Axillary Traction: An Effective Method of Resolving Shoulder Dystocia

Lesley Ansell

A thesis submitted to Auckland University of Technology in partial fulfilment of the requirements for the degree of
Doctor of Health Science

2020

Faculty of Health and Environmental Sciences

Abstract

Shoulder dystocia is a childbirth emergency which can result in significant neonatal morbidity and in some cases perinatal death. It is crucial therefore that management of shoulder dystocia is timely and efficient to reduce the risks of perinatal injury, some of which are permanent, or perinatal death.

Widely accepted manoeuvres for resolving shoulder dystocia include a series of external and internal manoeuvres (internal rotational manoeuvres known as Rubins' or Woods' screw) and delivery of the posterior arm. It is generally accepted that the more severe dystocias will require an internal manoeuvre for resolution and it is management by internal manoeuvres that is the focus of this study.

The main objective of this research is to evaluate the success rates of axillary traction which is an alternative internal manoeuvre for resolution of shoulder dystocia. This manoeuvre was introduced into clinical practice in Counties Manukau Health (CMH) in 2009 following qualitative research on the topic (Ansell et al., 2012). Counties Manukau Health is the largest District Health Board (DHB) in New Zealand and was the first to implement the use of axillary traction in an ethnically diverse population with high health needs including diabetes, obesity and fetal macrosomia. This is the first study to provide quantitative analysis of the success rates of axillary traction for the resolution of shoulder dystocia.

This thesis presents a systematic review of the literature examining the success rates of internal rotational manoeuvres and delivery of the posterior arm alongside complications associated with those manoeuvres. The review highlighted the conflicting definitions and diagnosis given for shoulder dystocia which makes evaluation of success rates and neonatal outcomes for individual manoeuvres difficult. The success rates given were wide ranging from 9.4% for internal rotation (Spain et al., 2015) to 100% for internal manoeuvres described as fetal manipulation (Gachon et al., 2016). The overall brachial plexus injury (BPI) rate was significantly higher with internal rotation ($p<0.001$) than delivery of the posterior arm (Michelotti et al., 2018). Posterior arm delivery was found to be more successful than internal rotation (Hoffman et al, 2011) but humeral fractures were higher with this manoeuvre (Leung et al., 2011; Michelotti et al., 2018). The more manoeuvres used to resolve the dystocia and the longer the head to body delivery interval (HBDI), the worse the neonatal outcomes ($p<0.01$) (Gherman et al., 1997, Spain et al., 2015; Michelotti et al., 2018). This review a highlighted the need for an effective method of managing shoulder dystocia in a timely manner.

A quantitative study was undertaken to assess the effectiveness of the alternative internal manoeuvre of axillary traction for resolution of shoulder dystocia (Ansell et al., 2019). The study population were women with a singleton fetus, cephalic presentation and beyond 34 weeks gestation who had experienced shoulder dystocia. Records over an eight-year period were reviewed (2006-13) and 226 women required an internal manoeuvre for resolution of shoulder dystocia. Data were analysed using the Statistical Package for the Social Sciences (SPSS)

version 24 (IBM, Armonk, NY, USA). Demographic and clinical data for the three internal manoeuvre cohorts were compared. Categorical data were compared using Chi-Square and Fisher's exact tests. Continuous data were compared using Student's t test (normal distribution) or Mann–Whitney or Kruskall–Wallace test for non-normal distributions. Where differences between the cohorts were noted with categorical data, the success rates of the internal manoeuvres were compared using Chi-Square or Fisher's exact test.

There were three main groups of internal manoeuvres used:

1. axillary traction which included all manoeuvres documented as axillary traction or removal of the posterior shoulder;

2. posterior arm delivery which was documented as such; and

3. internal rotational manoeuvres which included all manoeuvres documented as Woods' screw, reverse Woods' screw and/or internal rotation.

The results of that study showed that axillary traction had a significantly higher success rate of 95.8% ($p<0.001$) when used as the first internal manoeuvre versus posterior arm (85.7%) and internal rotation (48.3%). There was no significant difference in the maternal and neonatal complication rates between the cohorts. The Ansell et al. (2019) study demonstrates that axillary traction is an effective manoeuvre for the resolution of shoulder dystocia and can be used in all women regardless of co-morbidities.

The final part of this research study is a qualitative narrative which demonstrates how the process of reflection and critical analysis identified a gap in the available evidence for management of shoulder dystocia. This led to clinical dialogue and a realisation that many other practitioners had similar experiences. Following ongoing investigation, research and peer review, the process of clinical leadership resulted in a change in clinical practice. The willingness of other practitioners to accept and learn the manoeuvre of axillary traction demonstrates how ‘research in action’ has effected a change in how to manage shoulder dystocia.

In conclusion, axillary traction has a significantly higher success rate than other internal manoeuvres ($p<0.001$) without any increase in maternal or neonatal morbidity. It can be used for any woman in any circumstance and it is recommended that this be the first internal manoeuvre attempted when shoulder dystocia occurs.

Acknowledgements

I would like to express my sincere gratitude for the support I have received from many people who have enabled me to complete this thesis. Sincere thanks to my midwifery and obstetric colleagues who have shared their stories, practice experiences and insights and without whom this research would not have been possible.

I would like to thank my wonderful supervisors who have believed in my ability to complete this study. My primary supervisor Associate Professor Judith McAra-Couper has provided immeasurable support, advice and encouragement, and enabled me to get through me the times I wanted to give up. Without her this thesis would never have been completed. Sincere gratitude to my secondary supervisor Associate Professor Peter Larmer who provided expert advice, support and encouragement throughout. Thanks also to Dr. Nick Garret for statistical advice and support.

I am extremely grateful to Jose Entrican for her formatting advice and especially thankful to Shoba Nayar for her prompt, efficient and invaluable editing advice.

There are many other friends and colleagues who have supported me through this thesis but in particular I would like to thank my friend Juliette Wotton who assisted with data collection.

Finally, to David, my husband and co-author. His expertise with statistical analysis helped me to understand and report research outcomes, but more importantly his unfailing love, support and encouragement enabled me to complete this thesis.

Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Lesley Ansell

Date: 30th April 2020

Table of Contents

List of Figures

List of Tables

Chapter One:
Introduction to the Study

1.1 Introduction

Shoulder dystocia is a rare, unpredictable, and potentially life-threatening complication of childbirth. It is a result of the failure of the fetal shoulders to deliver following vaginal birth of the fetal head (Gherman, 2002). The outcomes of shoulder dystocia depend on rapid and effective recognition and management of the problem. This research will explore the management of shoulder dystocia and identify an effective method for its resolution.

This chapter will explain the research objective, question, hypothesis, and the justification for undertaking this project. The subjectivity of the definitions and diagnosis of the problem will be highlighted, prior to an explanation of the research approach and context of this study. The historical perspective of this problem will be described. A review of the complications, the incidence and causes/predisposing factors of shoulder dystocia will be presented. The management of shoulder dystocia will be described prior to the story of my own personal experience when dealing with the problem. As a result of that experience, the journey of clinical leadership with an aim to influence a change in the management of shoulder dystocia is described. Finally, an overview of the forthcoming chapters is presented.

1.2 Research Objective

As a midwifery practitioner, the genesis of this research project came from a problem that arose in clinical practice. The manoeuvres I had been taught to resolve shoulder dystocia failed, and I felt that there must be a better way to deal with the problem. I had a personal commitment to undertake research which would contribute to practice, potentially changing the management of shoulder dystocia to improve outcomes. This fitted well with the requirements of a Doctor of Health Science which focuses on making a contribution to the body of knowledge in the subject, and a change in practice to improve outcomes. When shoulder dystocia occurs, it is generally accepted that the more severe shoulder dystocias will require an internal manoeuvre (Spain et al., 2015). The focus of this research was to assess the success rates and any complications of axillary traction compared to other recommended internal manoeuvres for the resolution of shoulder dystocia.

1.3 Research Question

Is axillary traction an effective and safe manoeuvre for the management of shoulder dystocia when an internal manoeuvre is required to overcome shoulder dystocia?

1.4 Hypothesis

Axillary traction is a successful and safe manoeuvre for the management of shoulder dystocia when an internal manoeuvre is required to overcome shoulder dystocia.

1.5 Justification for the Study

Shoulder dystocia can result in severe and/or permanent injury to the baby such as brachial plexus injuries, fractures, neurological injury including cerebral palsy and, in some cases, perinatal death (Dajani & Magann, 2014). Injuries or disabilities as a result of shoulder dystocia may require a wide range of medical treatments such as physiotherapy, speech therapy, specialist fees, prescription costs, and hospital services. Mainstream education may not be appropriate or available for such children and so transport and possible relocation costs need to be considered. Apart from the grief and distress caused, parents with a severely disabled child suffer financially if they are unable to work and will often attempt to apply for compensation or financial assistance if their child suffers a disability.

The traditional management of shoulder dystocia involves a series of both internal and external manoeuvres to resolve the problem. The internal manoeuvres are the focus of this study and are known as Rubins' II and Woods' screw manoeuvres (internal rotation) and delivery of the posterior arm (Royal College of Obstetricians & Gynaecologists [RCOG], 2012). The description of how to perform internal rotation (Rubins' II and Woods') is as follows:

> Rotation can be most easily achieved by pressing on the anterior or posterior aspect of the posterior shoulder. Pressure on the posterior aspect of the posterior shoulder has the additional benefit of reducing the shoulder diameter by adducting the shoulders… If pressure on the posterior shoulder is unsuccessful, an attempt should be made to apply pressure on the posterior aspect of the anterior shoulder to adduct and rotate the shoulders into the oblique diameter. (RCOG, 2012)

If the internal rotational manoeuvres fail, then the recommended management is to deliver the posterior arm as follows:

> The fetal wrist should be grasped, and the posterior arm should be gently withdrawn from the vagina in a straight line. (RCOG, 2012).

A qualitative study published in 2012 by Ansell et al. identified that the rotational manoeuvres were extremely difficult for practitioners to remember, particularly when used so infrequently and in a stressful and emergency situation. The authors also found that practitioners had difficulty performing some of the manoeuvres and often location of the posterior arm was particularly difficult. They suggested that axillary traction, as an alternative manoeuvre, is simple to remember and easy to perform (Ansell et al., 2012).

Poorly managed shoulder dystocia increases the risk of injury to the baby and can result in significant emotional and financial costs to the family of the child and to society. In order to minimise these costs and to reduce the perinatal morbidity and mortality rate, it is imperative that the most successful manoeuvres are used to manage shoulder dystocia. The complications and consequences of how shoulder dystocia is managed provides justification for this study.

1.6 Definition and Diagnosis

The word *dystocia* is derived from the Greek words meaning 'not moving'. The term shoulder dystocia was first described in obstetric and midwifery literature by Fieux (as cited in Gherman, 2002) at the beginning of the 20th century, where 'dystocia' referred to a wide range of difficulties encountered with the delivery of the shoulders. Shoulder dystocia is now defined as failure of delivery of the anterior, posterior, or both fetal shoulders following the vaginal birth of the fetal head (Gherman, 2002).

In normal labour, the fetal head enters the pelvis (pelvic inlet) in the larger transverse diameter of the pelvis. Descent and internal rotation occur, and the fetal head rotates to the antero-posterior (A-P) diameter which is the widest diameter at the pelvic outlet. The shoulders are usually in the A-P diameter above the pelvic inlet but as rotation of the fetal head occurs, the shoulders rotate to enter the pelvis in the larger transverse diameter (Menticoglou, 2018). Once the fetal head is born, restitution occurs where the fetal head externally rotates as the shoulders rotate forwards in the pelvic cavity. This enables the shoulders to be born with the bisacromial diameter in the widest A-P diameter of the pelvic outlet (Menticoglou, 2018). The pubic arch then acts as a 'pivot' for the anterior shoulder and the posterior shoulder is born first (Sutton & Scott, 1996).

Shoulder dystocia occurs when either one or both shoulders fail to enter the pelvic cavity, and there is a persistent A-P location of the fetal shoulders at the pelvic brim (Gherman, 2002) so there is a size discrepancy between the fetal shoulders and the pelvic brim (Gherman et al., 2006). This may be a result of increased resistance between the fetus and the vaginal wall (e.g., macrosomic fetus) as the fetus has a large chest relative to the biparietal diameter or where the fetal trunk and shoulders fail to rotate (e.g., precipitous labour) at the level of the mid-pelvis (Gherman, 2002). Shoulder dystocia can also occur when the anterior shoulder becomes impacted behind the maternal symphysis and the posterior shoulder descends below the sacral promontory to lie in the hollow of the sacrum (Chauhan et al., 2010). This may be referred to as unilateral shoulder dystocia (O'Leary, 1992). Less commonly, the posterior fetal shoulder becomes impacted on the maternal sacral promontory and the anterior shoulder remains behind the maternal symphysis (Chauhan et al., 2010). This has been referred to as bilateral shoulder dystocia (O'Leary, 1992).

Warning signs of impending shoulder dystocia include the fetal head either retracting or being tightly applied to the vulva, difficulty with delivery of the face or chin, failure of the fetal head to

restitute, and failure of the shoulders to descend (American College of Obstetricians & Gynecologists [ACOG], 2012). The failure of the shoulders to descend causes the 'turtle' sign which is retraction of the fetal head against the perineum immediately following the birth of the head (RCOG, 2012).

The diagnosis of shoulder dystocia remains subjective. A head-to-body delivery interval of more than 60 seconds has been proposed as an objective diagnosis (Spong et al., 1995); but this occurs commonly when waiting for the next contraction after delivery of the fetal head and so is not an accurate diagnosis (Menticoglou, 2018). The American and British Colleges of Obstetrics and Gynaecology agree that the diagnosis of shoulder dystocia should only be made following delivery of the fetal head when additional obstetric manoeuvres are required to affect delivery of the shoulders because gentle downward traction has failed to do so (ACOG, 2012; RCOG, 2012).

1.7 Research Methodology

For the purpose of this practice-based doctorate, the chosen research design is that of mixed methods. Mixed methods is a design with philosophical assumptions that guide the direction of the research project, and uses both quantitative and qualitative data for analysis (Cresswell & Cresswell, 2017). The rationale is that both approaches, in combination, provide clinicians with a more comprehensive and better understanding of the topic in question (Cresswell & Cresswell, 2017). The value of using different methods when researching a topic is that the weaknesses of both qualitative and quantitative approaches can be offset (Cresswell & Cresswell, 2017). Cresswell and Cresswell (2017) typically identify mixed methods as both quantitative and qualitative data which are collected together in the same study using the same samples for analysis.

This research is not a typical mixed methods approach in that the same samples have not been used for both the qualitative and quantitative phases of the research. This research uses a modified methodology that it is based on the principles of using multiple methods for research (Cresswell & Cresswell, 2017) and is informed by a new approach to undertaking research which has been called the fourth research paradigm (Rapport & Braithwaite, 2018). This new, emerging paradigm sees data as emergent and being gathered in 'real time' which provides an opportunity to collect data from a wide range of sources and enables clinicians to see a more complete picture of the topic in question (Rapport & Braithwaite, 2018). Data presented in such a manner can significantly aid understanding and result in improved service delivery (Rapport & Braithwaite, 2018). The fourth paradigm approach is described as creative, emergent, fluid and flexible, with data collected from a range of opportunities such as visual technological data, mobile data, creative writing, biographies, and informal conversations (Rapport & Braithwaite, 2018). Rapport and Braithwaite (2018) argued that data collected from all sources allows a better understanding of health care as insights are more clearly exposed. The chosen approach to data collection allowed a better and more comprehensive understanding of the management of shoulder dystocia; and, to this end data were collected from three sources.

Introduction to the study

The first source of data collected was the systematic literature review which provides visual data as to how effective currently recommended management strategies (internal rotational manoeuvres and delivery of the posterior arm) are, and what effects those strategies have on the neonate.

The second source of research data is a quantitative study which involved a retrospective review of births where shoulder dystocia was reported along with the use of internal manoeuvres, including axillary traction. Data were collected retrospectively from the clinical records of women who experienced shoulder dystocia over an eight-year period. The challenges of collecting the data were numerous. Women who experienced shoulder dystocia were identified from the hospital database Casemix and were coded as 'shoulder dystocia'. Coding was undertaken by administrative staff and at times was incorrect. Women who had shoulder presentation, breech presentation requiring manipulation of the fetus to assist the birth of the shoulders and some women who had caesarean section were coded as having shoulder dystocia. They were excluded from the data collection. The clinical records for each woman and neonate were stored offsite and required transport to the hospital. This method of collecting data was costly and time consuming as each set of records incurred a transport charge and frequently there were time delays in receiving the records. All records remained in a secure, locked office until returned to storage.

Each record was manually scanned in detail and data entered onto an Excel spreadsheet. All of the records were handwritten, some of which were barely legible and often the documentation was inadequate. There was no standard definition of shoulder dystocia and documentation of the problem ranged from 'tight shoulders' to 'severe shoulder dystocia'. If there were no additional manoeuvres used, then it was deemed not to be a shoulder dystocia and the records excluded from the data. Only those with additional manoeuvres to the normal traction applied to the fetal head to assist the birth of the shoulders were included.

The severity of the shoulder dystocia was subjective and the opinion of the person in attendance as there is no standard classification for the severity of shoulder dystocia. There was no standard proforma for documenting the timing of, or the manoeuvres used, and different descriptions were used for different manoeuvres. McRoberts' and suprapubic pressure were often described as one manoeuvre and axillary traction was occasionally described as delivery of the posterior shoulder. In these cases, clarity as to the actual manoeuvre used was sought from the attending clinician. The process of manually scanning and seeking clarity of some descriptions of shoulder dystocia management was also very time consuming.

The third source of data is built on previous qualitative research by Ansell et al. (2012) where axillary traction was explored and described by practitioners. The fourth paradigm as described by Rapport and Braithwaite (2018) was used to integrate the quantitative and qualitative approaches to data collection. A descriptive narrative of my own personal and professional journey included those informal conversations, discussions in the process of managing shoulder dystocia, emails, text messages, telephone conversations and conference conversations. Those

connections and conversations about management of shoulder dystocia, provided important data that had to be included in this research to provide a complete picture. This data and these interactions capture the complexity of practice in the real world even though such data is often called anecdotal evidence. However, it became clear from this anecdotal evidence that practice had begun to change to the encompass the use of axillary traction rather than the commonly used methods to resolve shoulder dystocia. It was important that this change in practice be captured, but traditional research methods did not easily capture both the complexity of that practice and the 'real time' encounters which occurred. The use of the fourth paradigm allowed the 'real-world' insights into management of shoulder dystocia to emerge as data was collected 'on the hoof' (Rapport & Braithwaite, 2018). The use of the fourth paradigm took into account real time behaviours and allowed flexibility and creativity with the result that a change in practice occurred. The willingness and eagerness of practitioners to learn and adopt the use of axillary traction demonstrated the support of the multidisciplinary team and the powerful real time data that emerged. The fourth research paradigm approach to this part of the research project meant that the qualitative and quantitative research methods were enhance by the 'real time' and 'real world' sharing of practice (Rapport & Braithwaite, 2018).

The findings of this research project are captured in the published manuscripts. They reflect the research method and collection of data outlined above. The first article is the systematic review; the second, the findings of the retrospective quantitative study; and the third, a practice article which provides an exploration and demonstration of how to perform axillary traction. This approach to research has allowed a complete picture of the management of shoulder dystocia to emerge. Not being limited to one approach, it allows clinicians to see what has happened in the real world of shoulder dystocia management by presenting a complete research story.

1.8 Context of the Study

This study was conducted in Counties Manukau Health (CMH), New Zealand, and is the first to assess management of shoulder dystocia by axillary traction. Counties Manukau Health is the largest heath board in the country and serves an ethnically diverse population. The demographics for the research area are important as they relate to the risk factors associated with shoulder dystocia; and the rate of shoulder dystocia is likely to increase as a result of increasing risk factors.

Counties Manukau Health has an ethnically diverse population. In 2018, 29.3% of women giving birth were Pacifica, 24% were New Zealand European/Other, 20.1% were Māori, 13.7% were Indian, and 6.1% were Chinese (CMH, 2019). It is also one of the most socially deprived areas and 44.0% of those mothers birthing in the area between 2015 and 2018 were classified as quintile 5 which is the highest level of social deprivation. This is vastly more than the national average (CMH, 2019). With some of the highest deprivation in the country, CMH has the highest rate of perinatal mortality in New Zealand (Perinatal & Maternal Mortality Review Committee [PMMRC], 2019).

The New Zealand Health Survey (2019) found that adults living in the most socially deprived areas are 1.6 times more likely to be obese than those living in the least deprived areas. The rate of obesity in the general population has continued to rise over a seven-year period from 2011-2018 by 26.5%; and in CMH, the rate has increased by 46.8% for the same period (Ministry of Health [MoH], 2019). The rates of women birthing at CMH who are overweight or obese have been trending slightly upward with 31.2% women classified as overweight and 42.0% of women classified as obese (CMH 2018). The rates of obesity in women giving birth vary by ethnicity and were highest in Pacific (59%) and Māori (38.9%) women (CMH, 2017).

The high rates of diabetes and obesity can have a significant impact on the incidence of shoulder dystocia (Gherman, 2002). Diabetes is a significant and growing problem in CMH and rates of fetal macrosomia have been described as high as 40-50% in pregnancies complicated by diabetes (Lim et al., 2009). The percentage of women birthing at CMH who are diagnosed with diabetes in pregnancy has more than doubled from 3.1% (n=246) of all births in 2006 to 8% (n=584) of all births in 2014 (Counties Manukau District Health Board [CMDHB], 2015). The rate of diabetes also varies by ethnicity with 44% being Pacific women, 17% Indian women, 15% New Zealand European/Other women, and 11% Māori (CMDHB, 2015).

Diabetes, excessive maternal weight, and excessive weight gain in pregnancy are associated with fetal macrosomia (Johnson et al., 1992; Lim et al., 2009). Fetal macrosomia is defined as birthweight of 4kg or more (Pates et al., 2008) and is a significant risk factor for shoulder dystocia (Gherman 2002). In 2017, 2.4% of babies in CMH were born with a high birthweight (≥4.5 kg) (CMH, 2019).

1.9 Historical Perspective

Although the term shoulder dystocia has been used since the beginning of the 20th century, difficulty with birth of the shoulders is described as far back as 1730. Midwifery literature by McClintock (1877) describes the case of one of the earliest physicians, William Smellie, where there was delay in delivery of the shoulders:

> In the year 1730, I received a sudden call to a gentlewoman in labour; the child's head had been delivered a long time and the midwife had pulled with a great deal of force at intervals. But before I arrived the patient was delivered of a dead child whose shoulders were remarkably large. I have been called by midwives to many cases of this kind, in which the child was frequently lost. (p. 271)

It is interesting to note that what Smellie described, which today would be termed shoulder dystocia, is something that he had seen in "many cases". It would appear from his statement that the perinatal mortality rate was extremely high when shoulder dystocia occurred.

In 1879 Dr. Beech was called to attend to Miss Anne Swan during the birth of her second child. When the shoulders became 'stuck fast', he called Dr. Robinson to complete the delivery. The written report of the birth follows:

> It was our desire to deliver the child without mutilation, so we passed a strong bandage over the neck of the child, we made strong traction downwards and laterally and finally after a laborious siege we succeeded in delivering our patient of a male child weighing 23¾lbs with a length of 30 inches. (as cited in Gherman, 2002)

It seems that the problem of macrosomia is one which clinicians have faced for centuries. Donald (1974) described his feelings following a disastrous shoulder dystocia occurring in a macrosomic infant:

> My sorriest experience of it concerned an elderly primigravida with a 14lb. baby. (Her husband had weighed 15lbs. at birth – an important point to note in postmaturity and one which I overlooked in this case). After rotating and delivering the fetal head with Kielland's forceps I then ran into trouble with impaction of the anterior shoulder and wasted too much time trying to free it and before using the whole hand to bring down the posterior arm. In that hectic fifteen minutes of brute force, of which one could only be ashamed, the baby died. It is a nightmarish situation. (p. 853)

Morris (1955) gave a classic description of shoulder dystocia:

> The delivery of the head with or without forceps may have been quite easy, but more commonly there has been a little difficulty in completing the extension of the head. The hairy scalp slides out with reluctance. When the forehead has appeared, it is necessary to press back the perineum to deliver the face. Fat cheeks eventually emerge. A double chin has to be hooked over the posterior vulvar commisure, to which it remains tightly opposed …time passes. The child's face becomes suffused. It endeavors unsuccessfully to breathe. Abdominal efforts by the mother and by her attendants produce no advance. Gentle head traction is equally unavailing. Usually equanimity forsakes the attendants--they push, they pull. Alarm increases. Eventually, "by greater strength of muscle or by some infernal juggle," the difficulty appears to be overcome, and the shoulder and trunk of a goodly child are delivered. The pallor of its body contrasts with the plum-colored cyanosis of the face, and the small quantity of freshly expelled meconium about the buttocks. It dawns upon the attendants that their anxiety was not ill founded, the baby lies limp and voiceless, and only too often remains so despite all efforts at resuscitation.

The phenomenon of shoulder dystocia has long been a problem recognised and faced by midwives and obstetricians alike.

