASQ).

Regular age appropriate neurological examination should also be employed by the chiropractor to monitor proper and expected development. Infants with neurodevelopmental concerns identified by the chiropractor may need to be referred to an appropriate health care professional.

Key Action Statement – Referral to Other Health Care Providers

The chiropractor should recognise when referral to other health care providers is indicated, and refer when appropriate. In the event of uncertainty, the paediatrician should be the primary referral. In the absence of indications of infant illness, referral to an International Board Certified Lactation Consultant (IBCLC) should occur, as chiropractors have limited education in breastfeeding management.

12. Referral to Other Health Care Providers

Expertise from various health providers is often needed to assist in the management of infants with breastfeeding difficulty. Collaborative care involving a chiropractor and lactation consultant has been reported to be particularly beneficial (Tow & Vallone 2009; Miller et al. 2016; Lavigne 2012). According to a report by the World Breastfeeding Trends Initiative, the current level of breastfeeding education among health care professionals within Australia is not adequate (Australian Health Ministers' Conference 2017, Hull et al. 2018). Unless the chiropractor has received adequate training in breastfeeding management, an infant with suspected breastfeeding difficulty should be collaboratively managed with International Board Certified Lactation Consultant (IBCLC), particularly when there is a risk of premature cessation of breastfeeding, or risk to the infant's health.

Recognition of a serious condition outside of the chiropractic scope of practice should warrant immediate and appropriate referral. The infant will need to be referred to the appropriate health care providers when clinically indicated, including but not limited to:

- International Board Certified Lactation Consultant (IBCLC)/Lactation Consultant
- Paediatrician
- General Practitioner
- Paediatric-trained Chiropractor
- Dentist
- Registered Nurse/Maternal and Child Nurse/Midwife
- Physiotherapist/Osteopath/Occupational therapists (OT)
- Naturopath
- Paediatric surgeon, ear/nose/throat (ENT) surgeon
- Speech and language pathologist (SLP)
- Oromyofunctional therapist (OMT)
- Other feeding or airway specialists who may play various roles in the care of the infant (Vallone & Carnegie-Hargreaves 2016).

In the event of uncertainty of the appropriate referral, initial referral to a paediatrician, general practitioner or International Board Certified Lactation Consultant (IBCLC)/lactation consultant is recommended; depending on the case presentation and suspected aetiology of the breastfeeding dysfunction.

13. Summary

In Australia, breastfeeding difficulties are a common problem facing mothers in the community. Although initiation of breastfeeding is high at 90%, concern lies in the high rate of early breastfeeding cessation, with only 15% of mothers exclusively breastfeeding their infant by six months of age. It is important to express the benefits associated with breastfeeding, and promote breastfeeding as the primary source of nutrition for the infant. Strong support and promotion of breastfeeding is an important component of chiropractic management of infants with breastfeeding difficulty.

There are many potential causes for dysfunctional or premature cessation of breastfeeding, with frequently cited causes for premature cessation of breastfeeding including difficulty with attachment, suck and swallow. It is important for the chiropractor to understand and appreciate the neurology and biomechanics of the processes involved. Dysfunction of the cervical spine has been associated with altered proprioception, sensorimotor integration and cranial nerve activity, which may result in difficulty with attaching, suck and swallow (biomechanical breastfeeding difficulty). There is low-level evidence demonstrating improvement in breastfeeding with chiropractic management, and this may be a result of restoration of proper neurological and musculoskeletal function.

Biomechanical breastfeeding difficulty is only one of the possible causative factors of breastfeeding difficulty; simultaneous assessment and management by and International Board Certified Lactation Consultant (IBCLC) should be sought in cases of breastfeeding difficulty as chiropractic education of breastfeeding assessment and management is limited.

Infants with breastfeeding difficulty should have their growth and development routinely monitored. Not only is early intervention likely to improve breastfeeding practices, early and accurate identification of cases that require appropriate referral may reduce risk of adverse outcomes. Unless the chiropractor has received adequate training in breastfeeding management, collaboration with an International Board Certified Lactation Consultant (IBCLC) is recommended.

Chiropractors are positioned to be able to provide information regarding the benefits and importance of breastfeeding to mothers, perform neurological and musculoskeletal assessment of infants with breastfeeding difficulty, and provide treatment for infants exhibiting biomechanical breastfeeding difficulty. Research indicates that chiropractors should work alongside other healthcare professionals, particularly International Board Certified Lactation Consultants (IBCLCs), to facilitate improvements in rates of premature breastfeeding cessation.