1.10 Complications of Shoulder Dystocia

Shoulder dystocia poses a significant and profound risk to the life and wellbeing of the fetus, with high levels of fetal injury, some of which are irreversible (Dajani & Magann, 2014). It also poses a risk to the wellbeing of the mother. The overall rate of fetal injury following shoulder dystocia is approximately 24.9% (Gurewitsch et al., 2003; Jevitt, 2005) with serious morbidity

occurring in 11% (MacKenzie et al., 2007). Complications of shoulder dystocia include permanent or transient injury to the baby.

Brachial plexus injuries (BPI) result from stretching or avulsion of the nerve roots as they exit from the cervical spine and can be caused by excessive downward and lateral traction of the fetal head in an attempt to deliver the impacted anterior shoulder. Such injuries can be transient or permanent (Dajani & Magann, 2014). Approximately 80% of palsies following shoulder dystocia involve the nerves of the cervical roots 5-6, causing Erb-Duchenne palsy. The involvement of the nerve roots C8-T1 cause Klumpke's palsy which affects the hand and can be intermediate or complete (Gherman et al., 1999). Horner's syndrome (damage to the nerve roots of T1-T3 causing partial ptosis), facial nerve injuries, and diaphragmatic paralysis have also been reported (Gherman et al., 1999). Large variations in BPI rates have been reported (4-59.1%) (Dajani & Magann, 2014; Gurewitsch et al., 2003; Raio et al., 2003). The variation in reported rates is, again, probably due to inconsistencies in reporting, definition and diagnosis of shoulder dystocia. The risk of permanent injury is reported to occur in 10% or less of cases of BPI (ACOG, 2012).

Bone fractures, most commonly fracture of the clavicle, occur in approximately 10.6% of cases of shoulder dystocia (Rahman et al., 2009). Clavicular fractures commonly heal without complication but can be associated with injury to the lung or underlying vascular structures (Jevitt, 2005). Fractures of the humerus have been associated with the manoeuvres used to alleviate shoulder dystocia and with reported rates of up to 5.8% (Verklan, 2009). Humeral fractures usually heal without complication (Jevitt, 2005) but can be deeply distressing to the parents.

Hypoxic ischaemic encephalopathy (HIE), a result of fetal hypoxia, is reported to occur in 0.5-23% of infants following shoulder dystocia (Dajani & Magann, 2014). The development of fetal hypoxia has been attributed to compression of the fetal neck and carotid vessels by the maternal perineum, compression of the umbilical cord between the fetal body and the maternal pelvis, and premature separation of the placenta during prolonged head to body delivery interval (HBDI) (Gherman et al., 2006). Yet, the primary pathophysiological mechanism remains unclear. Cord arterial pH drops by 0.011 per minute during dystocia so fetal oxygenation deteriorates with increasing HBDI (Leung et al., 2011). The risk of HIE markedly increases if HBDI is more than 5 minutes (Dajani & Magann, 2014).

Sudden cardiac arrest leading to death or severe neurologic damage has been reported at birth after shoulder dystocia. It has been hypothesised that this is a result of poor cardiac and brain perfusion following compression of the umbilical cord (Mercer et al., 2009). Perinatal death due to acute hypoxic damage or fetal trauma occurs in 0.4-0.5% of deliveries complicated by shoulder dystocia (Gherman et al., 2006).

Maternal complications of shoulder dystocia include increased post-partum haemorrhage rates of up to 11% (Gherman et al., 1997; Grobman, 2013), third and fourth-degree vaginal lacerations (11-19.3%), cervical tears (2%), bladder atony, and uterine rupture (Dajani &

Magann, 2014; Gherman, 2002). Separation of the maternal symphysis and lateral femoral cutaneous neuropathy have been shown to be associated with aggressive hyperflexion of the maternal legs during the delivery (Gherman et al., 1998). Maternal psychological trauma has also been reported (Dajani & Magann, 2014).

1.11 Incidence

The reported incidences of shoulder dystocia vary. If using the definition of a HBDI of more than 60 seconds, the incidence of shoulder dystocia is 10% (Spong et al., 1995). More recently Gherman et al. (2006) reported rates of shoulder dystocia of 0.2-3.0%. Hansen and Chauhan (2014) conducted a literature review to examine rates of shoulder dystocia occurring in all vaginal births. They reviewed 15 studies which included publications from the USA, UK, Sweden, Norway, Ireland, and Israel and found a range of 0.2-2.4% with an overall rate of 0.7%. Some authors, however, report incidences as high as 4-7% (O'Connor, 2000). The wide range of reported incidences is largely due to inconsistency in the rates of reporting, discrepancies in reporting, and the subjectivity of the clinician's definition and diagnosis (Hansen & Chauhan, 2014).

1.12 Causes/Predisposing Factors

There are several factors which may be associated with shoulder dystocia. These include maternal obesity, maternal diabetes, high neonatal birthweight, previous shoulder dystocia, prolonged length of labour, operative vaginal delivery, and gestational age (Sentilhes et al., 2016). There are only two independent risk factors for shoulder dystocia which are previous shoulder dystocia and fetal macrosomia; with 10-20 times and 6-20 times the risk respectively (Sentilhes et al., 2016). Maternal obesity and diabetes are also associated with shoulder dystocia, but this may be due to the macrosomia associated with these conditions (Herzberg et al., 2017; Sentilhes et al., 2016). Shoulder dystocia remains an unpredictable childbirth emergency with more than half occurring in those with no risk factors (Sentilhes et al., 2016).

Maternal obesity before pregnancy is a risk factor which has been shown to increase the risk of shoulder dystocia (Zhang et al., 2018); and the higher the class of obesity, the higher the increased risk of shoulder dystocia (Lutsiv et al., 2015). Obesity is a worldwide public-health issue and according to the World Health Organization (WHO, 2020) report, the rate is increasing dramatically with rates in 2016 of 13% in the general population and 15% of women over the age of 18 years classified as obese (body mass index [BMI] ≥30 kg/m2).

Being overweight or obese before or throughout pregnancy is a major risk factor for the development of gestational diabetes mellitus (GDM) (Catalano et al., 1991), and maternal diabetes is associated with an increased risk of shoulder dystocia (Baskett, & Allen, 1995; Nesbitt et al., 1998). Gestational diabetes mellitus defined as a state of glucose intolerance and hyperglycaemia with first onset during pregnancy (Buchanan et al., 2012). Diagnoses of GDM have steadily increased over the last 25 years, in part due to the obesity epidemic (Ferrara,

2007). In addition to GDM, an increasing number of pregnancies are complicated by pre-gestational Type 2 diabetes (T2D) which is diabetes diagnosed prior to pregnancy and characterised by high blood sugar, insulin resistance, and relative lack of insulin (Agarwal et al., 2018).

Fetal macrosomia is defined as birthweight above 4000-4500g (Young & Ecker, 2013) and has shown to be associated with shoulder dystocia (Baskett, & Allen, 1995; Nesbitt et al., 1998). Maternal diabetes is associated with fetal macrosomia and rates as high as 40-50% in pregnancies complicated by diabetes have been described (Lim et al, 2009). Large cohort studies have demonstrated a correlation between increased rates of shoulder dystocia with increasing birthweight even in pregnancies not complicated by diabetes (Nesbitt et al., 1998; Overland et al., 2012). Nesbitt et al. (1998) also found rates of shoulder dystocia increased from 5.2% for infants weighing 4000-4250g, 9.1% for infants weighing 4250-4500g, 14.3% for infants weighing 4500-4750g and 21.1% for infants weighing 4750-5000g. Women with GDM or T2D, however, are at increased risk for shoulder dystocia even when controlling for birthweight and other confounders (Ecker et al., 1997), with rates of 8.4%, 12.3%, 19.9%, and 23.5% respectively (Nesbitt et al., 1998). This may be a result of the differences in fetal fat distribution as the infant of the diabetic mother has increased truncal and shoulder fat which increases the bisacromial diameter (Cohen et al., 1999) and makes it more difficult to navigate the maternal pelvis during birth (Herzberg et al., 2017). Herzberg et al. (2017) found that macrosomic infants were at a significantly higher risk of shoulder dystocia if vacuum extraction was required for birth of the fetal head. Of those birthed normally, the risk of shoulder dystocia was 3.04% versus 10% of those delivered by vacuum extraction (Herzberg et al., 2017).

Instrumental vaginal delivery is associated with an increased risk of shoulder dystocia (RR 4.6-28) (Gherman et al., 2006). Nesbitt et al. (1998) found that in infants with a birthweight of >3.5kg, delivered by vacuum or forceps, the rate of shoulder dystocia increased by 35-45%; whilst a randomised controlled trial (RCT) of forceps versus vacuum delivery (Bofill et al., 1997) found stronger association for shoulder dystocia with vacuum delivery than forceps. A meta-analysis conducted by Dall'Asta et al. (2016) also found vacuum delivery to be associated with a significantly higher risk of shoulder dystocia than that of spontaneous vaginal birth but found no difference in the rates of shoulder dystocia between vacuum delivery and forceps delivery ($p>0.05$).

Women with prior shoulder dystocia are at an increased risk of recurrent shoulder dystocia in a subsequent pregnancy (Ouzounian et al., 2012). A literature review by Al-Hawash et al. (2018) reported wide variations in the recurrence rate ranging from 1-25%; with one of the largest cohorts reporting a recurrence rate of 13.5%, which may be a more realistic figure. This would be in accordance with recurrence rates of 12-17% as reported by Gurewitsch (2016). Recurrence of shoulder dystocia is probably related to the fact that the underlying risks for fetal macrosomia, such as diabetes and maternal obesity, are present in subsequent pregnancies and possibly even to greater effect (Dildy & Clark, 2000).

Prolonged second stage of labour and increased rates of operative vaginal delivery are associated with shoulder dystocia (Baskett & Allen, 1995; McFarland et al., 1995; Tsur et al., 2012). The length of the second stage of labour (>2 hours) is significantly increased (7-fold) and the rate of operative vaginal delivery is increased in those with shoulder dystocia ($p<0.005$) (Mehta et al., 2004). In the presence of fetal macrosomia (birthweight >4000g) the risk increases further with 22% of those women experiencing shoulder dystocia versus 3% in the control group (Mehta et al., 2004). Oxytocin augmentation of labour has also been associated with shoulder dystocia (Rouse et al., 2001) but this is probably associated with the use of oxytocin in women with labour abnormalities and fetal macrosomia (Dildy & Clark, 2000).

1.13 Management of Shoulder Dystocia

Management of shoulder dystocia involves a series of external and internal manoeuvres to disimpact the fetal shoulders (RCOG, 2012). The external manoeuvres of McRoberts' position and suprapubic pressure involve flexion of the mother's legs to increase the pelvic outlet (Poggi et al., 2004) and suprapubic pressure which attempts to push the fetal shoulder under the maternal symphysis pubis (Advanced Life Support in Obstetrics [ALSO], 2000). The commonly used internal manoeuvres include Rubins' II which is aimed at reducing the bisacromial diameter by adducting the shoulder (Baxley & Gobbo, 2004); Woods' screw and reverse Woods' screw which are aimed at rotating the fetal shoulders through the circumference of the maternal pelvis to disimpact the shoulders (Baxley & Gobbo, 2004); and delivery of the posterior arm by grasping the fetal wrist and withdrawing the arm from the vagina in a straight line (RCOG, 2012). A qualitative study by Ansell et al. (2012) suggested the internal manoeuvre of axillary traction as a method of resolving shoulder dystocia. This involves securing and applying traction directly through the fetal axilla to release the posterior shoulder (Ansell et al., 2012).

1.14 Personal Experience

My interest in exploring the management of shoulder dystocia began when I was working as a Lead Maternity Care (LMC) midwife in CMH. My friend and LMC colleague had been caring for a woman in labour throughout the night. As the back-up midwife I decided to go to the hospital early in the morning to help her, as I was aware that she would be very tired. At the time of my arrival, the woman (whom I had met on many occasions) had been pushing for some time but to no avail. As a result, the obstetrician had applied the ventouse cup to assist with the birth. After much force and pulling over four contractions, the head was eventually born and the ventouse cup came off the fetal head whilst the suction was still on. The fetal head was pale, the scalp appeared to be full of blood (not just a chignon) and the head literally 'jammed' back up against the symphysis (the turtle sign). I thought I had witnessed, and managed, shoulder dystocia's in my career as a midwife but it was in that instant that I realised I had never witnessed anything of such magnitude before. We were in danger of losing the baby.

The obstetrician tried the internal rotational manoeuvres described in the HELPERR[1] management strategy to no effect, so my colleague and I took over. I applied suprapubic pressure whilst she put her hand into the vagina and grasped the posterior arm. She managed to 'drag' the baby's arm down through the pelvis but the humerus fractured in the process. We both heard the fracture occur and felt physically sick but, with my encouragement, she managed to continue with the traction on the arm because the baby seemed to be moving down. Finally, the baby was born, but in dreadful condition. She required full resuscitation and was admitted to the neonatal unit and ventilated. She suffered compromising blood loss from the bleeding into the scalp requiring blood transfusion, and a humeral fracture. Seizure activity occurred for the next two weeks and she spent three weeks in the neonatal unit.

Along with the parents, both my colleague and I were extremely traumatised by the experience. There were many sleepless nights and flashbacks. I became very anxious at every birth and began to dread managing the second stage of labour because I now realised how difficult managing a 'true' shoulder dystocia could be. I realised that the training I had received in managing shoulder dystocia had been ineffective and I questioned how I would manage if a similar situation arose again.

Eventually, I realised that if I were to continue with midwifery, I needed to face my own fears. I continually thought of how shoulder dystocia could be better managed and reflected on my colleague's actions when she grasped the fetal arm. She had in fact been trying to sweep the posterior arm across the fetal body in order to deliver the posterior arm. She was unable to bring the arm down but as she was pulling against the humerus the baby moved slightly. During this, however, the humerus suddenly fractured which caused her to stop. Together we realised that despite the fracture she had to keep pulling as this seemed to be the only way to free the baby. With verbal encouragement and tremendous effort, she eventually pulled the baby free. I thought about how far her hand was inside the woman's pelvis and realised that she had to go farther inside to reach the fetal elbow and wondered what would happen if the shoulder was to be grasped instead of the elbow. If the fetal axilla was located and the baby grasped at that point, it seemed possible that the humerus could be held in place so that the traction was not accidently applied to the humerus and there would be less risk of fracture. It also seemed that it would be a tangible point to apply traction and free the posterior shoulder.

1.15 Clinical Leadership

Following my own personal experience, I began to reflect on practice, in particular the internal manoeuvres I had been taught to resolve shoulder dystocia which had not worked in this situation. Reflection on practice has been described by Schön (1991) who identified how a reflective practitioner is someone who uses reflection to navigate complex problems arising in

[1] HELPERR is mnemonic for management of shoulder dystocia: H – Help; E – consider Episiotomy; L – Legs, McRoberts; P – suprapubic Pressure, E – Enter; R – Internal Rotation; R – Removal of posterior arm

their own clinical practice and which are not able to be resolved by the traditionally taught techniques. Schön also described how practitioners face a crisis in confidence in such situations, which was certainly true in my case. I personally began to 'fear' birth if the baby seemed slightly large as I was not confident that I would be able to resolve a shoulder dystocia with the knowledge I had. Reflective thinking also enables the practitioner to develop more complex insights and understanding of clinical practice (Ixer, 1999), and the practitioner is able to challenge and review clinical practices. Following that traumatic experience, I was certainly ready to challenge the teaching around shoulder dystocia. Shepard and Jensen (2002) described this as the hallmark of professional behaviour.

I believed I had identified a gap in evidence-based practice and was passionate about improving the quality of care. This is described as innovation (Byers, 2017; White, 2011). Innovation creates improvement in quality, cost-effectiveness and efficiency, and is crucial for progress in healthcare (Huber et al., 2019) which resulted in my decision to make shoulder dystocia the subject of my Masters' study. The results of that qualitative study recommended that when an internal manoeuvre is required to resolve shoulder dystocia, axillary traction should be the first manoeuvre used instead of the commonly used internal rotational manoeuvres and delivery of the posterior arm manoeuvres (Ansell et al., 2012).

During the course of the Masters' study, other clinicians in CMH became aware of axillary traction and began to use it themselves when other manoeuvres had failed. There were many verbal reports of its success and axillary traction began to 'creep' into practice. As a result, the method of axillary traction for managing shoulder dystocia was reviewed by the Obstetric Quality Forum at CMH in 2009 and a new guideline including axillary traction was approved. It was also taught as the method for managing shoulder dystocia during the in-house emergency skills and drills training sessions at CMH.

A change in how shoulder dystocia was managed had begun in my own clinical area and the word was beginning to spread throughout the country. This is the process of clinical leadership which requires a willingness of the leader who wants to influence change to stimulate collaboration with peers in order to 'get things done'. In this context, the leader needs to understand what the current situation is and influence change by the provision of knowledge and evidence. The change is then implemented through a community of peers (De Meyer, 2013) with whom I spent many hours discussing the management of shoulder dystocia.

There was resistance from some, however, to a change in practice; and the published study (Ansell et al., 2012) was not universally accepted by the profession—in particular, the New Zealand College of Midwives who are one of the main providers of the mandatory emergency skills training for midwives. A number of practitioners were reluctant to accept a qualitative study as evidence. The reason given was that a qualitative study has no statistical analysis and, therefore, was not 'proof'. As the results of shoulder dystocia can be devasting for both the neonate and their families and caregivers, I decided to pursue further research in the topic and provide those who would not accept qualitative evidence alone with quantitative evidence.

Introduction to the study

On enrolment in the Doctor of Health Science programme, I was clear that the research approach needed to include a quantitative study to provide the 'proof' needed for those who required statistical evidence. The hypothesis was that axillary traction is an effective and safe manoeuvre for the management of shoulder dystocia when an internal manoeuvre is required to overcome shoulder dystocia. This thesis tells the story of that research and sits within a professional, practice-based doctorate with the requirement that the research makes a contribution to practice; and, in this instance, to the management of shoulder dystocia.

1.16 Forthcoming Chapters

Chapter 2. Manuscript 1: This chapter provides a systematic review of the literature undertaken to identify the effectiveness of the internal manoeuvres currently used to resolve shoulder dystocia and provides a basis for the retrospective study. This systematic review has been accepted for publication and is presented in the format required for that publication.

Chapter 3. Manuscript 2: This chapter presents the results of the quantitative study; a retrospective review of clinical records of mother and baby for labours complicated by shoulder dystocia over an eight-year period. It is presented as the article published in the *Australia New Zealand Journal of Obstetrics and Gynaecology* (Ansell et al., 2019).

Chapter 4. Manuscript 3: The final part of the research is a qualitative narrative of my own personal and research journey which has led to a change in how to manage shoulder dystocia. This narrative has been accepted for publication and is presented in the format required for that publication.

Chapter 5. Discussion and Conclusion: In this, the final chapter, a summary and discussion of the key findings are drawn together and recommendations for education and practice are made.

1.17 Conclusion

Shoulder dystocia is a childbirth emergency which can have devastating consequences for all concerned. It is generally described as failure of delivery of the fetal shoulders following the vaginal birth of the fetal head (Gherman, 2002). The main objective and justification of this research is to investigate and analyse the way shoulder dystocia is managed so that the most successful manoeuvre can be identified in order to minimise those consequences. The research approach used is that of mixed methods, while embracing the new emerging fourth paradigm which enables data to be collected from a wide range of sources and provides a more complete picture of the topic in question. The high and increasing rate of risk factors for shoulder dystocia provide context for the study. The historical perspective highlights the fact that shoulder dystocia is a problem that clinicians have faced for centuries; the complications of which can be permanent or life threatening. The reported incidence of shoulder dystocia varies widely, probably as a result of clinicians' subjectivity in diagnosis and discrepancies in reporting of the problem. Management of shoulder dystocia involves a series of internal and external manoeuvres, but it is generally accepted that the more severe dystocias require management

using an internal manoeuvre (Spain et al., 2015). This study has been undertaken to evaluate the success rates of the internal management strategies of internal rotation and delivery of the posterior arm and compare those results with axillary traction. My own personal experience and reflection led to a pathway of clinical leadership. This project aims to change current practices through the research and leadership processes, and sits within a professional, practice-based doctoral programme.

Chapter Two: Manuscript 1
Literature Review

2.1 Introduction

This chapter presents the research methodology used to conduct a systematic review of the literature. The review was undertaken to identify the effectiveness of the internal manoeuvres currently used to resolve shoulder dystocia. A declaration of authors' contributions is included.

This systematic review of the literature has been accepted for publication in the peer reviewed journal *The Practicing Midwife* (Appendix A). It is presented in this chapter in the format required for that journal.

2.2 Research Approach

The first step in this research methodology explores in depth the success rates of the traditionally used methods for resolving shoulder dystocia. This rigorous and robust systematic review of the literature was conducted to investigate the success rates of the widely used methods of resolving shoulder dystocia when an internal manoeuvre (Rubins' II, Woods' screw, and delivery of the posterior arm) is required. The success rates of those methods could then be compared with the success rates of axillary traction which is also an internal manoeuvre. Undertaking a systematic review ensures a robust review of related literature that provides a solid theoretical foundation for the research and provides justification for the need for the research (Hefferman, 2013).

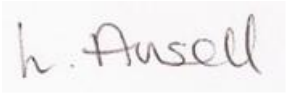
An extensive analysis of the literature has been described as document analysis and such analysis can be considered as a part of the methodology (Hefferman, 2013). The analysis is described in the methodology section of the article to follow. Document analysis, as such, has been described as a qualitative research method (Hefferman, 2013; Kysh, 2013). This analysis allows the reviewer to provide critical appraisal and evaluation of high-quality evidence to a focused clinical question and enables an evaluation of the research findings and treatment outcomes obtained in different studies to be summed up (Kysh, 21013). For the purpose of this systematic review, the clinical question applied to the problem of shoulder dystocia was: what are success rates of shoulder dystocia managed by internal rotational manoeuvres (Rubins' and Woods' screw) and delivery of the posterior arm?

2.3 Authors' Contributions

This article was written under the guidance of Associate Professor Judith McAra-Couper as principal supervisor and Associate Professor Peter Larmer as associate supervisor. The article was co-authored as follows:

Principal Author: Lesley Ansell

Contribution: 80%. My role was to develop search terms and review the databases and literature. I undertook the review and analysis process, writing of the manuscript, and suggested revisions in preparation for publication.

Signed ……  … Date……4th May 2020……

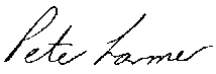
Co-Author: Associate Professor Judith McAra-Couper

Contribution: 10%. Supervision of the writing, provision of feedback, and formatting advice.

Signed…… Date……4th May 2020……

Co-Author: Associate Professor Peter Larmer

Contribution: 10%. Supervision of the writing, provision of feedback, and formatting advice.



Signed…… Date……4th May 2020……

2.4 Article for Publication

2.4.1 Title

Success Rates of Shoulder Dystocia Managed by Internal Rotational Manoeuvres and Delivery of the Posterior Arm: A Review of the Literature.

2.4.2 Introduction

Shoulder dystocia is a rare complication of childbirth which can result in significant neonatal and maternal morbidity and even neonatal death [1,2]. This literature review identifies the success rates of the internal rotational manoeuvres and delivery of the posterior arm to resolve shoulder dystocia and subsequent neonatal outcomes.

2.4.3 Background

Shoulder dystocia occurs when one or both fetal shoulders fail to enter the pelvic cavity and are impacted above the pelvic brim [3]. Neonatal consequences can be profound and include brachial plexus injury (BPI), clavicular and humeral fractures, severe birth asphyxia resulting in hypoxic ischaemic encephalopathy (HIE) and, in some cases, perinatal death [2].

Current management of shoulder dystocia includes a sequence of external and internal manoeuvres to disimpact the fetal shoulders [2]. External manoeuvres include McRoberts' position, suprapubic pressure and 'all fours' as the first steps followed by internal rotational manoeuvres (Rubins' II, Woods' screw and reverse Woods' screw) and delivery of the posterior arm as described in the HELPERR mnemonic [2]. It is difficult to determine the success rates of individual manoeuvres as they are used in different sequences and combinations. There are wide differences in reported incidences [4] because there is no universally accepted diagnostic criteria for shoulder dystocia. There are also wide variations in reported success rates of external and internal manoeuvres with no indication as to which should be used first [4,5,6,7,8,9]. It is generally accepted that less severe shoulder dystocias are more likely to be resolved with external manoeuvres while more severe dystocias will require internal manoeuvres [4]. The success rate of external manoeuvres has been previously studied [10,11].

A qualitative study [12] suggested an alternative internal manoeuvre of axillary traction may resolve shoulder dystocia more quickly and easily than other manoeuvres. The discrepancy and lack of agreement about shoulder dystocia has potential to create confusion for practitioners. A systematic literature review was, therefore, undertaken to examine the success of the internal manoeuvres currently used (Rubins' II, Woods' screw and delivery of the posterior arm). McRoberts' and suprapubic pressure are external manoeuvres used prior to internal manoeuvres, and McRoberts' is maintained while internal manoeuvres are performed. For this reason, the reported success rates for these external manoeuvres are included in this review. None of the studies identified the use of the all-fours manoeuvre.

2.4.4 Methodology

A review of the literature was undertaken to identify what is informing practice about effectiveness of the internal manoeuvres currently used to resolve shoulder dystocia. The search included seven databases: EBSCO Health (Medline and CINAHL), Scopus, Cochrane Library, MIDIRS Maternity and Infant Care, Ovid Emcare and Web of Science, and was conducted with an end date of April 2019. Reference lists from retrieved articles were scanned manually. The search was limited to humans and English language.

The inclusion criteria were research articles from journals that included the success rates of internal manoeuvres with neonatal and maternal outcomes. Studies were excluded if they were not research and there was no assessment of internal manoeuvres or were focused on prevention or predictive factors for shoulder dystocia. The articles were scored using a modified Joanna Briggs Institute checklist for cohort studies. Three authors scored each article independently and then the scores were discussed to reach consensus.

The search used the following keyword terms: 'shoulder dystocia' and management* or intervention* or treatment or prevention and control or manoeuvre* or maneuver* or outcome*. The search terms were used individually and in combination (and/or) and applied to the title, abstract, and body of all works. After applying search terms sequentially, 2880 articles were identified and manually screened. A further 12 articles were retrieved from reference lists; and 119 articles were duplicates and removed. The titles and abstracts of the remaining 2773 articles were evaluated to assess relevance and 179 articles were identified as having possible relevance, of which 172 did not meet the inclusion criteria and were excluded. The remaining seven articles met the inclusion criteria and were reviewed (Figure 2.1).

Articles for inclusion were assessed for methodological quality using a modified Joanna Briggs critical checklist for cohort studies (Table 2.1) (Appendix A). An arbitrary decision was made to deem studies good quality if they scored 75% or higher, average quality if they scored 74-50% and poor quality if 50% or less. Five studies had a good quality score (>75%) [4,6,7,9,13] and two an average quality score [5,8].

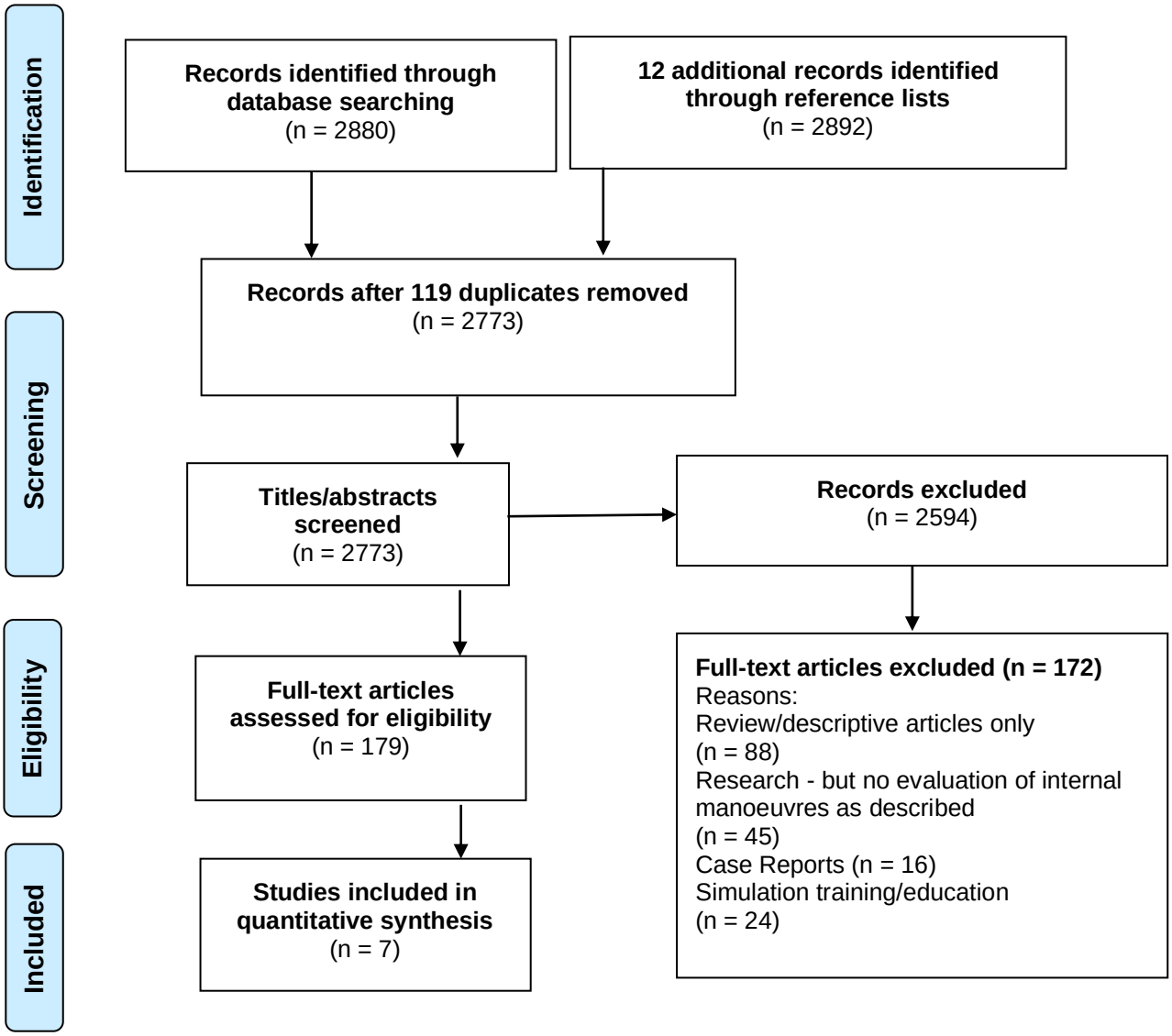


Figure 2.1 PRISMA Flow Diagram

Table 2.1 Joanna Briggs Score

Author/(Date)	**JB modified score** (not applicable questions excluded) **Score (%)**
Michelotti, Flatley, & Kumar (2018)	8/9 (88%)
Gachon, Desseauve, Fritel, & Pierre (2016)	5/8 (62%)
Spain et al. (2015)	8/9 (88%)
Hoffman et al. (2011)	8/8 (100%)
Leung et al. (2011)	7/8 (87%)
MacKenzie et al. (2007)	5/7 (71%)
Gherman et al. (1997)	7/7 (100%)

2.4.5 Results

The results of data extraction are presented in Table 2.2. All of the studies were retrospective reviews; five were reviews of clinical records [5,7,8,9,13] and two were cohort studies [4,6]. The total cohort of births for the 12 studies was 5971.

Three studies evaluated the efficacy of the manoeuvres used to resolve shoulder dystocia and associated neonatal outcomes [7,8,9]. Three of the studies examined the effects of the manoeuvres on neonatal morbidity and the success rates of internal manoeuvres [4,6,13]. One study examined the different types and sequences of manoeuvres in relation to neonatal injury rates [7].

The outcome measures included the success rates of manoeuvres that resolved shoulder dystocia [7,13] and neonatal outcomes such as APGARs, resuscitation (intubation), neonatal acidosis, admission to neonatal unit and length of stay, BPI, fractures, HIE, stillbirth or neonatal death [6,7,9,13].

All of the studies identified confounding factors which included maternal ethnicity, age, parity, maternal diabetes, body mass index (BMI), induction, augmentation of labour, epidural anaesthesia, duration of 2nd stage of labour, instrumental birth, fetal gender, and birthweight. There was no measurement of success rates as planned outcomes in any of the studies; nor did they report the effect of confounders for each different manoeuvre.

The definition of shoulder dystocia for six studies were additional manoeuvres beyond that of normal traction on the fetal head to effect delivery of the shoulders [4,5,6,7,9,13]. Two of the studies [7,13] included additional manoeuvres or head to body delivery interval (HBDI) of 60 seconds or more.

Three of the studies examined the success rates of internal rotational manoeuvres separately; that is, Rubins' and/or Woods' screw manoeuvres [6,9,13]. One study [6] found low success rates of internal manoeuvres (Rubins' 10.8% and Woods' screw 9.4%); whilst another [13] found higher success rates of Rubins' (66.0%) and Woods' screw (72%). One study [9] did not assess success rates of Rubins' II manoeuvre but found success rates of Woods' screw to be 42.9%, with or without episiotomy.

The remaining four studies [4,5,7,8] used an overall description such as 'rotational' or 'fetal manipulation' and did not provide an assessment of which manoeuvre resolved the dystocia. One study [4] found rotational manoeuvres were successful in 20.2%; one [7] described success rates of rotational manoeuvres as 72% and another [8] as 80% success when used as a second manoeuvre or 77.0% success when used as a third manoeuvre. One study [5] found 100% success rate for fetal manipulation but there were only 14 cases in this study.

This review identified wide variations in success rates of delivery of the posterior arm between16.7% and 97% [4,6,7,9]. One study [13] reported success rates of 84.4% but the

terms posterior arm and posterior shoulder were used interchangeably and the procedure for delivering the posterior shoulder was not described which could affect the results. One study [8] did not mention delivery of the posterior arm; whilst another [5] described the internal manoeuvres as fetal manipulation with success rates of 100% but with no description of the manoeuvres.

Six studies reported varying success rates for McRoberts' and suprapubic pressure (25.8-93.8%) which were analysed in the following studies as one manoeuvre [4,5,6,7,8,9]. One [13] analysed McRoberts' and suprapubic pressure as separate manoeuvres and found 24.3% success with McRoberts' and 62.2% with suprapubic pressure.

The more manoeuvres that are required to resolve a shoulder dystocia, the worse the neonatal outcome [4,6,9,13]. Two of the studies [9,13] found the total number of manoeuvres used correlated with neonatal injury. One study [4] found significantly worse neonatal outcomes ($p<0.001$), BPI (1.4%) and fractures (0.9%), with the use of internal rotational and delivery of the posterior arm. One study [13] assessed the rate of HIE to be 5.9%.

Four studies reported neonatal injury rates associated with individual internal manoeuvres [4,6,7,13]. One [4] reported a similar risk of BPI with internal rotation and delivery of the posterior arm with relative risk ratios of 3.40 and 3.35 respectively when compared with McRoberts' and suprapubic pressure. Fracture risk was increased significantly with posterior arm delivery with a relative risk ratio of 6.83 versus 1.68 for internal rotation. One of the studies [4] used an overall score for neonatal injury and found a significant increase of injury with Woods' screw manoeuvre ($p=0.009$). This study [4] also assessed the rate of neonatal injury when shoulder dystocia followed an operative vaginal birth versus spontaneous vaginal birth and found increased rates of 22.8% versus 14.5% respectively. Another study [7] found no increase in injuries with internal manoeuvres in addition to McRoberts' and suprapubic pressure ($p=0.334$). One study [9] had compared injury rates associated with McRoberts' and suprapubic pressure with and without internal manoeuvres but did not individualise internal manoeuvres. A composite score for neonatal injury was used in one study [6] and found increased odds ratio for both with delivery of the posterior arm and increased neonatal depression with Woods' screw manoeuvre. However, these findings were not statistically significant when adjusted for nulliparity and duration of the dystocia.

The duration of the dystocia correlates with worsening neonatal outcome [6,9,13] with the median duration of the shoulder dystocia increasing with the use of an increasing number of manoeuvres ($p<0.01$) [6].

Table 2.2 Results

Author and Date	• Study Design • Number of Subjects (n=) • Aim(s) of the Study	Main Outcome Measures	• Confounding Factors • Definition of SD	Findings	• Reviewers Critique • Quality Score
Michelotti et al. (2018)	• Retrospective cohort of term singleton cephalic births with or without shoulder dystocia. • 2540 • Assess the effect the manoeuvres used had on neonatal injury and maternal morbidity.	APGAR <3 @ 5mins Significant acidosis NICU admission BPI Fractures Death Lengthy hospital stay PPH Perineal trauma	• Maternal age • Parity • Diabetes • BMI • Gestation • Induction of labour • Duration of 2nd stage • Instrumental delivery • Fetal gender • Vaginal birth with additional manoeuvres beyond that of normal traction on the fetal head to effect delivery of the shoulders	Success of manoeuvres (calculated on the assumption that all clinicians followed the guideline of a sequence of manoeuvres (McR – SPP – Rotation – Posterior arm): • McR & SPP: 1957/2540 = 77% • Rotational manoeuvres: 20.2% • Posterior arm delivery: 329/447 = 70.7% Associated neonatal outcomes: • Apgar <3 @ 5mins and acidosis (p<0.001) • BPI 1.4% • Fractures 0.9% • Worsening outcomes with internal rotation and delivery of posterior arm (p<0.001) Associated maternal outcomes: • PPH (p<0.001)	• Possibility of bias by clinician entering data as how the data were extracted was not described. Success rate of manoeuvres not clearly stated in the paper and calculated on an assumption of clinicians practice. Supporting data not given for the trend of worsening injury with increasing number of manoeuvres. Appropriate confounders were examined except for the prolonged first stage and use of epidurals. The authors aims were achieved • **8/9**
Gachon et al. (2016)	• Retrospective review of clinical records of births with documented shoulder dystocia. • 227 • Compare severe maternal and neonatal morbidities when shoulder dystocia managed with or without fetal manipulation (internal manoeuvres).	Maternal: • Episiotomy • OASI Neonatal • Apgar <5 at 7 mins • Arterial cord pH < 7.1 • Permanent BPI	• BMI • Parity • Birthweight • Instrumental delivery • Additional manoeuvres required beyond the "usual management for delivery are required to complete a vaginal vertex delivery"	Incidence of SD: 2.4% Success of manoeuvres: • McR and SPP: 213/217 = 93.8% • Fetal manipulation: 14/14 = 100% Neonatal outcomes: No statistically significant differences in severe neonatal morbidity between the groups. Fetal manipulation not associated with neonatal injury. Maternal outcomes:	• No description of how data were collected; potential bias cannot be assessed. Data recorded by clinician involved – possibility of bias. Medical records include a standardised description of shoulder dystocia which should reduce risk of bias on data collection. Internal manoeuvres not individually described. The only fetal manipulation mentioned is delivery of the posterior arm. Only 4 confounding factors included.

Author and Date	• Study Design • Number of Subjects (n=) • Aim(s) of the Study	Main Outcome Measures	• Confounding Factors • Definition of SD	Findings	• Reviewers Critique • Quality Score
				High incidence of OASIS with fetal manipulation.	Very high success rates of rates of McR an SPP suggests less severe SD. Poor evidence for effectiveness of manoeuvres. • **5/8**
Spain et al. (2015)	• Retrospective cohort of clinically diagnosed shoulder dystocia requiring obstetric manoeuvres. • 231 • Examine the independent effects of each internal manoeuvre used in the management of SD as compared to McR and SPP alone on the risk of neonatal morbidity.	Neonatal morbidity: • Clavicular or humeral fracture • APGAR <7 at 5 mins • Arterial cord pH <7.1 • IPPV • Intubation RDS	• Gestation • Nulliparity • Advanced maternal age • Ethnicity • BMI • Diabetes • Regional anaesthesia • Instrumental delivery • Birthweight • Median duration of shoulder dystocia • A delivery that requires additional manoeuvres following failure of gentle downward traction to effect delivery of the shoulders	57.9% success with McR +/- SPP The median duration of shoulder dystocia increased with the use of an increasing number of manoeuvres ($p<0.01$). Neonatal injury occurred in exposure to the following: • McR and SPP alone: 5.8% • Posterior arm: 16.7% • Rubin's manoeuvre: 10.8% • Wood's manoeuvre: 9.4% Composite neonatal injury: • McR and SPP: 22.2% • Posterior arm: 16.7% • Rubin's manoeuvre: 36.1% • Wood's manoeuvre: 39.6% Babies who suffered neonatal depression had longer HBDI. Difference in neonatal morbidity rates for each manoeuvre not statistically significant when adjusted for nulliparity and duration of dystocia. The longer the SD the greater the risk of neonatal morbidity.	• No information about who extracted the data. No mention of axillary traction. Length of 1st of 2nd stage, labour induction or augmentation not included as possible confounding factors. Overall a good study for success rates of McR +/- SPP and neonatal outcomes and demonstrating the neonatal outcomes for internal manoeuvres and increased head to body delivery interval (HBDI). • **8/9**

Author and Date	• Study Design • Number of Subjects (n=) • Aim(s) of the Study	Main Outcome Measures	• Confounding Factors • Definition of SD	Findings	• Reviewers Critique • Quality Score
Hoffman et al. (2011)	• Retrospective review of clinical records. • 2018 • Assess the efficacy of the manoeuvres used to resolve SD. Assess the effect the manoeuvres have on neonatal injury when SD occurs.	Successful manoeuvre leading to delivery of the baby. Neonatal injury attributable to the management of SD: • BPI (Erb's or Klumke palsy) • Hypoxic Ischaemic Encephalopathy (HIE) Nonintentional fracture of clavicle or humerus.	• Age • Race • Parity • Birthweight • Body Mass Index (BMI) • Diabetes • Epidural • Instrumental delivery • Duration of 2nd stage • Either additional manoeuvres or documented head to body delivery time of 60 secs or greater.	Incidence of SD: 1.5% (definition included HBDI of 1 min or more and/or the need for additional obstetric manoeuvres). Success rates: • McR: 24.3% • SPP: 62.2% • Internal manoeuvres: ○ Rubin's 66.0% ○ Woods screw 72% • Posterior shoulder 84.4% Neonatal injury: • BPI 63.4% • HIE 5.9% • Fractures 40.6% Increased rate of neonatal injury after operative vaginal delivery v spontaneous (22.8% v14.5%). The total number of manoeuvres correlated with the rate of neonatal injury.	• Description of how data were extracted not given. The procedure for delivering the posterior shoulder was not identified. Confusion as the terms 'delivery of the posterior arm' and 'delivery of the posterior shoulder' are used interchangeably. Labour induction, augmentation and length of the 1st stage not included as potential confounders. The data presented supported the authors conclusions. • **8/8**
Leung et al. (2011)	• Retrospective review of clinical records. • 205 • Evaluate the different types and sequences used to overcome shoulder dystocia and the rates of associated fetal injury.	Success rates between McR, rotational methods and posterior arm delivery. BPI Fractured clavicle Fractured humerus	• Parity • Diabetes • Birthweight • Either additional manoeuvres or HBDI >1 min.	Success rates: • McR and SPP: 25.8% • Rotational manoeuvres: 72% • Posterior arm: 63.6%	• Low risk of bias as delivery data and outcomes checked by a second person and confirmed later following audit. Perinatal outcomes identified. Delivery of the posterior shoulder mentioned but no description available. Mostly Chinese women included therefore difficult to apply findings to other ethnicities. Overall good descriptive data on the number and order of manoeuvres used. • **7/8**

Author and Date	• Study Design • Number of Subjects (n=) • Aim(s) of the Study	Main Outcome Measures	• Confounding Factors • Definition of SD	Findings	• Reviewers Critique • Quality Score
Mackenzie et al. 2007	• Retrospective descriptive review of maternal and neonatal clinical records. • 514 • Investigate trends in incidence of SD. Investigate methods used to overcome SD and rates of maternal and neonatal morbidity	Incidence of SD Neonatal acidosis BPI Neonatal fractures PPH Perineal trauma	• Parity • Epidural • Labour induction • Length 1st stage • Length 2nd stage • Birthweight • Assisted delivery • Shoulder girdle dystocia during labour and delivery	Success rates: • McR: 45% success when used as first manoeuvre • Rotation of shoulders: 80% success when used as 2nd manoeuvre and 77% success when used as 3rd manoeuvre	• Possibility of bias as does not state who extracted neonatal data or if that person was blinded to the manoeuvres used. No mention of delivery of the posterior arm or axillary traction. High success rates of rotational manoeuvres may have been a result of persistence with those manoeuvres as posterior arm delivery does not appear to have been used. • **5/7**
Gherman et al. (1997)	• Retrospective review of shoulder dystocia. • 236 • Determine success rates of McR. Compare rate of maternal and neonatal morbidity associated with those that required additional manoeuvres. Assess those factors associated with successful McR.	Maternal • 4th degree laceration • PPH Neonatal: • APGAR <3 at 5 mins • Clavicular or humeral fracture • BPI	• Maternal age • Parity • Diabetes • Maternal weight • Gestation • Birthweight • Epidural • Induction • Augmentation • Duration of 2nd stage • Duration of active phase • Instrumental delivery • Additional manoeuvre required after gentle downward traction and episiotomy required for delivery of the shoulders	• McR successful: 41.5% • McR +/- SPP and/or episiotomy successful: 54.2% • Woods +/- episiotomy successful: 42.9% • Posterior arm delivery: 97.0% • BPI: McR only: 10.2% McR + other manoeuvres: 19.6%	• There were more than expected BPI and PPH in the group requiring internal manoeuvres, but this was not statistically significant at the 5% level. Possibility of bias as does not state who extracted neonatal data or if that person was blinded to the manoeuvres used. No mention of axillary traction. • **7/7**

2.4.6 Discussion

Research about success rates of internal manoeuvres used to resolve shoulder dystocia is both retrospective and limited. It would not be feasible to undertake a randomised controlled trial (RCT) because of the ethics of gaining consent for different manoeuvres when managing an uncommon complication and the need to resolve the dystocia with the restriction of one defined set of manoeuvres as an RCT would require.

The definition of shoulder dystocia most commonly used in the literature is 'additional manoeuvres beyond normal traction on the fetal head are used to effect delivery of the shoulders' [4,5,6,8,9,13]. The manoeuvres could be either internal, external, or a combination of both which obscures the overall effectiveness of individual manoeuvres. Some authors included a HBDI of 60 seconds or more [7,13] but when the head is born it is common practice to wait for the next contraction before attempting delivery of the shoulders which is often more than one minute. The use of this definition may result in an increase in the reported rates of shoulder dystocia which could affect the reported success rates of manoeuvres.

The review identified McRoberts' and suprapubic pressure are the most commonly used manoeuvres and usually employed first [4,5,7,13], but the order of these manoeuvres is often not recorded. The success rates of McRoberts' and suprapubic pressure are often presented as one manoeuvre [4,7]. There are wide variations in the reported success rates of McRoberts' and suprapubic pressure from 5.8% [5,6]. A lower threshold of diagnosis of shoulder dystocia (e.g., the use of head to body delivery interval (HBDI) of 60 secs or more may result in a higher incidence of shoulder dystocia and higher success rates of the first manoeuvre used [4]. One study [4] reported an incidence of 5.3% with a 77 % success rate of McRoberts' and suprapubic pressure. Conversely, another study [7] reported lower incidence rates of shoulder dystocia (0.34%) and success rates of 25.8% for McRoberts' and suprapubic pressure so their threshold for diagnosis of shoulder dystocia may have been higher.

Reported high success rates of McRoberts' and suprapubic pressure maybe associated with higher incidences of BPI and clavicular fracture. One study [5] reported high success rates but also described a high incidence of BPI. The BPI and clavicular fractures occurred only in the McRoberts' and suprapubic pressure groups which suggests that although persistence with these manoeuvres may give a higher success rate it may be at the cost of more neonatal trauma. Another study [7] found in a small number of cases managed by lateral traction alone, BPI was at its highest, which suggests the use of forceful lateral traction on the fetal head is associated with BPI.

Internal rotational manoeuvres and delivery of the posterior arm are commonly used when McRoberts' and suprapubic pressure fail but often have worse neonatal outcomes [4]. Higher BPI rates have been found with internal rotation [4,6], whilst humeral fractures were significantly higher with delivery of the posterior arm [4,7].

Research assessing the success of individual internal rotational manoeuvres of Rubins' and Woods' screw manoeuvres, have reported varying success (Rubins' 10.8-66.0%; Woods' screw 9.4-72%) [6,9,13]. Success rates of these manoeuvres could be influenced by either the severity of the shoulder dystocia or the experience of the practitioner.

There was conflicting evidence for the success of internal rotation. One study [4] reported low success for internal rotation whilst another [13] reported higher success but found delivery of the posterior arm was more successful than internal rotation. The overall BPI rate was found to be significantly higher with internal rotation than with delivery of the posterior arm [13]. None of the studies had success rates of manoeuvres as planned outcomes and so the influence of confounding factors was not assessed.

Maternal and neonatal injury appears to increase with the number of manoeuvres used to resolve shoulder dystocia [4,13]. Additional manoeuvres were found to have led to higher rates of neonatal morbidity as well as more neonatal depression in longer HBDI [6]. It could be argued that the severity of the shoulder dystocia is associated with the increased neonatal morbidity rather than the manoeuvres themselves, as the more severe the shoulder dystocia, the greater the number of manoeuvres required and the longer the HBDI interval will be.

No studies in this review mentioned axillary traction. One study [13] discussed delivery of the posterior shoulder and reported high rates of success rates with no associated neonatal injury. The authors suggest that delivery of the posterior shoulder should be the first manoeuvre considered after McRoberts' and suprapubic pressure but do not describe the method to be used. It could be similar to axillary traction, as described in the qualitative article previously mentioned [12], but as no description of how the shoulder was delivered this remains unclear.

2.4.7 Limitations of the Literature Review

All of the studies were retrospective studies. The definition and diagnosis of shoulder dystocia differs between studies which could affect outcomes. Also, in some studies the manoeuvres were not well described and the terms 'delivery of the posterior arm' and 'delivery of the posterior shoulder were used interchangeably. Axillary traction was not mentioned in any of the studies, but it is possible this was the method used when the authors referred to delivery of the posterior shoulder.