Chiropractors are uniquely placed to aid in the management of infants with biomechanical breastfeeding difficulty.

Appendix A – Methods

To attain the highest level of evidence regarding breastfeeding, breastfeeding difficulties, outcomes of non-optimal breastfeeding, and management of breastfeeding difficulties a thorough search of PubMed was performed using the following search criteria:

[Chiropractic AND breast feeding]
[Chiropractic AND breastfeeding]
[Breast feeding AND difficulty AND management]
[Breastfeeding AND difficulty AND management]
[Breastfeeding AND spinal manipulative therapy]
[Breast feeding AND spinal manipulative therapy]
[Spinal manipulation AND breast feeding]
[Spinal manipulation AND breastfeeding]
[Breast feeding AND difficulty AND management AND chiropractic]
[Breastfeeding AND difficulty AND management AND chiropractic]
[Temporomandibular joint AND breast feeding]
[Temporomandibular joint AND breastfeeding]
[TMJ AND breast feeding]
[Cranial therapy AND breast feeding]
[Cranial therapy AND breastfeeding]

The total number of papers found using these search criteria was 284.

Duplicate studies were removed (n=69).

Further exclusion criteria were set to exclude articles:

1. Not published in English
2. Not related to breast feeding, breast feeding difficulties, outcomes of non-optimal breastfeeding or management of breastfeeding difficulties
3. Presence of congenital malformation or genetic disorders
4. Presence of serious illness
5. Management based on trial pharmaceuticals or non-standard treatment
6. Surveys of support satisfaction
7. No abstract available

An additional 143 articles were excluded using these parameters, reducing the number of articles included from PubMed to 72. An additional 139 articles were provided from the author's private library or websites.

Appendix B – Failure to Thrive

Failure to Thrive, also known as "Poor Growth", is defined as a weight of less than the 3rd Centile on two or more separate occasions, or a weight which crosses two centile lines over time.

Accurate identification of Failure to Thrive requires regular examination monitoring weight, length and head circumference measurement. Observations on child appearance as well as parent responsiveness/degree of concern may aid in determining potential cause.

Failure to Thrive can result from:

- Inadequate caloric provision from the caregiver,
- Inadequate intake of calories by the infant
- Failure to properly retain or use those calories
- Increased metabolic demands

As a result, it is important to thoroughly investigate all potential avenues for the development of Failure to Thrive.

Possible Indicators of Failure to Thrive:

- Poor weight gain/Weight loss
- Disinterested in surroundings
- Decreased frequency of urination
- Avoidance of eye contact
- Irritability
- Lethargy
- Regular night waking
- Not reaching developmental milestones
- Abnormal respiration patterns
- Weak pulse
- Cool extremities
- Weak, feeble cry or an altered crying pattern
- Signs of abuse or neglect
- Poor carer understanding e.g. non-English speaking, intellectual disability
- Signs of family vulnerability e.g. drug and alcohol abuse, domestic violence, social isolation, no family support
- Signs of poor attachment
- Parental mental health issues
- Already/previously case managed by child protection services
- Did not attend or cancelled previous appointment/s

Signs of dehydration:

- Decreased skin turgor
- "Tenting" of skin
- Poor peripheral circulation
- Circumoral pallor

Signs of significant illness:

- Fever above 40C
- Petechial (non-blanching) rash
- Tachypnoea (rapid breathing)
- Cyanosis

Red Flag Indicators

- Unable to rouse/unconscious
- Pale, mottled, blue or ashen coloured skin
- Bile-stained vomiting
- Bulging fontanelle
- Parental concern
- Clinical instinct

This list is not exhaustive, and co-management, where appropriate, can still be maintained. Not all of these symptoms or signs in isolation may be an indication of a serious condition, but awareness of the extensive presentations possible is paramount for the chiropractor assisting in the management of an infant with breastfeeding difficulty. Appropriate referral is necessary when indicated. For more information refer to Nelson's Textbook of Pediatrics (Kliegman et al. 2015).

Appendix C – Ankyloglossia

Genetics are believed to play a role due to familial occurrence(Canadian Agency for Drugs and Technologies in Health (CADTH) 2016; O'Shea et al. 2017). Ankyloglossia has recently become more medically relevant because of the societal shift from bottle back to breastfeeding (Obladen 2010; Francis, Chinnadurai, et al. 2015; O'Shea et al. 2017). There have been suggestions that treatment of ankyloglossia has come to the forefront of breastfeeding as it is an actionable impediment, and frustrated parents are provided with few to no alternatives (Francis, Krishnaswami, et al. 2015).