2.4.8 Conclusion

Only seven studies reported success rates of internal manoeuvres in their research, and the wide variations of success rates highlight the lack of evidence in relation to the management of shoulder dystocia when an internal manoeuvre is required.

There is conflicting evidence regarding success rates and morbidity associated with individual manoeuvres used to resolve shoulder dystocia. Internal rotation is more successful than McRoberts and suprapubic pressure but is associated with higher rates of BPI. Delivery of the

posterior arm appears to be more successful than internal rotation, but humeral fractures were higher in this group.

There is evidence that the more manoeuvres that are required and the longer the HBDI, the worse the neonatal outcomes. One of the studies found high success rates and no neonatal injuries when delivery of the posterior shoulder was used [13]. Unfortunately, the authors gave no clear description of how that was performed but it may have been axillary traction as described in the 2012 qualitative study [12]. The manoeuvre of axillary traction therefore warrants more investigation.

The use of the most successful and first internal manoeuvre should be the primary focus of future research in order to reduce neonatal morbidity and mortality.

2.4.9 References

1. Gherman, R., Chauhan, S., Ouzounian, J. G., Lerner, H., Gonik, B., & Goodwin, T. (2006). Shoulder dystocia: The unpreventable obstetric emergency with empiric management guidelines. *American Journal of Obstetrics and Gynecology, 195*(3), 657-672. doi:10.1016/j.ajog.2005.09.007
2. Royal College of Obstetricians & Gynaecologists (RCOG). (2012). *Shoulder dystocia. Guideline no. 42.* London, UK: RCOG.
3. Gherman, R. (2002). Shoulder dystocia: An evidence-based evaluation of the obstetric nightmare. *Clinical Obstetrics & Gynecology, 45*(2), 345-362. doi:10.1097/00003081-200206000-00006
4. Michelotti, F., Flatly, C., & Kumar, S. (2018). Impact of shoulder dystocia, stratified by type of manoeuvre, on severe neonatal outcome and maternal morbidity. *Australia & New Zealand Journal of Obstetrics and Gynaecology, 58*(3), 298-305. doi:10.1111/ajo.12718
5. Gachon, B., Desseauve, D., Fritel, X., & Pierre, F. (2016). Is fetal manipulation during shoulder dystocia management associated with severe maternal and neonatal morbidities? *Archives of Gynecolgy & Obstetrics, 294*, 505-509. doi:10.1007/s00404-016-4013-1
6. Spain, J., Frey, H., Tuuli, M., Colvin, R., Macones, G., & Cahill, A. (2015). Neonatal morbidity associated with shoulder dystocia maneuvers. *American Journal of Obstetrics and Gynecology, 212*(3), 353, e1-5. doi:10.1016/j.ajog.2014.10.001
7. Leung, T., Stuart, O., Sahota, D., Suen, S., Lau, T., & Lao, T. (2011). Head-to-body delivery interval and risk of fetal acidosis and hypoxic ischaemic encephalopathy in shoulder dystocia: A retrospective review. *British Journal of Obstetrics & Gynaecology, 118*(4), 474-479. doi:10.1111/j.14710528.2010.02834.x
8. MacKenzie, I., Shah, M., Lean, K., Dutton, S., Newdick, H., & Tucker, D. (2007). Management of shoulder dystocia. *American Journal of Obstetrics and Gynecology, 5*, 1059-1068. doi:10.1097/01.AOG.0000287615.35425.5c
9. Gherman, R., Goodwin, T., Souter, I., Neumann, K., Ouzounian, J., & Paul, R. (1997). The McRoberts' maneuver for the alleviation of shoulder dystocia: How successful is it? *American Journal of Obstetrics and Gynecology, 176*(3), 656-661. doi:10.1016/s0002-9378(97)70565-9
10. American Journal of Obstetricians & Gynecologists (ACOG). (2002). *Shoulder dystocia. Practice pattern no. 40.* Washington DC: ACOG.
11. Chauhan, S. P., Laye, M., Lutgendorf, M., McBurney, J., Keiser, S., Magann, E., & Morrison J. A. (2014). Multicenter assessment of 1,177 cases of shoulder dystocia: Lessons learned. *American Journal of Perinatology, 31*(5), 401-406. doi:10.1055/s-0033-1350056

12. Ansell (Irving), L., McAra-Couper, J., & Smythe, E. (2012). Shoulder dystocia: A qualitative exploration of what works. *Midwifery, 28*(4), 461-468. doi:10.1016/j.midw.2011.05.007

13. Hoffman, M., Bailit, J., Branch, D., Burkman, R., Van Veldhusien, P., Lu, L., Kominiarek, M., Hibbard, J., Landy, H., Haberman, S., Wilkins, I., Gonzalez Quintero, V., Gregory, K., Hatjis, C., Ramirez, M., Reddy, U., Troendle, J., & Zhang. J. A. (2011). Comparison of obstetric maneuvers for the acute management of shoulder dystocia. *American Journal of Obstetrics and Gynecology, 117*(6), 1272-1278. doi:10.1097/AOG.0b013e31821a12c9

Chapter Three: Manuscript 2
Axillary Traction: An Effective Method of Resolving Shoulder Dystocia

3.1 Introduction

This chapter presents the research approach used to conduct a retrospective study undertaken to identify the effectiveness of the internal manoeuvres currently used to resolve shoulder dystocia. A declaration of author contributions is included. This study has been published in the *Australia and New Zealand Journal of Obstetrics and Gynaecology* (ANZJOG) (Ansell et al., 2109) and is presented in this chapter in the format required for that journal (Appendix C). This article was peer reviewed prior to publication (Appendix D). The purpose of peer review is evaluation of work by those with similar competences. It is used to maintain quality standards, provide credibility, and ensure that the research is robust by validating the integrity of the research so that the delivery of health care and safety is improved (Gregory & Denniss, 2019).

Publication creates further opportunities for peer review and interaction. Positive feedback has been received which adds to the robust nature of this research. Initial feedback following publication describes this article as one of the best articles that the journal has published in years, stating: “I congratulate them (the authors) on a very valuable clinical contribution to obstetrics and more than that I admire them… it takes courage to challenge the norms set by your peers.” (Appendix E)

Further feedback from an obstetrician stated, “I found it very in formative and helpful…. it seems an ‘easy’ technique to use in an emergency situation, and so I would like to educate our Registrars and Midwives in it” (Appendix F). The obstetrician also required clarification on the amount of traction that could be used and whether an episiotomy was of value in such cases. This was responded to accordingly by return email (Appendix F).

3.2 Research Approach

The second step of the research process was to undertake a quantitative study into the effectiveness of axillary traction as a method of resolving shoulder dystocia. The methods and methodology are described in detail in the article that follows. The reason for undertaking this study was to generate new knowledge on to how manage shoulder dystocia and validate the findings of the previously published qualitative research study (Ansell et al., 2012). Quantitative research is a systematic investigation which focuses on generating numerical data that can be transformed into usable statistics with results that can be generalised to a larger population (Given, 2008). The findings from quantitative research can be predictive, explanatory, and confirming (Leedy & Ormrod, 2001); hence, this method was used to provide evidence to those who required statistical (quantitative) data rather than qualitative evidence alone.

Manuscript 2 - Axillary Traction: An Effective Method of Resolving Shoulder Dystocia

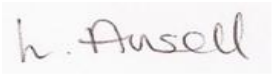
Following Ansell et al.'s (2012) qualitative study, axillary traction became a commonly used internal manoeuvre for the management of shoulder dystocia at Counties Manukau Health (CMH). In order to provide statistical analysis of the effectiveness of axillary traction, compared to other internal manoeuvres, a retrospective review of the clinical records for mother and baby for all labours complicated by shoulder dystocia was carried out for an eight-year period. The study was retrospective because shoulder dystocia is a childbirth emergency; therefore, treatment is required without the restriction of one set of manoeuvres as would be required by other research methods such as a randomised controlled trial (RCT). Ethics approval for the study was granted by the Southern Health and Disability Ethics Committee (HDEC); reference: 14/STH/154 (Appendix G).

3.3 Authors' Contributions

My contribution as the first author is under the guidance of Dr. Judith MaCara-Couper as principal supervisor and Dr. Peter Lamer as associate supervisor, who were involved in the supervision of ethics application and manuscript, and revisions prior to publication. Dr David Ansell and Dr Nicholas Garrett provided statistical analysis of the data. The article was co-authored as follows:

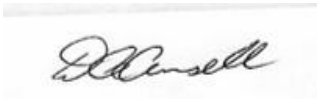
Principal Author: Lesley Ansell

Contribution: 80%. Collection and preparation of the data. Writing of the manuscript and suggested revisions in preparation for publication.

Signed …  …… Date……30th April 2020……

Co-Author: Dr David Ansell

Contribution: 10%. Statistical analysis of the data using Statistical Package for the Social Sciences (SPSS) version 24 (IBM, Armonk, NY, USA).

Signed……  Date……30th April 2020……

Co-Author: Associate Professor Judith McAra-Couper

Contribution: 4%. Supervision of the writing, provision of feedback, and formatting advice.

Signed……  …… Date……4th May 2020……

Co-Author: Associate Professor Peter Larmer

Contribution: 4%. Supervision of the writing, provision of feedback, and formatting advice.

Signed……  …… Date……4th May 2020……

Co-Author: Dr Nicholas Garrett

Contribution: 2%. Supervision of statistical analysis.

Signed……  Date……30th April 2020……

3.4 Published Article

3.4.1 Title

Axillary Traction: An Effective Method of Resolving Shoulder Dystocia.

3.4.2 Introduction

Shoulder dystocia is a childbirth emergency which has significant risks to fetal and maternal outcome.[1] Shoulder dystocia occurs when either one or both shoulders fail to enter the pelvic cavity.[2]

Current management of shoulder dystocia involves the use of various manoeuvre to alleviate the problem; yet there is a lack of randomised controlled trials (RCTs) or experiments that have directly compared their effectiveness. There are authors who recommend a well-coordinated sequence of manoeuvres such as those described by the HELPERR mnemonic,[3-5] but there is no clear evidence base for the order of use of these manoeuvres.[6,7]

A qualitative study carried out by Ansell et al.[8] suggested that axillary traction is a useful manoeuvre for the management of shoulder dystocia when and internal manoeuvre is required.

To perform axillary traction, the clinician's whole hand enters the posterior aspect of the pelvis. Regardless of which side the fetus is facing, the fetal shoulder is located and grasped by sliding the first finger under the axilla and placing the thumb on top of the shoulder. The second finger is placed alongside the fetal humerus to keep the arm firmly against the body. Traction is applied firmly and directly through the fetal axilla to follow the sacral curve until the posterior shoulder appears over the perineum while the anterior shoulder ‘pivots’ around the symphysis. Once the posterior shoulder is delivered then the anterior shoulder can easily be delivered by lateral traction (Figure 3.1). This manoeuvre differs from removal of the posterior arm as only the axilla is located rather than the elbow. No attempt is made to flex the fetal arm across the body. The fetal arm is held firmly against the body and no traction or pressure applied to the humerus or elbow. The aim is to deliver the posterior shoulder only rather than the whole arm.

The aim of this study was to assess the effectiveness of axillary traction when shoulder dystocia occurs. This retrospective review of the internal manoeuvres used in the management of shoulder dystocia is the first to document the use of axillary traction for a large number of women.

Enter posteriorly

Slide hand along fetal head to neck

Grasp posterior shoulder

Grasp:

Circle first finger and thumb around axilla

Second finger placed on top of arm

Keep arm firmly against chest and apply traction through axilla **only**

Apply **axillary traction** to follow the curve of the sacrum. Traction may need to be **very** significant.

Anterior shoulder 'PIVOTS' around symphysis – posterior shoulder delivered first.

Figure 3.1 Axillary traction.

3.4.3 Materials and Methods

A retrospective review of clinical records of women who experienced shoulder dystocia between 1 January 2006 and 31 December 2013 was conducted. All women gave birth within Counties Manukau Health (CMH), Auckland. Participants were identified from the hospital database Casemix.

The study was approved by the Southern Health and Disability Ethics Committee (HDEC), reference: 14/STH/154.

The inclusion criteria for the study were women with a singleton fetus, cephalic presentation beyond 34 weeks gestation, and who experienced shoulder dystocia during vaginal birth. Women with intrauterine fetal death before the onset of labour and major fetal abnormality were excluded.

Shoulder dystocia was defined as those women requiring more than the normal traction usually required or additional manoeuvres to effect delivery of the shoulders. There were a total of 52, 055 vaginal births during the study period. A total of 422 (0.81%) were identified as having shoulder dystocia.

The maternal and neonatal records of all women experiencing shoulder dystocia during the study period were reviewed by the lead author and an assistant. Information regarding the manoeuvres used to resolve the dystocia and the order in which the manoeuvres were employed were collected. McRoberts' and suprapubic pressure were treated as a single manoeuvre, and in CMH these manoeuvres are universally employed first. The final successful manoeuvre was identified.

There were three main groups of internal manoeuvres:

1. axillary traction which included all manoeuvres documented as axillary traction or removal of the posterior shoulder;
2. posterior arm delivery which was documented as such; and
3. internal rotational manoeuvres which included all manoeuvres documented as Woods' screw, reverse Woods' screw and/or internal rotation.

Maternal information included age, parity, ethnicity, body mass index (BMI), gestation, diabetes, induction of labour, augmentation of labour, epidural, normal vaginal birth, instrumental birth and type, length of the first stage and second stage of labour perineal trauma, and blood loss. Neonatal information included birthweight, APGAR score <7 at five minutes, brachial plexus injury (BPI), clavicular and humeral fractures, hypoxic ischaemic encephalopathy (HIE), and neonatal unit admission. Cord blood gas analysis results were not readily available during the study period; therefore, they were unable to be collected.

Data were collected onto a Microsoft Excel spreadsheet which was then analysed using the Statistical Package for the Social Sciences (SPSS) version 24 (IBM, Armonk, NY, USA). Demographic and clinical data for the three internal manoeuvre cohorts were compared. Categorical data were compared using $\chi 2$ and Fisher's exact tests. Continuous data were compared using Student's t test (normal distribution) or Mann–Whitney or Kruskall–Wallace test for non-normal distributions. Where differences between the cohorts were noted with categorical data, the success rates of the internal manoeuvres were compared using $\chi 2$ tests or Fisher's exact test.

3.4.4 Results

Data were collected for the 422 women whose births were complicated by shoulder dystocia at CMH for the period 1 January 2006 to 31 December 2013 (inclusive). The incidence of shoulder dystocia increased from 0.54% of all vaginal births in 2006 to 1.26% in 2013 with the average rate of shoulder dystocia over the study period being 0.81%.

Of the 422 women who experienced shoulder dystocia, a total of 226 required internal manoeuvres to resolve the problem (53.6%). The first internal manoeuvre used was as follows:

1. axillary traction in 119 women (52.7%)
2. posterior arm delivery in 49 women (21.7%)
3. rotational manoeuvres in 58 women (25.7%)

There were no significant differences in age, BMI, parity, gestation, ethnicity, incidence of diabetes, labour induction rates, syntocinon augmentation rates, epidural use, length of the first stage and birthweight across three cohorts (Table 3.1). The axillary traction cohort was less often preceded by ventouse than the posterior arm delivery and rotational manoeuvres cohort (p=0.03). The overall success rate of the first internal manoeuvre was no different if the ventouse was used or not (p=0.56). Labour induction rates between the cohorts neared statistical significance (p=0.07) but the overall success rate of the first internal manoeuvre was no different if it was preceded by labour induction (χ^2 p=0.59). Only 13 women had forceps deliveries with no statistically significant difference between the cohorts (p=0.13), and the overall success rate of the first internal manoeuvre was no different if it was preceded by forceps delivery (p=0.71). Length of the second stage of labour was significantly different between the cohorts (p=0.03) with the posterior arm delivery cohort having a median second stage 26 minutes longer than the axillary traction cohort and 1 minute longer than the rotational manoeuvres cohort. Again, the distribution of the length of the second stage was no different if the first internal manoeuvre was successful or not (p=0.025). Median length of the first stage was not significantly different for the three cohorts (p=0.19).

Table 3.1 Demographics and clinical characteristics of first internal manoeuvre cohorts

	Axillary traction	Posterior arm delivery	Rotational manoeuvres	P-value
Characteristics				
Age, years, median	29.0	31.0	28.0	0.26†
Body mass index, median	30.2	28.1	31.8	0.70†
Parity				
Nulliparous	35 (29.4%)	19 (38.8%)	18 (31.0%)	0.49
Multiparous	84 (70.6%)	30 (61.2%)	40 (69.0%)	
Gestation, weeks, median	40.1	40.1	40.0	0.50†
Ethnicity				
European	22 (18.5%)	14 (28.6%)	9 (15.6%)	0.15
Māori	10 (8.4%)	5 (10.2%)	11 (19.0%)	
Pacifica	44 (37.0%)	9 (18.4%)	20 (34.5%)	
Indian	21 (17.6%)	13 (26.5%)	9 (15.5%)	
Chinese	5 (4.2%)	4 (8.2%)	3 (5.2%)	
Other	17 (14.3%)	4 (8.2%)	6 (10.3%)	
Diabetes				
Type 1	0	1 (2.0%)	0	0.40‡
Type 2	2 (1.7%)	2 (4.1%)	3 (5.2%)	
Gestational diabetes	11 (9.2%)	6 (12.2%)	7 (12.1%)	
Labour characteristics				
Labour induction	21 (17.6%)	16 (32.7%)	10 (17.2%)	0.07
Syntocinon augmentation	34 (28.6%)	19 (38.8%)	15 (25.9%)	0.30
Epidural	25 (21.0%)	14 (29.2%)	15 (25.9%)	0.50
Forceps delivery	5 (4.2%)	6 (12.2%)	2 (3.4%)	0.13‡
Ventouse delivery	23 (19.3%)	20 (40.8%)	16 (27.6%)	0.03
Length of first stage, h, median	5.875	6.0	6.75	0.19†
Length of second stage, min, median	33.0	59.0	40.5	0.03†
Birth weight, g, median	4060	4080	4090	0.77†

†Kruskall–Wallace test.
‡Fisher exact test.

Axillary traction was used as a second internal manoeuvre for 14 women (Table 3.2), posterior arm delivery as a second manoeuvre for 14 women and rotational manoeuvres for 10 women. Overall, there was no significant difference in the success rates of the different second manoeuvres (p=0.71).

Overall, there was a highly significant difference (p<0.001) in the success rates of the first used internal manoeuvres (Table 3.2). In 119 (52.7%) cases the first internal manoeuvre used was axillary traction. This was successful in 114 cases (95.8%) and no further manoeuvres were required. Of the five which failed with axillary traction as the first internal manoeuvre, three were successfully delivered with the second use of axillary traction by a different practitioner, one with rotational manoeuvres and one with rotational manoeuvres followed by posterior arm delivery. The success rate of axillary traction as a first internal manoeuvre was significantly greater than that for rotational manoeuvre (p<0.001) and posterior arm delivery (p=0.025). In 49 (21.7%) cases posterior arm delivery was used as the first internal manoeuvre and was successful in 42 (85.7%) cases. In the seven cases where posterior arm delivery failed, one was delivered with a second attempt of the posterior arm, four with rotational manoeuvres and two with axillary traction. The success rate of use of posterior arm delivery was significantly less than that of use of axillary traction (p=0.025) but much higher than that of rotational manoeuvres (p<0.01). A third internal manoeuvre was required for just seven women; again, there being no significant difference in success rates (p=0.52).

Table 3.2 Success rates of the first three internal manoeuvres used

	Success n (%)	Failure n (%)	Total n	P-value
First manoeuvre				
Axillary traction	114 (95.8)	5 (4.2)	119	<0.001
Posterior arm	42 (85.7)	7 (14.3)	49	
Internal rotation	28 (48.3)	30 (51.7)	58	
Total	184 (81.4)	42 (18.6)	226	
Second manoeuvre				
Axillary traction	12 (85.7)	2 (14.3)	14	0.71†
Posterior arm	11 (78.6)	3 (21.4)	14	
Internal rotation	7 (70.0)	3 (30.0)	10	
Total	30 (78.9)	8 (21.1)	38	
Third manoeuvre				
Axillary traction	4	1	5	0.52†
Posterior arm	1	0	1	
Internal rotation	0	1	1	
Total	5	2	7	

†Fisher exact test.

There were no significant differences in neonatal and maternal complication rates between those managed without internal manoeuvres and those requiring any internal manoeuvres except for BPI. All BPI were Erb's palsies and all but five had recovered before hospital discharge. Axillary traction had been used for only one of these babies and all had recovered by three months of age (Table 3.3).

Table 3.3 Complications with and without internal manoeuvres

	No internal manoeuvres	Any internal manoeuvres	p-value
Neonatal:			
APGAR <7 at 5mins	8 (4.1%)	16 (7.1%)	0.18
Brachial plexus injury	15 (7.7%)	37 (16.4%)	0.02
Clavicle fracture	3 (1.5%)	3 (1.3%)	0.72 (a)
Humerus fracture	1 (0.5%)	5 (2.2%)	0.22 (a)
Hypoxic Ischaemic Encephalopathy:			0.28 (a)
Grade 1	0	2	
Grade 2	0	0	
Grade 3	1	1	
Neonatal Unit admission:	22 (11.3%)	34 (15.0%)	0.26
Maternal:			
Blood loss (mL):			0.90 (b)
Mean	477	458	0.35
Perineum:			
Episiotomy	41 (21.1%)	63 (28.8%)	
Second degree laceration	57 (29.4%)	51 (23.3%)	
Third/Fourth degree laceration	18 (9.3%)	16 (7.3%)	

†Fisher exact test.
‡Kruskall–Wallace test.

There were no significant differences in the complication rates (Table 3.4) of the different first manoeuvres in relation to perineal trauma (p=0.36), total neonatal birth injuries (p=0.39), and neonatal nerve palsies (p=0.70). There were just three recorded cases with HIE.

Table 3.4 Complications associated with internal manoeuvres

	Axillary traction	Posterior arm delivery	Rotational manoeuvres	p-value
Neonatal:				
APGAR < 7 at 5 mins	1 (0.8%)	3 (6.1%)	12 (20.1%)	<0.001(a)
Brachial plexus injury	17 (14.3%)	10 (20.4%)	10 (17.2%)	0.70
Clavicular fracture	3 (2.5%)	0	0	0.15 (a)
Humerus fracture	1 (0.8%)	1 (2.0%)	3 (5.3%)	0.21(a)
Hypoxic Ischaemic Encephalopathy:				0.59(a)
Grade 1	2	0	0	
Grade 2	0	0	0	
Grade 3	0	0	1	
NNU admission	18 (15.1%)	6 (12.2%)	10 (17.2%)	0.7
Maternal:				
Blood loss (mL)				0.03 (b)
Mean	373	560	546	
Perineum				0.36(a)
Episiotomy	28 (22.2%)	21 (43.8%)	14 (24.1%)	
Second degree tear	24 (20.9%)	13 (22.9%)	16 (27.6%)	
Third/fourth degree tear	9 (7.8%)	3 (6.3%)	4 (6.9%)	

†Fisher exact test.
‡Kruskall–Wallace test.
NNU, neonatal unit

3.4.5 Discussion

Management of shoulder dystocia involves the use of both internal and external manoeuvres to overcome the problem; yet there is a lack of RCTs to compare their effectiveness. Such trials would not be feasible because of the difficulty in obtaining informed consent from all women for different manoeuvres when managing an uncommon complication of vaginal birth. Furthermore, every measure possible to resolve the problem is required without the restriction of one defined set of manoeuvres as would be required with a RCT. The internal manoeuvres currently used to resolve shoulder dystocia, therefore, have been implemented largely because of case reports, individual practitioner experience and expert opinion. [9,10]

Mackenzie et al.[11] report increasing rates of shoulder dystocia with a trend of 0.3% per year. The rates of shoulder dystocia in the current study were seen to increase from 0.54% in 2006 to 1.26% in 2013. This is an increasing trend of 0.12% per year, comparable with the study by Mackenzie et al.[11]

The average BMI in the study population was 30.87 which is categorised as obese[12] and there is evidence that maternal obesity and fetal macrosomia is associated with shoulder dystocia. [13,14] The results of this study show that axillary traction show that axillary traction was a highly

successful manoeuvre when used as the first internal manoeuvre (95.8%) and no further manoeuvres were required. Posterior arm delivery also had a significant success rate (85.7%) when used as the first internal manoeuvre but was not as successful as axillary traction. Posterior arm delivery was significantly more successful than rotational manoeuvres (48.3%) but neither manoeuvre was as successful as axillary traction.

The choice of the first internal manoeuvre was not affected by ethnicity, maternal age, BMI, maternal diabetes, gestation, labour induction, syntocinon augmentation, epidural, length of the first stage, forceps delivery, or birthweight. Posterior arm delivery was significantly more likely to be the first manoeuvre used in women who had longer second stage or ventouse delivery.

Shoulder dystocia is associated with birth injuries such as BPI, skeletal fractures, birth asphyxia and neurological injury.[13,14] It is likely that the higher rate of BPI seen in the group managed by internal manoeuvres was due to the use of multiple manoeuvres and/or the severity of the shoulder dystocia.

In this study, axillary traction had been used for a large number of women with no evidence of increased adverse effects on the neonate. There was a slightly lower incidence of birth injuries in the axillary traction group, but this was not statistically significant. There were no statistical differences in the number or Erb's palsies and total birth injuries in any of the groups. From this case series, there is no indication that axillary traction increases the risk of BPI. Shoulder dystocia is associated with high rates of BPI[16] and is possibly related to excessive traction on the fetal head rather than the internal manoeuvres used to resolve the problem.[17] The amount of traction applied to the fetal head in all cases in the study population was unable to be assessed due to lack of documentation.

The results of this study show that axillary traction is a very effective manoeuvre for resolving shoulder dystocia with no increased adverse outcomes to the neonate and should be considered as the first-line management when an internal manoeuvre is required.

3.4.6 Benefits and Limitations of the Study

One of the main benefits of this study is that there were multiple ethnicities and high average BMI in the study population which means that the results are applicable to most women.

The limitations of the study are acknowledged. There was no consistency in the definition of shoulder dystocia and diagnosis was based on clinical judgement. However, as the cases of shoulder dystocia in the study population all required an internal manoeuvre to resolve the problem, there is an assumption that the shoulder dystocia was significant. The head to body delivery intervals were seldom recorded, so this measure, often used in diagnosis and assessing the severity of shoulder dystocia,[18] is not available. However, this measure of severity may not be applicable to this study population as it is usual practice to wait for the next contraction following birth of the head before attempting delivery of the shoulders.

Data collection was difficult because there was no formal method for documenting shoulder dystocia. It is possible that not all of the manoeuvres used have been recorded, with only the manoeuvre that resolved the shoulder dystocia being recorded. Even when a proforma was introduced in 2010 to capture the order of the manoeuvres used and the length of time each manoeuvre was attempted, it was often not complete, and methods of management were extracted from the clinical notes.

It is also unclear as the why the practitioner chose a particular manoeuvre as there were no clinical criteria s to when to use each manoeuvre. This may be related to individual practitioners who manage shoulder dystocia depending on their training and experience, or to the perceived difficulty of the shoulder dystocia. Resident Medical Officers who had worked in other hospitals may not have been exposed to axillary traction and may, therefore, have been more likely to use delivery of the posterior arm or rotational manoeuvres.

3.4.7 Conclusion

This retrospective study showed a significant increase in the rate of shoulder dystocia for women in the study period (0.54-1.26%). The reason for this increase is unknown but may be related to the high level of diabetes and obesity in the study population.

Axillary traction is found to be a highly successful manoeuvre when used as the first internal manoeuvre (95.8%). Removal of the posterior arm also had a significant success rate (85.7%) when used as the first internal manoeuvre but was not as successful as axillary traction but significantly more successful than internal rotation. There were slightly less birth injuries in the axillary traction group and, although not statistically significant, warrants further investigation

This study, therefore, provides good evidence that axillary traction has a high success rate and a low complication rate and can be used for all women. Axillary traction should be recommended as the first internal manoeuvre attempted when shoulder dystocia occurs.

3.4.8 References

1. Dajani NK, Magann EF. Complications of shoulder dystocia. Semin Perinatol 2014; 38:201-204.
2. Gherman RB. Shoulder dystocia: an evidence-based evaluation of the obstetric nightmare. Clin Obstet Gynecol 2002; 45:345–362.
3. Royal College of Obstetricians and Gynaecologists (RCOG). Shoulder dystocia, guideline no. 42. London: Guidelines and Audit Committee of RCOG; 2012.
4. Camune B, Brucker MC. An overview of shoulder dystocia: the nurse's role. Nurs Women's Health 2007; 11:488-498.
5. Advanced Life Support in Obstetrics (ALSO). Advanced life support in obstetrics. Course syllabus part I. USA: American Academy of Family Physicians; 2000.
6. American College of Obstetrics and Gynecology (ACOG). Shoulder dystocia. ACOG practice pattern no. 7. Int J Gynecol Obstet 1998; 60:306-313.
7. Simpson KR. Shoulder dystocia: nursing interventions and risk management strategies. Am J Matern Child Nurs 1999; 24:305-311.
8. Ansell Irving L, McAra-Couper J, Smythe E. Shoulder dystocia: a qualitative exploration of what works. Midwifery 2012; 28:461-468.
9. Taddei E, Marti C, Capoccia-Brugger R, Brunisholz Y. Posterior axilla sling traction and rotation. A case report of an alternative for intractable shoulder dystocia. J Obstet Gynaecol 2017; 37:387-389.

10. Schramm M. Impacted shoulders – a personal experience. Aust NZ J Obstet Gynaecol 1983; 108:755-757.
11. MacKenzie IZ, Shah M, Lean K et al. Management of shoulder dystocia: trends in incidence and maternal and neonatal morbidity. Obstet Gynecol 2007; 110:1059-1068.
12. Ministry of Health (MoH). Report on maternity 2015. Wellington: Ministry of Health; 2017.
13. Zhang C, Wu Y, Li S, Zhang D. Maternal pre-pregnancy obesity and the risk of shoulder dystocia: a meta-analysis. Br J Obstet Gynaecol 2018; 125:407-413.
14. Dodd JM, Catcheside B, Scheil W. Can shoulder dystocia be reliably predicted? Aust NZ J Obstet Gynaecol 2012; 52:248-252.
15. Iffy L, Brimacombe M, Apuzzio JJ et al. The risk of shoulder dystocia related permanent fetal injury in relation to birth weight. Eur J Obstet Gynecol Reprod Biol 2008; 136:53-60.
16. Gherman RB, Chauhan S, Oh C, Goodwin M. Brachial plexus palsy. Fetal Matern Med Rev 2005; 16:221-243.
17. Sentilhes L, Sénat MV, Boulogne AI et al. Shoulder dystocia: guidelines for clinical practice from the French College of Gynecologists and Obstetricians (CNGOF). Eur J Obstet Gynecol Reprod Biol 2016; 203:156-161.
18. Spong CY, Beall M, Rodriques D, Ross MG. An objective definition of shoulder dystocia: prolonged head-to-body delivery intervals and/or use of ancillary obstetric maneuvers. Obstet Gynecol 1995; 86:433-436.

Chapter Four: Manuscript 3
Changing Practice in Shoulder Dystocia

4.1 Introduction

This chapter presents the manuscript '*Changing Practice in Shoulder Dystocia*'. In the prelude of this chapter, I present the research methodology used to write the narrative of my own personal journey which has led to a change in practice in how shoulder dystocia is managed, particularly in New Zealand. This narrative has been accepted for publication in *The Practicing Midwife* and is presented in this chapter in the format required for that journal. The email acceptance of this article states, "this work is an excellent example of 'research in action' with great applicability to clinical practice" (Appendix A). A declaration of authors' contributions is also included.

4.2 Research Approach

The third step of this research project was the writing of a qualitative narrative which allows the reader to capture the rich data within stories. The purpose of a writing a narrative is to describe my own personal and professional learning experiences which has ultimately led to a change in practice in how to manage shoulder dystocia. This description is based on the events that have happened throughout my own personal and professional journey. This is not just a simple description; however, rather an exploration of what happened and what can be learned. The focus is on how individuals or groups make sense of events and actions in their lives through examining the story (Riessman, 1993).

As a method, this narrative begins with my own experiences expressed in a lived and told story. The procedure of implementing this research method focuses on the chronological reporting and meaning of the individual's experience (Czarniawska, 2004). This narrative describes the problem of shoulder dystocia and how that problem came about. The story of my own reflection of practice is highlighted when I realised that I needed to navigate a complex problem which had arisen in my own clinical practice which was not able to be resolved by the traditionally taught techniques (Schön, 1991). Schön (1991) described how practitioners face a crisis in confidence in such situations and the narrative highlights the crisis I faced. Reflection and challenging current practices has been described as the hallmark of professional behaviour. (Shepard & Jensen, 2002)

The narrative also describes how the process of innovation began (Byers, 2017; White, 2011), as I believed I had identified a gap in evidence-based practice and was passionate about improving the quality of care. The process of critical thinking which requires scientific analysis and evaluation and is self-directed and self-disciplined (Ennis, 1962), is evident in the narrative as the process of the discussions, research, and change process in clinical practice is described.

This narrative, however, is not just simple description. It is an exploration of what happened, what emerged, what was learned, and how it informed the next step. The events occurring throughout my own personal journey are an example of the new emerging fourth paradigm of research where qualitative and quantitative approaches conjoin, and more flexible real time data are presented (Rapport & Braithwaite, 2018). This approach adds available and emerging data from a wide range of sources to the traditional methods of data collection in order to present a more clear and complete picture. As a result, research occurs in 'real time' settings and the data are fluid, exploratory, shared, emergent, and flexible (Rapport & Braithwaite, 2018). This approach also allows multi-disciplinary and creative insights which enables the researcher to bring about change with greater clarity and realistic implementable goals. (Rapport & Braithwaite, 2018). A change in practice in how shoulder dystocia is managed with improved success rates has occurred as a result of this research.

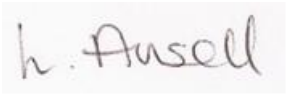
In order to share knowledge as widely as possible, and ensure other clinicians have the ability to learn the manoeuvre, I have created a YouTube video which outlines how to perform the manoeuvre of axillary traction. The video can be found using the following link: https://youtu.be/F1FVAcUwOXY

4.3 Authors' Contributions

My contribution as the first author is under the guidance of Associate Professor Judith McAra-Couper as principal supervisor and Associate Professor Peter Larmer as associate supervisor and was co-authored as follows:

Principal Author: Lesley Ansell

Contribution: 80%. Preparation and writing of the manuscript and suggested revisions in preparation for publication.

Signed …  …… Date……4th May 2020……

Co-Author: Associate Professor Judith McAra-Couper

Contribution: 10%. Supervision of the writing, provision of feedback, and formatting advice.

Signed…… Date……4th May 2020……

Co-Author: Associate Professor Peter Larmer

Contribution: 10%. Supervision of the writing, provision of feedback, and formatting advice.

Signed…… Date……4th May 2020……

4.4 Article for Publication

4.4.1 Title

Changing Practice in Shoulder Dystocia: A Midwife's Journey

4.4.2 Introduction

Shoulder dystocia is a childbirth emergency which can result in significant maternal and neonatal trauma, and even neonatal death. Shoulder dystocia is defined as failure of the anterior, posterior, or both fetal shoulders to enter the pelvic cavity following the vaginal birth of the fetal head [1]. This potentially life-threatening emergency is one of the most alarming problems midwives face, but the relative rarity of shoulder dystocia means there is little opportunity to become 'expert' in dealing with the problem [1].

This article presents my personal and research journey which led to a change in practice when presented with shoulder dystocia. This journey led to the recommendation and subsequent adoption into practice that axillary traction be the first internal manoeuvre attempted when shoulder dystocia occurs. This change in practice is presented along with an explanation of how to 'do' axillary traction.

4.4.3 The Journey

I witnessed a severe shoulder dystocia where the failure of the McRoberts', suprapubic pressure, internal rotational manoeuvres and then an attempt at delivery of the posterior arm resulted in a complete fracture of the humerus. The baby was born by literally being 'dragged' out by the broken arm and required full resuscitation. Following this traumatic experience, I spent many hours reflecting on the events of that birth. I thought about the attempt at delivery of the posterior arm and the shock I felt when I heard the humerus fracture. The midwife who eventually delivered the baby explained the difficulty she had in trying to locate the fetal elbow because both fetal shoulders had remained above the pelvic brim. In trying to locate the elbow she only manged to grasp the upper arm and the subsequent traction against the arm had caused the fracture. The traction had caused some movement in the shoulder and so she continued to pull on the damaged arm until the shoulder eventually descended below the pelvic brim and she was able to pull the baby through the pelvis. I asked her why she did not grasp the fetal shoulder and use that to pull the baby down (my thought had been that if any child was trapped anywhere the natural reaction is to secure the child under their armpits to attempt to pull them free). Her response was "that's not what we are taught"! That was a fair comment—it was not what we were taught. I began to question what I would do if I was in the same situation again. It was evident that the manoeuvres we had been taught in our emergency skills days had failed in this situation and I realised the enormity of the practice problem we were facing.

4.4.4 Discussion with Colleagues and the Start of the Research Journey

I began to discuss management of shoulder dystocia with other colleagues, a number had been in similar situations with the failure of the internal rotational manoeuvres and delivery of the posterior arm. I reflected on the need to move the fetal shoulders through the pelvis. This made me think more about the possibility of using the fetal axilla but in a way that would secure the arm firmly against the body so to prevent traction being applied to the humerus which could result in a fracture. Traction could then be driven through the fetal axilla to move the shoulder through the pelvis. Also, it seemed reasonable that if a hand is placed into the pelvic cavity, the fetal shoulder is located first before the fetal elbow. I began to question why we would by-pass the axilla which it is a more accessible and tangible place to secure the fetus and then apply traction to move the shoulder through the pelvis.

I researched the management of shoulder dystocia and found that the literature promoted the HELPERR mnemonic and the internal rotational manoeuvres of Rubins' II, Woods' screw or delivery of the posterior arm [2]. I also investigated the mechanism of normal birth of the shoulders. Once the fetal head is born the shoulders enter the pelvic cavity through the pelvic brim in the oblique or transverse diameter (the larger diameters at the inlet). The shoulders then rotate to the antero-posterior (A-P) diameter of the pelvis and the anterior shoulder lies behind the symphysis pubis. Restitution occurs whereby the fetal head externally rotates and the shoulders rotate forwards in the pelvic cavity [3]. This enables the shoulders to be born with the bisacromial diameter in the A-P diameter of the pelvic outlet [4]. Delivery of the shoulders is, therefore, facilitated by making use of the widest diameter at the outlet. The pubic arch acts as a 'pivot' for the anterior shoulder and the posterior shoulder is born first [5]. Literature from the early 1990s supports that if birth is allowed to progress normally and unassisted that the posterior shoulder in most cases is spontaneously born first [6]. Using this principle, it seemed reasonable that locating and grasping the posterior shoulder and applying traction to bring it down through the pelvis (while the anterior shoulder pivots around the symphysis in the same way as normal birth) could achieve birth during shoulder dystocia.

I began work as a Clinical Midwifery Educator at Auckland University of Technology (AUT), and during that time there were many discussions about the management of shoulder dystocia. These discussions often included the use of a doll and pelvis with demonstrations of how to 'do' axillary traction. As a result, I was encouraged to investigate the viability of axillary traction as a method of resolving shoulder dystocia. Subsequently, shoulder dystocia became the subject of my Masters in Health Science Degree (MHSc) at AUT. This study [7] identified the difficulties practitioners had with both remembering and performing the internal manoeuvres, described in HELPERR, as well as their lack of effectiveness at times. When attempting the internal rotational manoeuvres practitioners, without being aware, had often used axillary traction by 'accident' with success in resolving the shoulder dystocia.

4.4.5 Axillary Traction in Practice

During the course of the Masters' study, other clinicians I worked with became aware of axillary traction and had witnessed traction being used with a good deal of success. They requested to be taught the manoeuvre and began to use it themselves in practice, again with a good degree of success. Axillary traction began to 'creep' into practice. The Senior Medical Officers (SMOs), Resident Medical Officers (RMOs), and midwives working in the area embraced the use of axillary traction. Frequently, clinicians would contact me to tell me they had used it and how effective it was. As a result, the method of axillary traction for managing shoulder dystocia was reviewed by the Obstetric Quality Forum at Counties Manukau Health (CMH), Auckland, New Zealand in 2009 and a new guideline including axillary traction was approved. As a result of that guideline, axillary traction was also included in the Practical Obstetrical Multi-Professional Training (PROMPT) emergency skills and drills training courses.

The original guideline only included a description of how to perform axillary traction but the most recent updated version (2018) includes photographs to assist with the description. The following is an excerpt from the 2018 guideline showing how to 'do' axillary traction:

4. Axillary traction

- *Slide hand along fetal neck POSTERIORLY to shoulder*
- *Grasp posterior shoulder with thumb and first finger*
- *Place second finger on top of arm and hold down firmly*
- *Apply axillary traction to follow the curve of the sacrum. The anterior fetal shoulder will 'pivot' around the symphysis pubis and the posterior shoulder will be delivered first.*
- *The degree of traction required to may be very significant. Applying traction through the axilla only and not against the fetal arm is unlikely to cause injury.*

➢ ***Slide hand along fetal neck posteriorly to shoulder***

- ***Grasp posterior shoulder with thumb and first finger***

- ***Place second finger on top of arm***

- ***Apply axillary traction to follow the curve of the sacrum:***

- ***Anterior shoulder 'pivots' around the symphysis pubis – the posterior shoulder is delivered first:***

Document ID: A2794 **Version:** 4.0
Department: Obstetric and Gynaecology **Last Updated:** 8/03/2018
Document Owner: Clinical Leader - Obstetrics **Next Review Date:** 8/03/2021
Approved by: Women Health Controlled Documents Group **Date First Issued:** 01/02/2004
Counties Manukau Health

4.4.6 Spreading the Word

The word about the use of axillary traction began to spread. In September 2010 I presented at the New Zealand College of Midwives (NZCOM) 11th biennial national conference highlighting axillary traction '*as an alternative and effective strategy for the management of this obstetric emergency…*'.

The session was extremely well attended, and I began to receive requests from midwives and midwifery educators for the shoulder dystocia power point presentation to be used as a teaching resource in midwifery schools throughout New Zealand. The presentation was repeated at Waitakere Hospital (Auckland, New Zealand) the following month at the request of the midwifery clinical educators. An application to the NZCOM to have axillary traction included in the mandatory clinical skills training programme for midwives was, however, declined in 2010 (anonymous, personal communication, Feb 1, 2010) on the basis that the manoeuvre had not been evaluated. Further research on my part led me to realise that the internal rotational manoeuvres (Rubins' II, Woods' screw) or delivery of the posterior arm had not been objectively evaluated either [8], but these manoeuvres were still being taught in New Zealand.

In 2012, the findings of the qualitative study for management of shoulder dystocia by axillary traction was published in *Midwifery* [7]. Following that publication, I was approached by more midwifery educators and managers from several District Health Boards in New Zealand who wanted to include it in their shoulder dystocia guidelines and emergency skills training days.

As a result of the anecdotal success of axillary traction, I was also approached by the Pacific Women's Health Unit at Auckland University to write a chapter on the management of shoulder dystocia, including the use of axillary traction for the Pacific Emergency Maternal and Neonatal Training Manual. I have received feedback that axillary traction had been used a number of times in the Pacific islands with a great deal of success.

The word continued to spread. Midwifery students, new staff midwives, and RMOs had heard about the manoeuvre and would approach me to teach them 'how do it'. Many hours have been spent in the clinical area with a doll and pelvis with clinicians learning and practicing the manoeuvre. Often it was referred to as 'Lesley's' manoeuvre' and if a shoulder dystocia had occurred there were discussions around whether 'Lesley's' manoeuvre' had been used and if it had worked. On virtually every occasion it seemed to have worked; and if it had not worked for one clinician, then it usually did so if another clinician who was more experienced with the use of axillary traction took over.

4.4.7 Anecdotal Evidence to Research

As the anecdotal success of axillary traction grew, it became clear we needed further research to prove that axillary traction was effective in resolving shoulder dystocia. In 2014, I decided to undertake research to examine the success rates of the manoeuvres used to resolve shoulder dystocia. Axillary traction had been 'introduced' in 2009 so I decided to review the pre and post axillary traction years. I applied to the hospital research department for permission to conduct an audit of births complicated by shoulder dystocia from 2006 (3 years before introduction) and 2012 (3 years after introduction) to see if there was any evidence to support the use of axillary traction. Permission was granted by the hospital research department to undertake the study. Ethics approval was sought and granted by Southern Health and Disability Ethics Committee (reference: 14/STH/154) and shoulder dystocia became the subject of my doctoral work.

The doctoral study investigated the effectiveness of axillary traction when shoulder dystocia occurs. This retrospective review of internal manoeuvres used in the management of shoulder dystocia is the first to document the use of axillary traction for a large number of women. Of the 422 women who experienced shoulder dystocia, a total of 226 (53.6%) required internal manoeuvres to resolve the problem. The first internal manoeuvres used were classified as axillary traction, posterior arm delivery, or internal rotational manoeuvres.

The results of the study demonstrated a highly significant difference ($p<0.001$) in the success rates of the first used internal manoeuvres. In 52.7% cases the first internal manoeuvre used was axillary traction which was successful in 95.8% of cases and no further manoeuvres were required. The success rate of axillary traction as a first internal manoeuvre was significantly greater than that for rotational manoeuvres ($p<0.001$) and posterior arm delivery ($p<0.025$) [9].

In October 2018, the results of that study were presented in the following poster at the Royal Australia and New Zealand College of Obstetricians and Gynaecologists Conference in Brisbane (Figure 4.1).

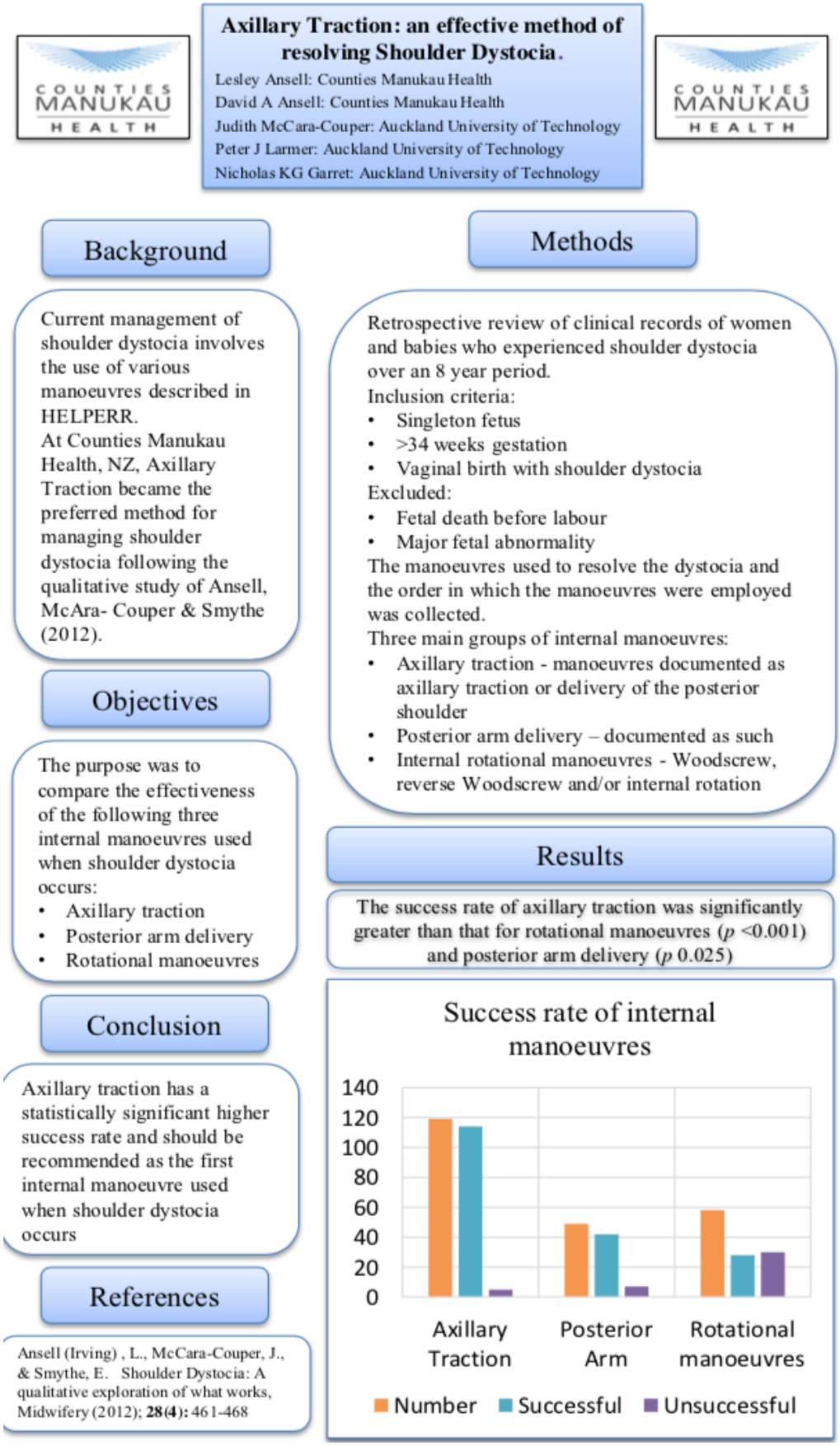


Figure 4.1 Poster Axillary Traction effective method of resolving should dystocia.