There are only two validated assessment tools to identify potential tongue-tie. The Hazelbaker Assessment Tool for Lingual Frenulum Function (HATLFF) is the most popular and comprehensive (Drazin 1994; Amir et al. 2006; Francis, Chinnadurai, et al. 2015; Canadian Agency for Drugs and Technologies in Health (CADTH) 2016), however it is cumbersome to use (Segal et al. 2007; 2016). The most recent Bristol Tongue Assessment Tool (BTAT) (Table 1) has been tested against the ATLFF, which has been found to be as effective in identification while being much simpler to use (Ingram et al. 2015;Canadian Agency for Drugs and Technologies in Health (CADTH) 2016).

Assessment tools based on morphology and not function are not considered adequate for diagnosis of ankyloglossia.

Table 1 Bristol Tongue Assessment Tool (BTAT)

	0	1	2	Score
Tongue tip appearance	Heart shaped	Slight cleft/notched	Rounded	
Attachment of frenulum to lower gum ridge	Attached at top of gum ridge	Attached to inner aspect of gum	Attached to floor of mouth	
Lift of tongue with mouth wide (crying)	Minimal tongue lift	Edges only to mid-mouth	Full tongue lift to mid-mouth	
Protrusion of tongue	Tip stays behind gum	Tip over gum	Tip can extend over lip	

Reviews to date have demonstrated conflicting conclusions regarding treatment of tongue-ties (O'Shea et al. 2017). All have agreed that there is value in frenotomy when true ankyloglossia has been diagnosed, and that evidence is still lacking. At best, frenotomy seems safe and leads to maternal perceive benefit in short-term breastfeeding improvement, but long-term benefits regarding breastfeeding practices have not yet been demonstrated (O'Shea et al. 2017), including effect on weight gain (Francis, Krishnaswami, et al. 2015), a consistent diagnostic standard, the validity of non-surgical treatments, and the appropriate age for intervention (O'Shea et al. 2017).

Frenotomy is generally regarded as a safe when performed by a trained practitioner, with no serious adverse effects reported (Canadian Agency for Drugs and Technologies in Health (CADTH) 2016). The most common complications are minor bleeding (Canadian Agency for Drugs and Technologies in Health (CADTH) 2016; Haham et al. 2014; O'Shea et al. 2017; Francis, Krishnaswami, et al. 2015; Opara et al. 2012), repeat frenotomy (Niittynen et al. 2012; Ghaheri et al. 2017; O'Callahan et al. 2013), infection, pain and scarring have been reported (Canadian Agency for Drugs and Technologies in Health (CADTH) 2016). There have been no studies performed to ascertain the pain experienced by neonates during or after frenotomy (Canadian Agency for Drugs and Technologies in Health (CADTH) 2016; O'Shea et al. 2017). There is insufficient research in other conditions associated with ankyloglossia at older ages.

There has been a recent shift to the use of laser to perform frenectomy (laser ablation of the frenulum), and while there is evidence suggesting improved pain outcomes, there is still conflict with its use and long-term outcomes (Ghaheri et al. 2017; Aras et al. 2010; Darshan & Pavithra 2011; Genna et al. 2017). Further research in this area is required.

Chiropractors are well placed to help assess and manage neurological and musculoskeletal conditions, such as cranial nerve dysfunction, that may mimic true ankyloglossia or other oral tethers and impact on breastfeeding success.

Appendix D - Acknowledgements

The initial draft was written by J.T. and C.F. This draft was opened to members of the Australian College of Chiropractic Paediatrics for internal review.

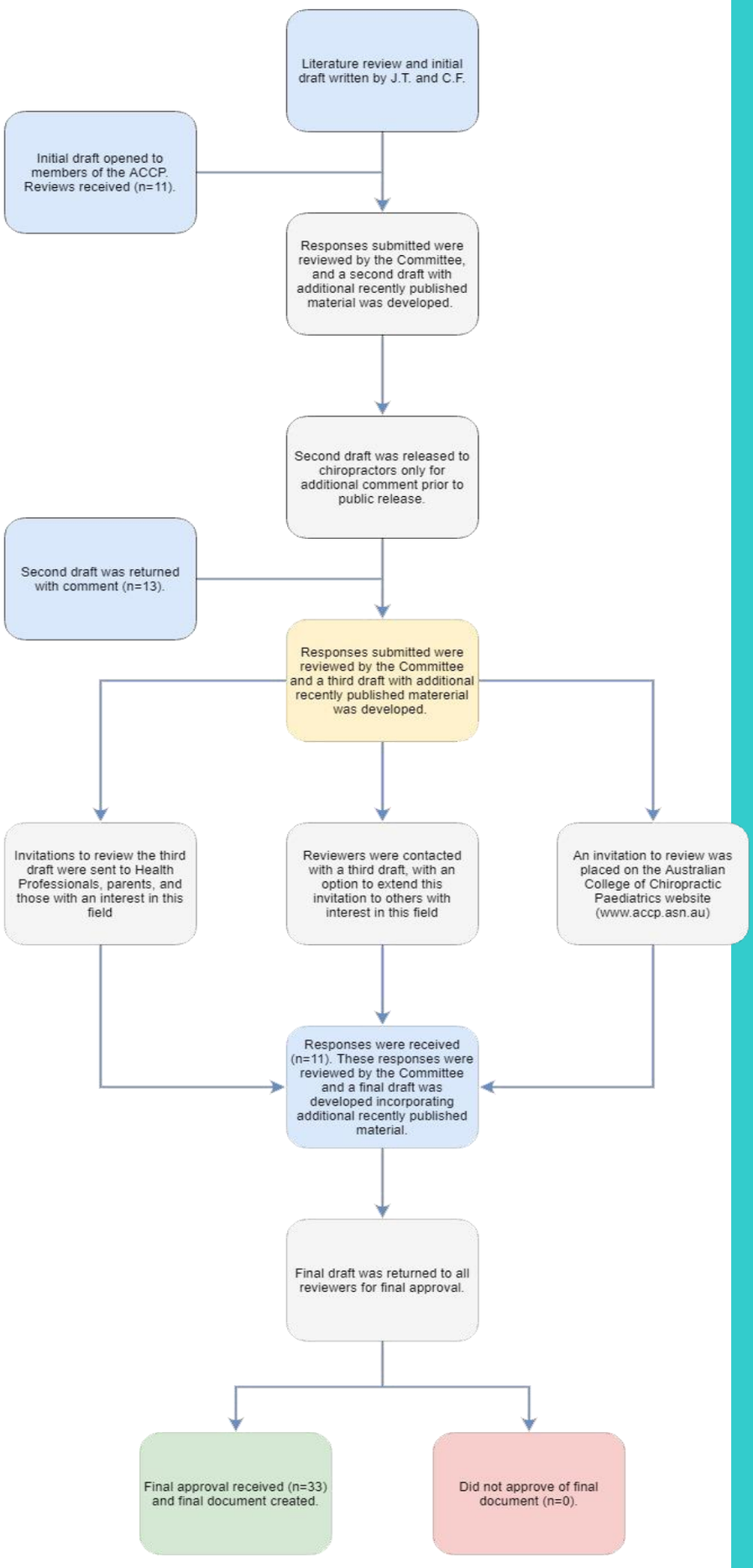
After writing the initial draft, a Committee on Breastfeeding Difficulty was formed with additional authors included. At this point, all responses received were reviewed by the Committee on Breastfeeding Difficulty, and a second draft generated. This draft was released to chiropractors for further review.

Upon receiving feedback, the Committee developed a third draft. This draft was released to the general public, with invitation for review sent to:

- International Board Certified Lactation Consultants
- Paediatricians
- General Practitioners
- Maternal and Child Health Nurses
- Breastfeeding mothers and parents of breastfeeding children
- Various Associations involved in aiding and promoting breastfeeding

In addition to this, this draft was made available on the ACCP website (www.accp.asn.au) with an invite to share the document for review by any who may be interested.

Feedback received from this review was collected and reviewed by the Committee leading to the development of the fourth and final draft. This final draft was re-sent to all previous reviewers for final approval. Final



input was received by 33 reviewers, with 33 responding with "Approve".

Input was received from reviewers representing the following aspects of healthcare and the greater community:

- Chiropractic
- Chiropractors with a clinical interest in paediatrics
- International Board Certified Lactation Consultants
- Dentists
- Maternal and Child Health Nurses/Registered Nurses
- Midwives
- Occupational Therapy
- Researcher/Academics
- Breastfeeding parents

The reviewers held the following qualifications:

- 4 PhD
- 22 Master
- 33 Bachelor or equivalent
- 16 Diplomate of the ACCP (DACCP) or Fellow of the ACCP (FACCP)
- 3 IBCLC

The Committee would like to acknowledge and thank the following reviewers for their contributions:

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