4.4.8 Sharing Practice Knowledge

Although this has been my journey, to date it has not yet been endorsed within the wider maternity community. In order to share this knowledge as widely as possible I have created a YouTube video which outlines how to do axillary traction. The video can be found using the following link: https://youtu.be/F1FVAcUwOXY

4.4.9 Conclusion

Shoulder dystocia is a life-threatening complication of childbirth which has been recognised by midwives and obstetricians for centuries. My own personal experience led me to discuss, investigate, and research the notion of axillary traction as a method of resolving shoulder dystocia. The results of both anecdotal and research evidence have demonstrated the effectiveness of axillary traction for the resolution of shoulder dystocia. Axillary traction, therefore, should be the first manoeuvre used when an internal manoeuvre is required to resolve shoulder dystocia.

4.4.10 References

1. Gherman, R. (2002). Shoulder dystocia: An evidence-based evaluation of the obstetric nightmare. *Clinical Obstetrics & Gynecology, 45*(2), 345-362. doi:10.1097/00003081-200206000-00006
2. Royal College of Obstetricians & Gynaecologists (RCOG). (2012). *Shoulder dystocia. Guideline no. 42*. London, UK: RCOG.
3. Sleep, J. (1993). Physiology and management of the second stage of labour. In V. Bennet & L. Brown (Eds.), *Myles textbook for midwives* (12th ed., pp. 531-554). Edinburgh, Scotland: Churchill Livingstone.
4. McEwan, A., & Johnson, I. (2004). The problem of shoulder dystocia. *Current Obstetrics & Gynaecology, 14*, 62-67. doi:10.1054/cuog.2000.0148
5. Sutton, J., & Scott, P. (1996). *Understanding and teaching optimal fetal positionin*g (2nd ed.). Tauranga, New Zealand: Birth Concepts.
6. Williams, J. (1908). *Obstetrics: A textbook for the use of student and practitioners* (2nd ed.). London, UK: Sidney Appleton.
7. Ansell (Irving), L., McAra-Couper, J., & Smythe, E. (2012). Shoulder dystocia: A qualitative exploration of what works. *Midwifery, 28*(4), 461-468. doi:10.1016/j.midw.2011.05.007
8. Gurewitsch, E., Kim, E., Yang, B., Outland, K., McDonald, M., & Allen, R. (2005). Comparing McRoberts' and Rubin's maneuvers for initial management of shoulder dystocia: An objective evaluation. *American Journal of Obstetrics and Gynecology, 192*(1), 153-160. doi:10.1016/j.ajog.2004.05.055
9. Ansell, L., Ansell, D., McAra-Couper, J., Larmer, P., & Garrett, N. (2019). Axillary traction: An effective method of resolving shoulder dystocia. *Australia and New Journal of Obstetrics & Gynaecology, 59*(5)*,* 627-633. doi:10.1111/ajo.1302

Chapter Five:
Discussion and Conclusion

5.1 Introduction

This is the first study to evaluate the success rates of the manoeuvre of axillary traction for resolution of shoulder dystocia. It provides statistical evidence of the effectiveness of axillary traction and is the first to provide photographic/video and detailed explanation of how to perform the manoeuvre. The main aim of this study was to test the hypothesis that axillary traction is a successful and safe manoeuvre for the management of shoulder dystocia when an internal manoeuvre is required. The focus of the research was to assess the success rates and any complications of axillary traction compared to other recommended internal manoeuvres for the resolution of shoulder dystocia.

This chapter discusses the interpretation of the findings related to the definition, diagnosis, and documentation of shoulder dystocia. The findings of the systematic review of the literature, the results of the quantitative study, and the change that has come about in practice as a result of this research project are also discussed in the narrative section. The strengths and limitations of this research are acknowledged. Recommendations for practice, education, and further research are made prior to a final conclusion.

5.2 Definition, Diagnosis, and Documentation of Shoulder Dystocia

Throughout the course of this research project it has become evident that there is no standardised definition or diagnosis of shoulder dystocia. There is also no standardised proforma for clinical documentation of the manoeuvres undertaken or timing of those manoeuvres. The absence of this information can have a significant effect on the incidence rates and reported results. It also makes comparisons between different management strategies or research areas unreliable.

One definition of shoulder dystocia is ‘strong downward traction’ required. The definition of normal traction is very subjective and can vary considerably between clinicians. Excessive traction on the fetal head during shoulder dystocia was identified by Ansell et al. (2019) as clinicians reported that when they felt an obstruction, the reflex action was to pull harder rather than to stop pulling at all. Excessive downward traction on the fetal head is thought to cause brachial plexus injury (BPI) (Dyachenko et al., 2006; Gurewitsch et al., 2006) by stretching the brachial plexus; and although the cause of BPI is often attributed to the shoulder dystocia itself, it is more likely that it is caused by undue traction on the fetal head in an attempt to assist the birth of the shoulders.

Another definition given for shoulder dystocia is head to body delivery interval (HBDI) of 60 seconds or more (Hoffman et al., 2011; Leung et al., 2011). This is problematic in that it is common practice in many areas to wait for the next contraction following delivery of the fetal head before attempting delivery of the shoulders. The contractions at this time may be 1-2 minutes apart or even longer, which means that during normal uneventful births the HBDI is more than 60 seconds. In areas where it is not practice to wait for the next contraction, traction on the fetal head begins immediately once the head is born. This practice is potentially a problem as there may not have been time for restitution of the fetal head and shoulders and the clinician is attempting to deliver the shoulders before they have rotated into the normal A-P diameter of the pelvis. This is more likely to cause difficulty or delay in delivery of the shoulders with a greater risk of fetal trauma. This definition, therefore, could result in a significant increase in the reported incidence of shoulder dystocia.

The most common definition given 'is additional manoeuvres beyond that of normal traction on the fetal head to effect delivery of the shoulders' (Gachon et al., 2016; Gherman et al., 1997; Hoffman et al., 2011; Michelotti et al., 2018; Spain et al., 2015). Additional manoeuvres include the external manoeuvres of McRoberts' and suprapubic pressure, and these manoeuvres are usually employed first. If they fail, then the clinician will usually attempt internal manoeuvres. This would suggest that the more severe the shoulder dystocia, the more likely an internal manoeuvre is required. This definition alone could be misinterpreted; however, as often external manoeuvres are used prophylactically in anticipation of shoulder dystocia even when it has not occurred. The definition of 'additional manoeuvres beyond that of normal traction on the fetal head to effect birth of the shoulders' is probably the most appropriate as in normal birth these additional manoeuvres are not required.

I believe it would be appropriate to use the definition of additional manoeuvres with further clarification, and in conjunction with a classification relating to the severity of the shoulder dystocia in order to provide a clear diagnosis. The terms mild, moderate, or severe are often documented in clinical notes; yet there is no clear definition of what these terms mean. I would suggest two classifications of mild and significant. Mild shoulder dystocia would be diagnosed if external manoeuvres only were used and there was no neonatal injury. Significant shoulder dystocia would be diagnosed if any internal manoeuvres were used and/or any neonatal injury occurred regardless of which manoeuvres (either external or internal) were used. This significant group in particular are the ones that require long term follow up as there may be maternal or neonatal morbidity and the woman requires review and management planning in the next pregnancy. Future research could be focused on this group.

Clinical documentation of shoulder dystocia is problematic. Accurate and complete documentation are frequently found to be significantly lacking (LeRiche et al., 2015). Inaccurate documentation can have a significant effect on the reported incidences of shoulder dystocia and management of the woman's future pregnancies. The various definitions can influence documentation and subsequent incidence rates as different clinicians, even working in the same area, may apply different criteria to both the definition and the management strategies.

Discussion and Conclusion

Documentation of shoulder dystocia may be written in the clinical notes or entered into an electronic record, often a significant time after the birth. Documentation should be standardised and preferably electronic with required fields. A proforma could be available in the birthing room whereby an attendant can immediately and accurately document the following in minutes and seconds.

- Time of birth of the fetal head.
- Time of first attempt at birth of the shoulders by routine lateral traction.
- Time and type of external manoeuvres used to include number of times lateral traction attempted.
- Time and type of first/second/third/etc., internal manoeuvre used. Tick boxes with the names of the manoeuvres (axillary traction, posterior arm, internal rotation) and the order in which they were attempted on the proforma.
- Identify which shoulder was anterior and which shoulder was posterior and which shoulders/arms had manoeuvres applied.
- Time of birth of the fetal body.

A clear record of any maternal and neonatal injuries should be documented including follow up at discharge, 6 months, 12 months, and beyond if ongoing sequalae.

Accurate definition, diagnosis, and documentation is critical as any woman who is diagnosed as previously having a shoulder dystocia will require referral to obstetric services and counselling in future pregnancies as there approximately a 13.5% risk of recurrence (Moore et al., 2008). The discussion about management will include the appropriateness of induction of labour prior to expected date of delivery, elective caesarean section, or conservative management. Management will also depend on other factors such as fetal growth, maternal BMI, or maternal diabetes. Interventions carry risks of maternal morbidity (Allen et al., 2003) and inappropriate conservative management could result in recurrence of shoulder dystocia; hence the need to have accurate definition and diagnosis.

Variable definitions for shoulder dystocia influence the reported incidence and success rates of manoeuvres used and may explain the high success rate of some manoeuvres as the authors may be dealing with less severe shoulder dystocia. If the definition of shoulder dystocia cannot be agreed, then researching the problem and deciding appropriate management strategies are very difficult. In general terms, any hospital which reports a very high incidence of shoulder dystocia may be reporting the outcomes of a large proportion of less severe shoulder dystocia. Therefore, any prospective research involving shoulder dystocia would require all involved to have the same criteria for definition, diagnosis, and management to ensure validity of the results.

5.7 Systematic Literature Review

A systematic review of the literature was undertaken to explore the research currently informing clinical practice in the management of shoulder dystocia. The aim was to identify success rates of the commonly used internal manoeuvres (internal rotation and delivery of the posterior arm). The manoeuvre of axillary traction was not identified in this review as the review was completed prior to publication (Ansell et al., 2019).

The systematic review identified the lack of studies regarding the success rates of internal manoeuvres and only seven articles which had statistical analysis of their data were eligible for inclusion. The review also identified that the published research related to management of shoulder dystocia is all retrospective. The difficulty with retrospective analysis is that confounding and bias are more common, but retrospective analysis is useful in evaluating the effects of rare conditions/situations. Shoulder dystocia is a rare event; hence, most of the studies are retrospective.

It would be difficult to undertake a prospective study in the case of shoulder dystocia; hence my own retrospective study which will be discussed in detail in this chapter. A randomised controlled trial (RCT) would require informed consent prior to labour. All women would need full discussion and explanation of all manoeuvres for a problem which occurs in approximately 1% of vaginal births. Discussion of such a nature may cause unnecessary anxiety in those who are not at risk of shoulder dystocia and could increase the possibility of maternal request for caesarean section to avoid the problem altogether. A policy of elective caesarean section for those at risk has not proven to be of benefit (Rouse et al., 1996) so such discussions could be very counterproductive.

Wide variation in success rates of delivery of the posterior arm were also found. Spain et al. (2015) found success rates of only 16.7% whilst Gherman et al. (1997) report success rates of 97%. Hoffman et al. (2011) reported success rates of 84.4% for delivery of the posterior arm but the terms posterior arm and posterior shoulder were used interchangeably and the procedure for delivering the posterior shoulder was not described which could influence the results.

The review demonstrated the lack of clarity in the definition of shoulder dystocia, the problems of which have previously been discussed. Most authors used the definition of ‘additional manoeuvres beyond that of normal traction on the fetal head to effect delivery of the shoulders’ (Gachon et al., 2016; Gherman et al., 1997; Hoffman et al., 2011; Michelotti et al., 2018; Spain et al., 2015) but the definition of normal traction on the fetal head was not explained, so could vary considerably between practitioners with possible sequelae of excessive downward traction on the fetal head. HBDI of 60 seconds or more was used by some authors (Hoffman et al., 2011; Leung et al., 2011) and the difficulty with this definition has been previously discussed.

The lack of studies reporting the success rates of internal manoeuvres used to resolve shoulder dystocia were also identified in this review. Some studies evaluated the specific manoeuvres of Rubins’ II and Woods’ screw with wide ranging results between 10.8% and 72% (Hoffman et al.,

2011; Spain et al., 2015) and the wide-ranging results highlight the difficulty in researching this topic. Other studies did not identify the individual manoeuvres used and they were referred to as 'rotational' or 'fetal manipulation' (Gachon et al., 2016; Leung et al., 2011; MacKenzie et al., 2007; Michelotti et al., 2018). Success rates for these manoeuvres were also wide ranging from 20.2-80% (MacKenzie et al., 2007; Michelotti et al., 2018). One study reported fetal manipulation as having 100% success rate but there were only 14 cases in this study (Gachon et al., 2016). Studies with such low case numbers are likely to have overestimated the significance of their findings and lack of clarity of which manoeuvre was used makes assessment of the safety of particular manoeuvres exceedingly difficult.

Wide variations in success rates of delivery of the posterior arm were also found in this review of between 16.7% and 97% (Gherman et al., 1997; Hoffman et al., 2011; Spain et al., 2015). Hoffman et al. (2001) used the terms posterior arm and posterior shoulder interchangeably and the procedure for delivering the posterior shoulder was not described which could influence their results. It is very difficult to compare success rates and attribute causation of adverse outcomes when the manoeuvres used have not been documented, identified, or described adequately.

Reasons for the wide variation in the reported success rates with internal manoeuvres include differences in definition of shoulder dystocia, use of different number and sequences of manoeuvres, and problems with documentation. With regard to neonatal outcome, it is possible that it is the severity of the shoulder dystocia itself that causes an increase in the duration of the HBDI and the number of manoeuvres required which results in poorer neonatal outcome; rather than the individual manoeuvres themselves having a direct effect neonatal outcome.

There are significant risks to the neonate when managing shoulder dystocia. Whilst some studies report on neonatal outcomes associated with individual manoeuvres (Hoffman et al., 2011; Leung et al., 2011; Michelotti et al., 2018; Spain et al., 2016) others did not (Gherman et al., 1997). One large study demonstrated worse outcomes including low Apgar scores, BPI, and fractures if the internal rotational manoeuvres and/or delivery of the posterior arm were required (Michelotti et al., 2018). These finding were supported by Hoffman et al. (2011) who found increased injury and hypoxic ischaemic encephalopathy (HIE) rates if internal manoeuvres were required. Spain et al. (2015) reported 231 shoulder dystocia cases requiring internal manoeuvres with no difference between different internal manoeuvres in the incidence of neonatal complications but did find a correlation between incidence of neonatal complications and HBDI. A report of 2540 cases of shoulder dystocia, however, demonstrated worse outcomes including low Apgar scores, BPI, and fractures if the internal rotational manoeuvres and/or delivery of the posterior arm were required (Michelotti et al., 2018). Therefore, it is essential to identify the manoeuvre which causes the least (or no) damage to the baby.

Head to body delivery interval (HBDI) does have an effect on neonatal outcome and the longer the duration taken to resolve the shoulder dystocia, the worse the neonatal outcome (Gherman et al., 1997; Hoffman et al., 2011; Spain et al., 2015). When the duration of the shoulder dystocia increases, the more manoeuvres are used with a significantly worse neonatal outcome

($p<0.01$) (Spain et al., 2015). The use of additional manoeuvres leading to increased HBDI was also found to increase the rate of neonatal depression (Spain et al., 2015).

It is likely that the wide variations in the reported success rates and outcomes highlight the difficulty in identifying the success rates of individual manoeuvres because of the differences in definition of shoulder dystocia, documentation of, and the number of manoeuvres used. With regard to neonatal outcome, it is possible that it is the severity of the shoulder dystocia itself that causes an increase in the duration of HBDI and, subsequently, the number of manoeuvres used which results in poorer neonatal outcome rather than the individual manoeuvres themselves having a direct effect on neonatal outcome.

None of the studies in the review assessed the experience of the attending practitioner dealing with the shoulder dystocia. This could have a direct effect on the success rates and outcomes. Whilst it is difficult to become expert in managing shoulder dystocia, experienced labour ward practitioners will have more experience and confidence in dealing with the problem. Consideration of this factor along with standardised definition, diagnosis, and documentation of shoulder dystocia would greatly assist further research.

5.8 Quantitative Retrospective Study

A quantitative retrospective review of clinical records was undertaken for all labours complicated by shoulder dystocia over an eight-year period (Ansell et al., 2019) in Counties Manukau Health (CMH). Maternal and neonatal information were compared for the three cohorts of the first internal manoeuvre documented: axillary traction, posterior arm delivery, and rotational manoeuvres.

The results of this study (Ansell et al., 2019) show that of the women who experienced shoulder dystocia ($n=226$) required an internal manoeuvre to resolve the problem. In 52.7% of cases the first manoeuvre used was axillary traction and was statistically significantly successful ($p<0.0001$) in 95.8%. Posterior arm delivery was used as the first manoeuvre in 21.7% of cases with a success rate of 85.7% and rotational manoeuvres were used first in 27.7% of cases with success in 48.3%. The success rate of posterior arm delivery, therefore, was significantly less than that of axillary traction ($p<0.025$) but much higher than that of rotational manoeuvres ($p<0.01$). There were no significant differences in the complication rates of the different first manoeuvres in relation to total birth injuries ($p=0.39$) and neonatal nerve palsies ($p=0.70$) which suggests that axillary traction is an effective and safe manoeuvre for the management of shoulder dystocia when an internal manoeuvre is required.

Ansell et al. (2019) found similar success rates of delivery of the posterior arm to that of Hoffman et al. (2011) but this manoeuvre is associated with a higher incidence of neonatal morbidity (Hoffman et al., 2011). A report of 2540 cases of shoulder dystocia demonstrated worse outcomes including low Apgar scores, BPI, and fractures if the internal rotational manoeuvres and/or delivery of the posterior arm were required (Michelotti et al., 2011). It is

essential therefore to identify the manoeuvre which causes the least (or no) damage to the baby.

The Ansell et al. (2019) study was conducted in CMH which has a population with many different ethnicities including New Zealand European/Pakeha, Māori, Pacifica, Indian, and Chinese. Counties Manukau Health (CMH) is one of the most socially deprived areas in New Zealand and the rate of obesity and diabetes in the area is high and increasing (CMDHB, 2015). Diabetes, obesity, and excessive weight gain in pregnancy are associated with fetal macrosomia which is a significant risk factor for shoulder dystocia (Lim et al., 2009). In 2017, 2.4% of babies in CMH were born with a significantly high birthweight of ≥4.5kg (CMH, 2019) and the rates of shoulder dystocia in the area have been found to be increasing (Ansell et al., 2019). In this study, there were no significant differences in the success rates of any internal manoeuvres used in relation to BMI, diabetes, ethnicity, high birthweight, induction of labour, epidural and instrumental births, and there was a high success rate for axillary traction in all subgroups. In all of those cases, McRoberts' and suprapubic pressure were attempted first but both procedures can be very difficult due to the inability to flex the maternal legs or access the area above the symphysis when there is a very large panus. It is also likely that the clinicians in this study were dealing with more difficult cases of shoulder dystocia because of the maternal characteristics and high birthweight. Thus, the high level of success found with axillary traction (Ansell et al., 2019) indicates that this manoeuvre is suitable for those with significant shoulder dystocia and is likely to be useful in all women in different communities and clinical settings.

There are no previous reports of the neonatal injury rates associated with axillary traction and there are no randomised trials comparing the neonatal injury rates associated with other internal manoeuvres. Ansell et al.'s (2019) study is the first and only study to report the neonatal outcome of a large number of shoulder dystocia cases managed with axillary traction. The procedure for delivering the shoulder, in this case, is designed to ensure that the traction used is directed through the axilla and not against the humerus, so it is likely that there is less risk of humeral fracture using this method.

Shoulder dystocia is an unpredictable event; so it is unlikely that any one person can become 'expert' in dealing with the problem. It is essential, therefore, that any manoeuvres used are easy to remember, easy to perform, and easy to teach. Axillary traction has been described as 'an easy manoeuvre to use' (Ansell et al., 2012). It is important that it is an easier to use manoeuvre for the clinician, but it is possible that it is less painful and less traumatic for the woman. Some internal rotational manoeuvres require the fingers of both hands to enter the vagina whilst removal of the posterior arm requires the hand to be pushed much further into the maternal pelvis than is required for axillary traction.

This study is the first quantitative study to be published regarding the use and success of axillary traction for managing shoulder dystocia. It provides statistical evidence of its effectiveness and is the first to provide photographic and detailed explanation of how to perform the manoeuvre. This manoeuvre has been presented at a midwifery conference and study days, emergency skill training days, and has been presented in a poster at a Royal Australia, New

Zealand College of Obstetricians and Gynaecologists (RANZCOG) meeting. A YouTube video has been created. The published study (Ansell et al., 2019) has been cited and received positive feedback. The word is spreading. We are now seeing many district health boards in New Zealand incorporating axillary traction into their hospital guidelines for management of shoulder dystocia and emergency skills training days. Clinicians are adopting it and using it regularly, and I have received many comments from them such as "*this is all I use now… it's fantastic… it has never let me down"*. Midwifery schools are teaching axillary traction to their undergraduate students, as well as in midwifery skills study days. Axillary traction for management of shoulder dystocia is becoming the 'norm'!

5.9 Qualitative Narrative

The qualitative narrative describes my own personal journey of leadership and professional learning experiences which has ultimately led to a recognised change in practice in how to manage shoulder dystocia. It is an exploration of my own personal experiences and the experiences of my colleagues and other clinicians. I have been heartened by the eagerness and willingness with which other clinicians have been keen to learn the manoeuvre of axillary traction. Some of those were clinicians who had never been involved with a shoulder dystocia and were simply keen to learn, but many of them were clinicians who had had a similar experience to myself and voiced their concerns when internal rotation manoeuvres or delivery of the posterior arm had failed. Often the baby had suffered severe morbidity, or mortality. The detail with which they described their experiences made me realise that those memories would never leave them, and they were very anxious that they would find themselves in the same position again. To have this extra 'tool' helped to relieve some of that anxiety.

Axillary traction was introduced into practice at CMH in 2009 following the results of my qualitative Master's study in the topic. Anecdotal evidence of its success was available before the qualitative study and CMH was teaching the manoeuvre as part of the emergency skills training days. Publication of the qualitative study, however, has resulted in many areas adopting the practice.

The published narrative article begins with my own experiences expressed in a lived and told story. The story describes my own reflection when I believed I had identified a gap in evidence-based practice following the failure of traditionally taught techniques to manage shoulder dystocia. This reflection led me to challenge clinical practice as a professional. Critical analysis made me realise that there was a complex problem to navigate and resolve which required scientific analysis and evaluation and led to this research project.

The narrative is not just simple description. It is an exploration of what happened, what emerged, what was learned, and how it informed the next step. As a result, the qualitative and quantitative approaches complement each other. These creative insights enabled me to bring about change with greater clarity and realistic implementable goals. A change in practice in how

shoulder dystocia is managed with improved success rates has occurred as a result of this research.

The process of change initially began following discussion and debriefing with colleagues both in practice and in education. Following these discussions, axillary traction beginning to 'creep' into practice. As a result, the method of axillary traction for managing shoulder dystocia was reviewed in 2009 by the Obstetric Quality Forum at CMH (Auckland, New Zealand) and a new guideline including the manoeuvre of axillary traction was approved. Axillary traction was also included in the Practical Obstetrical Multi-Professional Training (PROMPT) emergency skills and drills training courses at CMH.

In 2010, I presented axillary traction as an alternative and effective strategy for the management of shoulder dystocia at the New Zealand College of Midwives 11th biennial national conference in Rotorua, which resulted in a huge response from midwives wanting to learn the manoeuvre. Midwifery educators subsequently requested presentations at a local level. I was approached by the Pacific Women's Health Unit at Auckland University and wrote a chapter on the management of shoulder dystocia including the use of axillary traction for the Pacific Emergency Maternal and Neonatal Training Manual. I have received feedback that axillary traction had been used a number of times in the Pacific islands with a good deal of success.

Some clinicians and educators had reservations about the validity of a qualitative study, so I decided to undertake doctoral studies and include a quantitative study to further evaluate the manoeuvre of axillary traction. Prior to this study, I undertook a systematic review of the literature to see what was informing current practice; then, following ethics approval, began the quantitative retrospective analysis to evaluate the success rate of axillary traction compared to internal rotation and delivery of the posterior arm. This retrospective review is the first to document the use of axillary traction for a large number of women. In 2018, the results of that study were presented in a poster at the RANZCOG Conference in Brisbane and published in 2019 (Ansell et al.). In order to share knowledge as widely as possible I have created a YouTube video which outlines how to perform the manoeuvre of axillary traction: https://youtu.be/F1FVAcUwOXY

The process by which practice has begun to change is described above but it is also important to consider that in order to change practice an acceptance by those who use that practice is required. It is probable that the internal rotation manoeuvres of Rubins', Woods', and delivery of the posterior arm (also known as the Barnum manoeuvre) have been popularised by the mana[2] of the medical practitioners who described the manoeuvres and whom the manoeuvres are named after, rather than by clear evaluation of their success. The prominence of the practitioners, after whom the manoeuvres are named, probably influenced the adoption of those manoeuvres into practice and to becoming part of the HELPERR pneumonic. A pneumonic is a useful way of teaching and HELPERR became an internationally used strategy for teaching

[2] Mana is a Māori concept that means: authority, control, influence, prestige or power, honour

management of shoulder dystocia despite little evidence of the effectiveness of those internal manoeuvres.

Throughout the course of this research I have developed a reputation in CMH of being able to deal with difficult shoulder dystocia and this has encouraged other midwives to learn the procedure from me. They have subsequently made it part of their practice. Midwives would often take over from medical practitioners when the manoeuvres they were using failed, and the midwife would deliver the baby successfully using axillary traction. This encouraged medical practitioners to do the same. As a midwife it can be very difficult to 'break' into the medical world and influence their practice but clinical practice, leadership, and publication of the quantitative article (Ansell et al., 2019) gives the manoeuvre of axillary traction credibility amongst the medical profession. Together, this has led to a significant change in practice in how to manage shoulder dystocia.

5.10 Strengths and Limitations of the Study

The strengths of this research are that the data collected were for a large number of women who required internal manoeuvres. Axillary traction was used in women with different ethnicities, high BMI, diabetes, high birthweight, induction of labour, epidural and instrumental births with a high success rate for all subgroups. Axillary traction, therefore, is likely to be useful in all women in different communities and clinical settings.

The limitations of this research are acknowledged. Data collection was difficult because there was no formal method of documenting or diagnosing shoulder dystocia, and the data were extracted from the clinical notes. There was consistency in this research, however, as all cases required an internal manoeuvre to resolve the problem.

This research is retrospective, as is the majority of research relating to shoulder dystocia given it would be difficult to conduct an RCT in the circumstances. It was difficult, therefore, to control for confounders as the there was no randomisation or possibility of blinding. Axillary traction, however, had a very high success rate regardless of confounding factors so it is not likely that there would be any influence from those factors.

5.11 Recommendations for Practice

A standard definition of shoulder dystocia is essential in order to minimise the risk of over or underreporting of the problem. The most common definition of 'additional manoeuvres beyond that of normal traction on the fetal head to effect delivery of the shoulders' is probably the most appropriate, as in normal birth these manoeuvres are not required. Without a clear, standardised definition, studying whether the rates are increasing or decreasing, and what is the appropriate management becomes exceedingly difficult.

Classification of the severity of shoulder dystocia is required. The terms mild, moderate, or severe are often documented in clinical notes; yet there is no clear definition of what these

terms mean. I have argued that it would be more appropriate to use the terms mild or significant. Mild shoulder dystocia could be classed as external manoeuvres only used and no neonatal injury. Significant could be any internal manoeuvres required and/or any neonatal injury. This classification would also justify the definition.

Documentation of shoulder dystocia should be standardised and preferably electronic with required fields. Ideally, documentation should include all timing in minutes and seconds as previously discussed. A clear record of any maternal and neonatal injuries including follow up at discharge, 6 months, and 12 months and beyond if ongoing sequalae.

Hospital guidelines for management of shoulder dystocia should be updated to include axillary traction as the results of this retrospective study (Ansell et al., 2019) clearly demonstrate its effectiveness as a method of resolving shoulder dystocia when an internal manoeuvre is required.

5.12 Recommendations for Education

One of the most important messages for education of clinicians is that when shoulder dystocia occurs '**do not pull**' on the fetal head. Trying to overcome the obstruction by applying excessive traction on the fetal head causes BPI (Dyachenko et al., 2006; Gurewitsch et al., 2006), some of which is permanent and seldom relieves the problem.

If the external manoeuvres of McRoberts' and suprapubic pressure fail, or are difficult to perform, use axillary traction as the first line management as it has a much higher success rate than internal rotation and/or delivery of the posterior arm (Ansell et al., 2019).

Education regarding accurate documentation and practice with a proforma should be included in skills training.

Include axillary traction in the emergency skills and drills training for all midwives and medical practitioners; and identify that this manoeuvre should be attempted first when an internal manoeuvre is required.

5.13 Recommendations for Research

It would be of value to repeat the audit of shoulder dystocia management and outcomes at CMH once documentation is improved via a standardised proforma and electronic recording with required fields. With improved data, more reliable information will be available about sequence and times of manoeuvres used and HBDI. The experience of the clinician in regard to previous management of shoulder dystocia could be recorded and whether more than one clinician was required to resolve the dystocia. This would give an indication of whether it was the manoeuvres or the experience of the clinician which affected the outcome.

Ideally observers reporting neonatal and baby outcomes should be blinded as to the manoeuvres used. Again, uniform agreement is needed for documentation proforma. This should include reporting on any injury and which side(s) any injury occurred.

Maternal data could also be collected. The aim would be to have one person extract the birth information and another to document all maternal data perineal trauma and, where appropriate, levator muscle avulsion, urinary incontinence, haemorrhage, and infection. As much as possible, this should be done for both short term and long-term outcomes.

It is possible to research the force applied to the fetal head during lateral traction, external and internal manoeuvres. The possibility of pressure measuring gloves have previously been suggested. Computer modelling of shoulder dystocia management in CMH could also be considered.

A final recommendation would be to continue discussions regarding the ethics and practicalities of having a randomised trial of axillary traction versus rotational manoeuvres as the first internal manoeuvre to be used.

5.14 Conclusion

The manoeuvre of axillary traction for resolution of shoulder dystocia has been evaluated in this research project. It is the first study to assess the success rates of axillary traction for management of shoulder dystocia. The systematic review of the literature highlighted the wide ranging reported success rates of the commonly used internal manoeuvres of internal rotation and delivery of the posterior arm which, in part, may be due to the lack of a standardised definition or diagnosis of shoulder dystocia and inaccuracies in documentation. It is evident, however, that neonatal injury can occur with the use of these internal manoeuvres or when there is a prolonged HBDI.

The quantitative study undertaken as part of this research project provides good evidence that axillary traction is an effective manoeuvre with significantly higher success rates than internal rotation or delivery of the posterior arm. There were no differences in neonatal outcome with the use of axillary traction but the lack of formal neonatal follow up made this more difficult to assess and warrants further investigation. The qualitative narrative demonstrated how to influence a change in practice by a process of reflection, clinical dialogue, clinical leadership, research and investigation, presentations, publications, and peer review.

This project has provided statistical evidence that axillary traction is more effective than the commonly used internal rotational manoeuvres or delivery of the posterior arm. The manoeuvre of axillary traction contributes to the body of knowledge in how to manage the problem with the recommendation that axillary traction be the first manoeuvre used when an internal manoeuvre is required to resolve shoulder dystocia.

On the day of submission of this thesis an email was received stating that the paper; Axillary Traction: An Effective Method of Resolving Shoulder Dystocia which was published in

Australian and New Zealand Journal of Obstetrics and Gynaecology (Ansell et al., 2019) is among the top 10% of most downloaded papers from this journal for 2018-19 (Appendix H). This gives credibility to the value and impact of the manoeuvre of axillary traction and is another indication of the potential this research has for challenging and changing practice.

References

Advanced Life Support in Obstetrics (ALSO). (2000). *Advanced life support in obstetrics. Course syllabus part I. USA*. American Academy of Family Physicians.

Agarwal, P., Morriseau, S. T., Kereliuk, S. M., Doucette, C. A., Wicklow, B. A., & Dolinsky, V. W. (2018). Maternal obesity, diabetes during pregnancy and epigenetic mechanisms that influence the developmental origins of cardiometabolic disease in the offspring. *Critical Reviews in Clinical Laboratory Sciences, 55*(2), 71-101. https://doi-org.ezproxy.aut.ac.nz/10.1080/10408363.2017.1422109

Al-Hawash, S., Whitehead, C. L., & Farine, D. (2018). Risk of recurrent shoulder dystocia: Are we any closer to prediction? *Journal of Maternal-Fetal & Neonatal Medicine, 32*(17), 2928-2934. https://doi.org/10.1080/14767058.2018.1450382

Allen, V. M., O'Connell, C. M., Liston. R. M., & Baskett, T. F. (2003). Maternal morbidity associated with cesarean delivery without labor compared with spontaneous onset of labor at term. *Obstetrics & Gynecology, 102*(3), 477-482. https://doi.org/10.1016/s0029-7844(03)00570-2

American Journal of Obstetricians & Gynecologists (ACOG). (2012). *Shoulder dystocia. Practice pattern no. 40.* ACOG.

Ansell, L., Ansell, D. A., McAra-Couper, J., Larmer, P. J., & Garrett, N. K. G. (2019). Axillary traction: An effective method of resolving shoulder dystocia. *Australia and New Journal of Obstetrics & Gynaecology, 59*(5)*,* 627-633. https://doi.org/10.1111/ajo.13029

Ansell (Irving), L., McAra-Couper, J., & Smythe, E. (2012). Shoulder dystocia: A qualitative exploration of what works. *Midwifery, 28*(4), 461–468. https://doi.org/10.1016/j.midw.2011.05.007

Baskett, T. F., & Allen, A. C. (1995). Perinatal implications of shoulder dystocia. *Obstetrics & Gynecology, 86*(1)*,* 14-17. https://doi.org/10.1016/0029-7844(95)00099-D

Baxley, E. G., & Gobbo, R. W. (2004). Shoulder dystocia. *American Family Physician, 69*(7), 1707-1714. https://www.aafp.org/afp/20040401/1707.html

Bofill, J. A., Rust. O. A., Devidas, M., Roberts, W. E., Morrison, J. C., & Martin J. N. (1997). Shoulder dystocia and operative vaginal delivery. *Journal of Maternal-Fetal & Neonatal Medicine, 6*(4)*,* 220-224. https://doi.org/10.1002/(SICI)1520-6661(199707/08)6:4<220::AID-MFM7>3.0.CO;2-L

Buchanan, T. A., Xiang, A. H., & Page, K. A. (2012). Gestational diabetes mellitus: Risks and management during and after pregnancy. *Nature Review. Endocrinology, 8*(11), 639-649. https://doi.org/10.1038/nrendo.2012.96

Byers, V. (2017). The challenges of leading change in health-care delivery from the front-line. *Journal of Nursing Management, 25*(6), 449-456. https://doi.org/10.1111/jonm.12342

Catalano, P. M., Vargo, K. M., Bernstein, I. M., & Amini, S. B. (1991). Incidence and risk factors associated with abnormal postpartum glucose tolerance in women with gestational diabetes. *American Journal of Obstetrics & Gynecology, 165*(4), 914-919. https://doi.org/10.1016/0002-9378(91)90438-w

References

Chauhan, S. P., Gherman, R., Hendrix, N. W., Bingham, J. M., & Hayes, E. (2010). Shoulder dystocia: Comparison of the ACOG practice bulletin with another national guideline. *American Journal of Perinatology, 27*(2)129-136. https://doi.org/10.1055/s-0029-122486

Cohen, B., Penning, S., Aynsley, D., Porto, M., & Garite, T. (1999). The incidence of shoulder dystocia correlates with a sonographic measurement of asymmetry in patients with diabetes. *American Journal of Perinatology, 16*(4), 197-201. https://doi.org/10.1055/s-2007-993858

Counties Manukau District Health Board (CMDHB). (2015). *Maternity quality and safety programme annual report 2013-2014.* Author.

Counties Manukau Health (CMH). (2017). *Maternity quality and safety programme annual report 2015-2016.* Author.

Counties Manukau Health (CMH). (2018). *Women's health and newborn annual report 2016-2017*. Author.

Counties Manukau Health (CMH). (2019). *Women's health and newborn annual report 2017-2018.* Author.

Cresswell, J. D., & Cresswell, J. W. (2017*). Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage.

Czarniawska, B. (2004*). Narratives in social science research. Introducing qualitative methods*. Sage.

Dajani, N. K., & Magann, E. F. (2014). Complications of shoulder dystocia. *Seminars in Perinatology, 38*(4), 201-204. https://doi.org/10.1053/j.semperi.2014.04.005

Dall'Asta, A., Ghi, T., Pedrazzi, G., & Frusca, T. (2016) Does vacuum delivery carry a higher risk of shoulder dystocia? Review and meta-analysis of the literature. *European Journal of Obstetrics & Gynecology and Reproductive Biology, 204,* 62-68. https://doi.org/10.1016/j.ejogrb.2016.07.506

De Meyer, A. (2013). Collaborative leadership. *The European Business Review.* http://www.europeanbusinessreview.com/?p=3316

Dildy, G. A., & Clark, S. L. (2000). Shoulder dystocia: Risk identification. *Clinical Obstetrics & Gynecology, 43*(2), 265-282. https://doi.org/10.1097/00003081-200006000-00005

Donald. I. (1974). *Practical obstetric problems* (4th ed.). Lloyd-Luke Ltd.

Dyachenko, A., Ciampi., A., Fahey, J., Mighty, H., Oppenheimer, L., & Hamilton, E. (2006). Prediction of risk for shoulder dystocia with neonatal injury. *American Journal of Obstetrics and Gynecology, 195*(6), 1544-1549. https://doi.org/10.1016/j.ajog.2006.05.013

Ecker, J. L., Greenberg, J. A., Norwitz, E. R., Nadel, A. S., & Repke, J. T. (1997). Birth weight as a predictor of brachial plexus injury. *Obstetrics & Gynecology, 89*(5), 643-7. https://doi.org/10.1016/s0029-7844(97)00007-0

References

Ennis, R. H. (1962). A concept of critical thinking. *Harvard Educational Review, 32*(1), 81-111.

Ferrara, A. I. (2007). Increasing prevalence of gestational diabetes mellitus: A public health perspective. *Diabetes Care, 30,* S141–146. https://doi.org/10.2337/dc07-s206

Gachon, B., Desseauve, D., Fritel, X., & Pierre, F. (2016). Is fetal manipulation during shoulder dystocia management associated with severe maternal and neonatal morbidities? *Archives of Gynecolgy & Obstetrics, 294*(3)*,* 505-509. https://doi.org/10.1007/s00404-016-4013-1

Gherman, R. (2002). Shoulder dystocia: An evidence-based evaluation of the obstetric nightmare. *Clinical Obstetrics & Gynecology, 45*(2), 345-362. https://doi.org/10.1097/00003081-200206000-00006

Gherman, R. B., Chauhan, S., Ouzounian, J. G., Lerner, H., Gonik, B., & Goodwin T. M. (2006). Shoulder dystocia: The unpreventable obstetric emergency with empiric management guidelines. *Obstetrics & Gynecology, 195*(3), 657-672. https://doi.org/10.1016/j.ajog.2005.09.007

Gherman, R., Goodwin, T., Souter, I., Neumann, K., Ouzounian, J., Paul, R. (1997). The McRoberts' maneuver for the alleviation of shoulder dystocia: How successful is it? *American Journal of Obstetrics and Gynecology, 176*(3), 656-661. https://doi.org/10.1016/s0002-9378(97)70565-9

Gherman, R.B., Ouzounian, J.G., & Goodwin, T.M. (1999). Brachial plexus palsy: An in-utero injury? *American Journal of Obstetrics and Gynecology, 181*(5), 1271-1272. https://doi.org/10.1016/s0002-9378(99)70633-2

Gherman, R. B., Ouzounian, J. G., Incerpi, M. H., Goodwin, T. M. (1998). Symphyseal separation and transient femoral neuropathy associated with the McRoberts maneuver. *American Journal of Obstetrics & Gynecology,178*(3), 609–10. https://doi.org/10.1016/s0002-9378(98)70447-8

Given, L. M. (2008). Qualitative research methods. In N. J. Salkind (Ed.), *The Encyclopedia of Educational Psychology* (pp. 827-831). Sage.

Gregory, A. T., & Denniss, A. R. (2019). Everything you need to know about peer review –The good, the bad and the ugly. *Heart, Lung and Circulation, 28*(8), 1148-1153. https://doi.org/10.1016/j.hlc.2019.05.171

Grobman, W. (2013). Shoulder dystocia. *Obstetrics & Gynecology Clinics of North America, 40*(1), 59-67.

Gurewitsch Allen, E.D. (2016). Recurrent shoulder dystocia: Risk factors and counselling. *Clinical Obstetrics & Gynecology, 59*(4), 803-812. https://doi.org/10.1097/GRF.0000000000000229

Gurewitsch, E. D., Donithan, M., Moore, P., Allen, L., Petersen, S., & Allen, R. (2003). Outcomes of mild vs severe shoulder dystocia. *American Journal of Obstetrics & Gynecology, 189*(6), Supplement 1, S208. https://doi.org/10.1016/j.ajog.2003.10.552

Gurewitsch, E., Johnson, E., Hamzehzadeh, S., & Allen, R. (2006). Risk factors for brachial plexus injury with and without shoulder dystocia. *American Journal of Obstetrics & Gynecology, 194*(2), 486-492. https://doi.org/10.1016/j.ajog.2005.07.071

References

Hansen, A., & Chauhan, S. P. (2014). Shoulder dystocia: Definitions and incidence. *Seminars in Perinatology, 38*(4), 184-188. https://doi.org/10.1053/j.semperi.2014.04.002

Hefferman, C. (2013). *Qualitative research approach.* Retrieved from http://www.explorable.com

Herzberg, S., Kabiri, D., Mordechai, T., Haj Yahya, R., Chill, H., Levitt, L., Amsalem, H., & Ezra, Y. (2017). Fetal macrosomia as a risk factor for shoulder dystocia during vacuum extraction. *Journal of Maternal-Fetal & Neonatal Medicine*, *30*(15), 1870-1873. https://doi.org/10.1080/14767058.2016.1228060

Hoffman, M., Bailit, J., Branch, D., Burkman, R., Van Veldhusien, P., Lu, L., Kominiarek, M., Hibbard, J., Landy, H., Haberman, S., Wilkins, I., Gonzalez Quintero, V., Gregory, K., Hatjis, C., Ramirez, M., Reddy, U., Troendle, J., & Zhang, J. (2011). A comparison of obstetric maneuvers for the acute management of shoulder dystocia. *American Journal of Obstetrics and Gynecology, 117*(6), 1272-1278. https://doi.org/10.1097/AOG.0b013e31821a12c9

Huber, D. L., Bair, H., Moorhead, S., & Hanrahan, K. (2019). A typology of innovations in nursing. *The Journal of Nursing Administration, 49*(7-8), 389-395. https://doi.org/10.1097/NNA.0000000000000773

Ixer, G. (1999). There's no such thing as reflection. *British Journal of Social Work, 29*(4), 513–527. https://doi.org/10.1093/bjsw/29.4.513

Jevitt, C. M. (2005). Shoulder dystocia: Etiology, common risk factors, and management. *Journal of Midwifery and Women's Health, 50*(6), 485-497. https://doi.org/10.1016/j.jmwh.2005.07.005

Johnson, J. W., Longmate, J. A., & Frentzen, B. (1992). Excessive maternal weight and pregnancy outcome. *American Journal of Obstetrics & Gynecology, 167*(2), 353-370. https://doi.org/10.1016/s0002-9378(11)91414-8

Kysh, L. (2013). *Difference between a systematic review and a literature review*. Retrieved from http://dx.doi.org/10.6084/m9.figshare.766364

Leedy, P., & Ormrod, J. (2001.) *Practical research: Planning and design* (7th ed.). Merrill Prentice Hall.

LeRiche, T., Oppenheimer, L., Caughey, S., Fell, D., & Walker, M. (2015). Shoulder dystocia documentation: An evaluation of a documentation training intervention. *Journal of Patient Safety & Volume, 11*(1), 18-22. https://doi.org/10.1097/PTS.0b013e3182948a51

Leung, T. Y., Stuart, O., Sahota, D. S., Suen, S. S. H., Lau, T. K., & Lao, T. T. (2011). Head-to-body delivery interval and risk of fetal acidosis and hypoxic ischaemic encephalopathy in shoulder dystocia: A retrospective review. *British Journal of Obstetrics & Gynaecology, 118*(4), 474-479. https://doi-org.ezproxy.aut.ac.nz/10.1111/j.1471-0528.2010.02834.x

Lim, E. L., Burden, T., Marshall, S. M., Davison, J. M., Blott, M. J., Waugh, J. S. J., & Taylor, R. (2009). Intrauterine growth rate in pregnancies complicated by type 1, type 2 and gestational diabetes. *Obstetric Medicine, 2*(1), 21-25. https://doi.org/10.1258/om.2008.080057

Lutsiv, O., Mah, J., Beyene, J., McDonald, S. D. (2015). Obesity reviews: An official journal of the International Association for The Study of Obesity. *Obesity Review, 16*(7), 531-46.

References

MacKenzie, I., Shah, M., Lean, K., Dutton, S., Newdick, H., & Tucker, D. (2007). Management of shoulder dystocia: Trends in incidence and maternal and neonatal morbidity. *American Journal of Obstetrics & Gynecology, 110*(5), 1059-1068. https://doi.org/10.1097/01.AOG.0000287615.35425.5c

McClintock, A.H. (1877). *Smellie's treatise on the theory and practice of midwifery* (Vol. 2). The New Sydenham Society.

McFarland, M., Hod, M., Piper, J. M., Xenakis, E. M., & Langer, O. (1995). Are labor abnormalities more common in shoulder dystocia? *American Journal of Obstetrics & Gynecology, 173*(4), 1211-1214. https://doi.org/10.1016/0002-9378(95)91355-6

Mehta, S. H., Bujold, E., Blackwell, S. C., Sorokin, Y., & Sokol, R. J. (2004). Is abnormal labor associated with shoulder dystocia in nulliparous women? *American Journal of Obstetrics & Gynecology, 190*(6), 1604-1609. https://doi.org/10.1016/j.ajog.2004.03.067

Menticoglou, S. (2018). Shoulder dystocia: Incidence, mechanisms, and management strategies. *International Journal of Women's Health, 10*, 723-732. https://doi.org/10.2147/IJWH.S175088

Mercer, J., Erickson-Owens, D., & Skovgaard, R. (2009). Cardiac asystole at birth: Is hypovolemic shock the cause? *Medical Hypotheses, 72*(4), 458-463. https://doi.org/10.1016/j.mehy.2008.11.019

Michelotti, F., Flatly, C., & Kumar, S. (2018). Impact of shoulder dystocia, stratified by type of manoeuvre, on severe neonatal outcome and maternal morbidity. *Australia & New Zealand Journal of Obstetrics and Gynaecology, 58*(3), 298-305. https://doi.org/10.1111/ajo.12718

Ministry of Health (MoH). (2019). *The New Zealand health survey 2018/19.* Author.

Morris, W. I. C. (1955). Report of the Newcastle-upon-Tyne Obstetrical & Gynecological Society – Shoulder dystocia. *Journal of Obstetrics & Gynaecology of the British Empire, 62,* 302-306.

Nesbitt, T. S., Gilbert, W. M., & Herrchen B. (1998). Shoulder dystocia and associated risk factors with macrosomic infants born in California. *American Journal of Obstetrics & Gynecology, 179*(2), 476-480. https://doi.org/10.1016/s0002-9378(98)70382-5

New Zealand Health Survey. (2019, Nov 14). *Annual update of key results 2018/19.* Retrieved from https://www.health.govt.nz/publication/annual-update-key-results-2018-19-new-zealand-health-survey

O'Connor, M. (2000). Shoulder dystocia: The accoucheur's bete-noir. *Obstetrics & Gynecology, 2*(3), 161-167.

O'Leary, J. A. (1992). *Shoulder dystocia and birth injury: prevention and treatment.* McGraw-Hill.

Ouzounian, J. G., Gherman, R. B., Chauhan, S., Battista, L. R., & Lee, R. H. (2012). Recurrent shoulder dystocia: Analysis of incidence and risk factors. *American Journal of Perinatology, 29*(7), 515-518. https://doi.org/10.1055/s-0032-1310522

References

Overland, E. A., Vatten, L. J., & Eskild, A. (2012). Risk of shoulder dystocia: Associations with parity and offspring birthweight. A population study of 1,914,544 deliveries. *Acta Obstetrics & Gynecology of Scandinavia, 91*(4), 48-488. https://doi.org/10.1111/j.1600-0412.2011.01354.x

Pates, J. A., McIntire, D. D., Casey, B. M., & Leveno, K. J. (2008). Predicting macrosomia. *Obstetrical & Gynecological Survey, 63*(5), 294-295. https://doi.org/10.1097/01.ogx.0000312296.15836.85

Perinatal & Maternal Mortality Review Committee. (2019). *Thirteenth annual report of the Perinatal and Maternal and Maternal Mortality Review Committee.* Health Quality & Safety Commission.

Poggi, S. H., Allen, R. H., Patel, C. R., Ghidini, A., Pezzullo, J. C., & Spong, C. Y. (2004). Randomized trial of McRobert's versus lithotomy positioning to decrease the force that is applied to the fetus during delivery. *American Journal of Obstetrics & Gynecology, 191*(3)*,* 874-878. https://doi.org/10.1016/j.ajog.2004.07.024

Rahman, J., Bhattee, G., & Rahman, M. S. (2009). Shoulder dystocia in a 16-year experience in a teaching hospital. *Journal of Reproductive Medicine, 54*(6)*,* 378-384.

Raio, L., Ghezzi, F., Naro, E. D., Buttarelli, M., Franchi, M., Dürig, P., & Brühwiler, H. (2003). Perinatal outcome of fetuses with a birth weight greater than 4500g: an analysis of 3356 cases. *European Journal of Obstetrics & Gynecology & Reproductive Biology, 109*(2), 160-165. https://doi.org/10.1016/s0301-2115(03)00045-9

Rapport, F., & Braithwaite, J. (2018). Are we on the cusp of a fourth research paradigm? Predicting the future for a new approach to methods-use in medical and health services research. *BMC Medical Research Methodology*, *18*(1) 131. http://doi.org/10.1186/s12874-018-0597-4

Riessman, C. K. (1993). *Qualitative research methods* (Vol. 30). *Narrative analysis.* Sage.

Rouse, D. J. Owen, J., Goldenberg, R. L., & Cliver, S. P. (1996). The effectiveness and costs of elective caesarean delivery for fetal macrosomia diagnosed by ultrasound. *JAMA, 276*(18), 1480-1486.

Rouse, D. J., Owen, J., Savage, K. G., & Hauth, J. C. (2001). Active phase labor arrest: revisiting the 2-hour minimum. *Obstetrics & Gynecology*, *98*(4), 550-554. https://doi.org/10.1016/S0029-7844(01)01516-2

Royal College of Obstetricians & Gynaecologists (RCOG). (2012). *Shoulder dystocia. Guideline no. 42.* RCOG.

Schön D. A. (1991). *The reflective practitioner: How professionals think in action*. Ashgate.

Sentilhes, L., Sénat, M. V., Boulogne, A. I., Deneux-Tharaux, C., Fuchs, F., Legendre, G., Le Ray, C., Lopez, E., Schmitz, T., & Lejeune-Saada, V. (2016). Shoulder dystocia: Guidelines for clinical practice from the French College of Gynecologists and Obstetricians (CNGOF). *European Journal of Obstetrics, Gynecology and Reproductive Biology*, *203,* 156-161. https://doi.org/10.1016/j.ejogrb.2016.05.047

Shephard, K., & Jensen, G. M. (2002). *Handbook of teaching for physical therapists* (2nd ed.). Butterworth-Heinemann.

References

Spain, J., Frey, H., Tuuli, M., Colvin, R., Macones, G., & Cahill, A. (2015). Neonatal morbidity associated with shoulder dystocia maneuvers. *American Journal of Obstetrics & Gynecology, 212*(3), 353, e1-5. https://doi.org/10.1016/j.ajog.2014.10.001

Spong. C. Y., Beall, M., Rodrigues, D., & Ross, M.G. (1995). An objective definition of shoulder dystocia: Prolonged head-to-body delivery intervals and/or the use of ancillary obstetric maneuvers. *Obstetrics & Gynecology, 86*(3), 433–436. https://doi.org/10.1016/0029-7844(95)00188-W

Sutton, J., & Scott, P. (1996). *Understanding and teaching optimal fetal positioning* (2nd ed.). Birth Concepts.

Tsur, A., Sergienko, R., Wiznitzer, A., Zlotnik, A., & Sheiner, E. (2012). Critical analysis of risk factors for shoulder dystocia. *Archives of Gynecology & Obstetrics, 285*(5), 1225-1229. https://doi.org/10.1007/s00404-011-2139-8

Verklan, M. T. (2009). The chilling details: Hypoxic–ischemic encephalopathy. *Journal of Perinatal & Neonatal Nursing, 23*(1), 59-68. https://doi.org/10.1097/01.JPN.0000346222.25331.e8

White, C. L. (2011). Nurse champions: A key role in bridging the gap between research and practice. *Journal of Emergency Nursing, 37*(4), 386-387. https://doi.org/10.1016/j.jen.2011.04.009

World Health Organization (WHO). (2020, March 3). *Obesity and overweight: Key facts.* Retrieved from https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Young, B. C., & Ecker, J. L. (2013). Fetal macrosomia and shoulder dystocia in women with gestational diabetes: Risks amenable to treatment? *Current Diabetes Report, 13*(1), 12-18. https://doi.org/10.1007/s11892-012-0338-8

Zhang, C., Wu, Y., Li, S., & Zhang, D. (2018). Maternal pre-pregnancy obesity and the risk of shoulder dystocia: A meta-analysis. *British Journal of Obstetrics & Gynaecology, 125*(4), 407-413. https://doi-org.ezproxy.aut.ac.nz/10.1111/1471-0528.14841

Appendices

Appendix A: Acceptance of article for publication in *The Practising Midwife*

From: Claire Feeley <claire@all4maternity.com>
Date: 22 January 2020 at 9:15:15 PM NZDT
To: Judith McAra-Couper <judith.mcara@aut.ac.nz>
Cc: "jayne@all4maternity.com" <jayne@all4maternity.com>
Subject: RE: Literature review article Success rates of Shoulder Dystocia managed by Internal Rotational Manoeuvres and delivery of the Posterior Arm: A Review of the Literature

Dear Judith,

Thank you so much for making these revisions, I am delighted to accept this article and we can publish the lit review in our May issue.

We are running a normal birth advancing practice series from September onwards, so I would love to use the 2nd article as an evidence series article in our September issue. It will work brilliant alongside this other series- and your work is an excellent example of 'research in action' with great applicability to clinical practice.

I appreciate that publication is some way off, but if you could send us head shots of all the authors, twitter or insta handles, and fill in this contract and return to Jayne, cc'd in. We'll be in touch end of March with author proofs for the first article.

Thanks again for all your hard work and submitting with us at TPM.

Very best wishes,
Claire

Appendix B: Joanna Briggs Appraisal Checklists for Cohort Studies

1. JB Critical appraisal checklist for cohort studies

Reviewer: Lesley Ansell **Date**: April 2019 **Record Number:** 1

Author: Michelotti, F., Flatly, C., & Kumar, S. **Year:** 2018

	Yes	No	Unclear	N/A
1. Were the two groups similar and recruited from the same population?	☐	☐	☐	☐
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	☐	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	☐	☐	☐	☐
4.Were confounding factors identified?	☐	☐	☐	☐
5. Were strategies to deal with confounding factors stated?	☐	☐	☐	☐
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	☐	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	☐	☐	☐	☐
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	☐	☐	☐	☐
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	☐	☐	☐	☐
10. Were strategies to address incomplete follow up utilized?	☐	☐	☐	☐
11. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments: Success rates were not in authors outcome measures but could be calculated from their results.

Score
8/9

2. JB Critical appraisal checklist for cohort studies

Reviewer: Lesley Ansell **Date:** April 2019 **Record Number:** 2

Author: Gachon, B., Desseauve, D., Fritel, X., & Pierre, F. **Year:** 2016

	Yes	No	Unclear	N/A
1. Were the two groups similar and recruited from the same population?	□	□	□	☒
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	□	□	□	☒
3. Was the exposure measured in a valid and reliable way?	☒	□	□	□
4.Were confounding factors identified?	□	□	☒	□
5. Were strategies to deal with confounding factors stated?	□	□	☒	□
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	☒	□	□	□
7. Were the outcomes measured in a valid and reliable way?	☒	□	□	□
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	☒	□	□	□
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	□	☒	□	□
10. Were strategies to address incomplete follow up utilized?	□	□	□	☒
11. Was appropriate statistical analysis used?	☒	□	□	□

Overall appraisal: Include ☒ Exclude □ Seek further info □

Comments: High success rates.

Score
5/8

3. Critical appraisal checklist for cohort studies

Reviewer: Lesley Ansell **Date:** April 2019 **Record Number:** 3

Author: Spain, J., Frey, H., Tuuli, M., Colvin, R., Macones, G., & Cahill, A. **Year**: 2015

	Yes	No	Unclear	N/A
1. Were the two groups similar and recruited from the same population?	☐	☐	☐	☐
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	☐	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	☐	☐	☐	☐
4. Were confounding factors identified?	☐	☐	☐	☐
5. Were strategies to deal with confounding factors stated?	☐	☐	☐	☐
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	☐	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	☐	☐	☐	☐
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	☐	☐	☐	☐
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	☐	☐	☐	☐
10. Were strategies to address incomplete follow up utilized?	☐	☐	☐	☐
11. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments: Apart from success McRoberts and SPP success rates not given.

Score
8/9

4. JB Critical appraisal checklist for cohort studies

Reviewer: Lesley Ansell **Date**: April 2019 **Record Number:** 4

Author: Hoffman, M., Bailit, J., Branch, D., Burkman, R., Van Veldhusien, P., Lu, L. et al. **Year:** 2011

	Yes	No	Unclear	N/A
1. Were the two groups similar and recruited from the same population?	□	□	□	☒
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	□	□	□	☒
3. Was the exposure measured in a valid and reliable way?	☒	□	□	□
4. Were confounding factors identified?	☒	□	□	□
5. Were strategies to deal with confounding factors stated?	☒	□	□	□
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	☒	□	□	□
7. Were the outcomes measured in a valid and reliable way?	☒	□	□	□
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	☒	□	□	□
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	☒	□	□	□
10. Were strategies to address incomplete follow up utilized?	□	□	□	☒
11. Was appropriate statistical analysis used?	☒	□	□	□

Overall appraisal: Include ☒ Exclude □ Seek further info □

Comments: Some potential confounders not included.

Score
8/8

5. JB Critical appraisal checklist for cohort studies

Reviewer: Lesley Ansell **Date**: April 2019 **Record Number:** 5

Author: Leung, T. Y., Stuart, O., Sahota, D. S., Suen, S. S. H., Lau, T. K., & Lao, T. T. **Year:** 2011

	Yes	No	Unclear	N/A
1. Were the two groups similar and recruited from the same population?	□	□	□	☑
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	□	□	□	☑
3. Was the exposure measured in a valid and reliable way?	☑	□	□	□
4.Were confounding factors identified?	☑	□	□	□
5. Were strategies to deal with confounding factors stated?	□	☑	□	□
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	☑	□	□	□
7. Were the outcomes measured in a valid and reliable way?	☑	□	□	□
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	☑	□	□	□
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	☑	□	□	□
10. Were strategies to address incomplete follow up utilized?	□	□	□	☑
11. Was appropriate statistical analysis used?	☑	□	□	□

Overall appraisal: Include ☑ Exclude □ Seek further info □

Comments: Good descriptive data.

Score:
7/8

6. JB Critical appraisal checklist for cohort studies

Reviewer: Lesley Ansell **Date**: April 2019 **Record Number:** 6

Author: MacKenzie, I., Shah, M., Lean, K., Dutton, S., Newdick, H., & Tucker, D. **Year:** 2011

	Yes	No	Unclear	N/A
1. Were the two groups similar and recruited from the same population?	□	□	□	☒
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	□	□	□	☒
3. Was the exposure measured in a valid and reliable way?	☒	□	□	□
4.Were confounding factors identified?	☒	□	□	□
5. Were strategies to deal with confounding factors stated?	□	□	☒	□
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	☒	□	□	□
7. Were the outcomes measured in a valid and reliable way?	☒	□	□	□
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	□	☒	□	□
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	□	□	□	☒
10. Were strategies to address incomplete follow up utilized?	□	□	□	☒
11. Was appropriate statistical analysis used?	☒	□	□	□

Overall appraisal: Include ☒ Exclude □ Seek further info □

Comments: Success rates were not in authors outcome measures but could be calculated from their results.

Score
5/7

7. JB Critical appraisal checklist for cohort studies

Reviewer: Lesley Ansell **Date**: April 2019 **Record Number:** 7

Author: Gherman, R., Goodwin, T., Souter, I., Neumann, K., Ouzounian, J., Paul, R. **Year:** 2011

	Yes	No	Unclear	N/A
1. Were the two groups similar and recruited from the same population?	□	□	□	☑
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	□	□	□	☑
3. Was the exposure measured in a valid and reliable way?	☑	□	□	□
4.Were confounding factors identified?	☑	□	□	□
5. Were strategies to deal with confounding factors stated?	☑	□	□	□
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	□	□	□	☑
7. Were the outcomes measured in a valid and reliable way?	☑	□	□	□
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	☑	□	□	□
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	☑	□	□	□
10. Were strategies to address incomplete follow up utilized?	□	□	□	☑
11. Was appropriate statistical analysis used?	☑	□	□	□

Overall appraisal: Include ☑ Exclude □ Seek further info □

Comments: Good statistical analysis

Score
7/7

Appendix C: Original article published in *Australia and New Zealand Journal of Obstetrics and Gynaecology*

Aust N Z J Obstet Gynaecol **2019; 1–7**

ANZJOG

DOI: 10.1111/ajo.13029

ORIGINAL ARTICLE

Axillary traction: An effective method of resolving shoulder dystocia

Lesley Ansell[1], David Alan Ansell[2], Judith McAra-Couper[3], Peter John Larmer[4] and Nicholas Kenneth Gerald Garrett[5]

[1]Birthing and Assessment, Middlemore Hospital, Auckland, New Zealand

[2]Women's Health, Middlemore Hospital, Auckland, New Zealand

[3]Faculty of Health and Environmental Sciences, Auckland University of Technology, Auckland, New Zealand

[4]Faculty of Health and Environmental Sciences, School of Clinical Sciences, Auckland University of Technology, Auckland, New Zealand

[5]Faculty of Health and Environmental Sciences, Department of Biostatistics and Epidemiology, Auckland University of Technology, Auckland, New Zealand

Correspondence: Lesley Ansell, 209E St Andrews Road, Epsom, Auckland 1023, New Zealand.
Email: lesley.ansell@xtra.co.nz

Conflicts of interest: **The authors report no conflicts of interest.**

Received: 19 August 2018; Accepted: 31 May 2019

Abstract

Background: **At Counties Manukau Health in Auckland, New Zealand, axillary traction is being used when an internal manoeuvre is required for resolution of shoulder dystocia.**

Aims: **This study presents the outcomes for mother and baby from use of axillary traction and other internal manoeuvres.**

Materials and Methods: **Retrospective review of the clinical records of mother and baby for all labours complicated by shoulder dystocia was carried out for an eight-year period. Maternal and neonatal information were compared for the three cohorts of the first internal manoeuvre documented: axillary traction, posterior arm delivery and rotational manoeuvres.**

Results: **There were 226 women who required the use of internal manoeuvres with no significant differences in age, body mass index, parity, ethnicity, diabetes incidence, induction and augmentation of labour rates, length of the first stage and birth weight between the cohorts. Axillary traction was the first internal manoeuvre used for 119 (52.7%) with a success rate of 95.8%. Posterior arm delivery was used first for 49 (21.7%) women with a success rate of 85.7%. Rotational manoeuvres were used first for 58 (25.7%) women with a statistically inferior success rate of 48.3%. There was no significant difference in the maternal and neonatal complication rates between the cohorts.**

Conclusion: **Axillary traction has been utilised as the first internal manoeuvre for a large number of women with a higher success rate than other internal manoeuvres without any increase in maternal or neonatal morbidity. It is recommended that this be the first internal manoeuvre attempted when shoulder dystocia occurs.**

KEYWORDS

axillary traction, birth injury, posterior arm delivery, rotational manoeuvres, shoulder dystocia

INTRODUCTION

Shoulder dystocia is a childbirth emergency which has significant risks to fetal and maternal outcome.[1] Shoulder dystocia occurs when either one or both shoulders fail to enter the pelvic cavity.[2]

Current management of shoulder dystocia involves the use of various manoeuvres to alleviate the problem, yet there is a lack of randomised controlled trials or experiments that have directly compared their effectiveness. There are authors who recommend a well-coordinated sequence of manoeuvres such as those described by the HELPERR mnemonic,[3-5] but there is no clear evidence base for the order of use of these manoeuvres.[6,7]

A qualitative study carried out by Ansell *et al.*[8] suggested that axillary traction is a useful manoeuvre for the management of shoulder dystocia when an internal manoeuvre is required. To perform axillary traction the clinician's whole hand enters the posterior aspect of the pelvis. Regardless of which side the fetus is facing, the fetal shoulder is located and grasped by sliding the first finger under the axilla and placing the thumb on

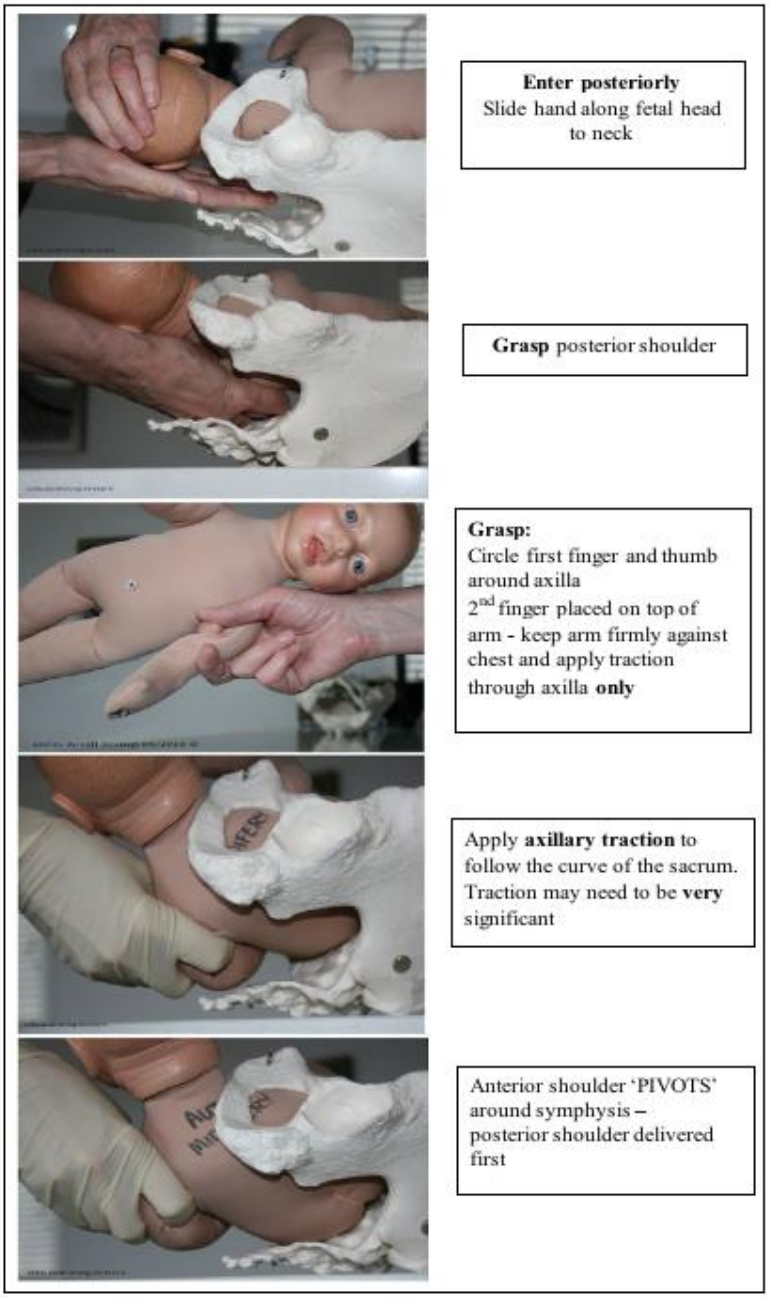


FIGURE 1 **Axillary traction.**

TABLE 1 Demographics and clinical characteristics of first internal manoeuvre cohorts

	Axillary traction	Posterior arm delivery	Rotational manoeuvres	*P*-value
Characteristics				
Age, years, median	29.0	31.0	28.0	0.26†
Body mass index, median	30.2	28.1	31.8	0.70†
Parity				
Nulliparous	35 (29.4%)	19 (38.8%)	18 (31.0%)	0.49
Multiparous	84 (70.6%)	30 (61.2%)	40 (69.0%)	
Gestation, weeks, median	40.1	40.1	40.0	0.50†
Ethnicity				
European	22 (18.5%)	14 (28.6%)	9 (15.6%)	0.15
Māori	10 (8.4%)	5 (10.2%)	11 (19.0%)	
Pacifica	44 (37.0%)	9 (18.4%)	20 (34.5%)	
Indian	21 (17.6%)	13 (26.5%)	9 (15.5%)	
Chinese	5 (4.2%)	4 (8.2%)	3 (5.2%)	
Other	17 (14.3%)	4 (8.2%)	6 (10.3%)	
Diabetes				
Type 1	0	1 (2.0%)	0	0.40‡
Type 2	2 (1.7%)	2 (4.1%)	3 (5.2%)	
Gestational diabetes	11 (9.2%)	6 (12.2%)	7 (12.1%)	
Labour characteristics				
Labour induction	21 (17.6%)	16 (32.7%)	10 (17.2%)	0.07
Syntocinon augmentation	34 (28.6%)	19 (38.8%)	15 (25.9%)	0.30
Epidural	25 (21.0%)	14 (29.2%)	15 (25.9%)	0.50
Forceps delivery	5 (4.2%)	6 (12.2%)	2 (3.4%)	0.13‡
Ventouse delivery	23 (19.3%)	20 (40.8%)	16 (27.6%)	0.03
Length of first stage, h, median	5.875	6.0	6.75	0.19†
Length of second stage, min, median	33.0	59.0	40.5	0.03†
Birth weight, g, median	4060	4080	4090	0.77†

†Kruskall–Wallace test.
‡Fisher exact test.

top of the shoulder. The second finger is placed alongside the fetal humerus to keep the arm firmly against the body. Traction is applied firmly and directly through the fetal axilla to follow the sacral curve until the posterior shoulder appears over the perineum while the anterior shoulder 'pivots' around the symphysis. Once the posterior shoulder is delivered then the anterior shoulder can easily be delivered by lateral traction (Fig. 1). This manoeuvre differs from removal of the posterior arm as only the axilla is located rather than the elbow. No attempt is made to flex the fetal arm across the body, the fetal arm is held firmly against the body and no traction or pressure applied to the humerus or elbow. The aim is to deliver the posterior shoulder only rather than the whole arm.

The aim of this study was to assess the effectiveness of axillary traction when shoulder dystocia occurs. This retrospective review of the internal manoeuvres used in the management of shoulder dystocia is the first to document the use of axillary traction for a large number of women.

MATERIALS AND METHODS

A retrospective review of clinical records of women who experienced shoulder dystocia between 1 January 2006 and 31 December 2013 was conducted. All women gave birth within Counties Manukau Health (CMH), Auckland. Participants were identified from the hospital database Casemix.

The study was approved by the Southern Health and Disability Ethics Committee (HDEC); Ethics reference: 14/STH/15.

The inclusion criteria for the study were women with a singleton fetus, cephalic presentation beyond 34 weeks gestation and who experienced shoulder dystocia during vaginal birth. Women with intrauterine fetal death before the onset of labour and major fetal abnormality were excluded.

Shoulder dystocia was defined as those women requiring more than the normal traction usually required or additional manoeuvres to effect delivery of the shoulders. There were a total

TABLE 2 Success rates of the first three internal manoeuvres used

	Success *n* (%)	Failure *n* (%)	Total *n*	*P*-value
First manoeuvre				
Axillary traction	114 (95.8)	5 (4.2)	119	<0.001
Posterior arm	42 (85.7)	7 (14.3)	49	
Internal rotation	28 (48.3)	30 (51.7)	58	
Total	184 (81.4)	42 (18.6)	226	
Second manoeuvre				
Axillary traction	12 (85.7)	2 (14.3)	14	0.71†
Posterior arm	11 (78.6)	3 (21.4)	14	
Internal rotation	7 (70.0)	3 (30.0)	10	
Total	30 (78.9)	8 (21.1)	38	
Third manoeuvre				
Axillary traction	4	1	5	0.52†
Posterior arm	1	0	1	
Internal rotation	0	1	1	
Total	5	2	7	

†Fisher exact test.

of 52 055 vaginal births during the study period. A total of 422 (0.81%) were identified as having shoulder dystocia.

The maternal and neonatal records of all women experiencing shoulder dystocia during the study period were reviewed by the lead author and an assistant. Information regarding the manoeuvres used to resolve the dystocia and the order in which the manoeuvres were employed were collected. McRoberts and suprapubic pressure were treated as a single manoeuvre and in CMH these manoeuvres are universally employed first. The final successful manoeuvre was identified.

There were three main groups of internal manoeuvres:

1. axillary traction which included all manoeuvres documented as axillary traction or removal of the posterior shoulder
2. posterior arm delivery which was documented as such
3. internal rotational manoeuvres which included all manoeuvres documented as Woods' screw, reverse Woods' screw and/or internal rotation.

TABLE 3 Complications with and without internal manoeuvres

	No internal manoeuvres	Any internal manoeuvres	*P*-value
Neonatal			
APGAR < 7 at 5 min	8 (4.1%)	16 (7.1%)	0.18
Brachial plexus injury	15 (7.7%)	37 (16.4%)	0.02
Clavicle fracture	3 (1.5%)	3 (1.3%)	0.72†
Humerus fracture	1 (0.5%)	5 (2.2%)	0.22†
Hypoxic ischaemic encephalopathy			
Grade 1	0	2	0.28†
Grade 2	0	0	
Grade 3	1	1	
Neonatal unit admission	22 (11.3%)	34 (15.0%)	0.26
Maternal			
Blood loss, mL			0.90‡
Mean	477	458	0.90
Perineum			
Episiotomy	41 (21.1%)	63 (28.8%)	
Second degree laceration	57 (29.4%)	51 (23.3%)	0.35
Third/fourth degree laceration	18 (9.3%)	16 (7.3%)	

†Fisher exact test.
‡Kruskall–Wallace test.

Maternal information included age, parity, ethnicity, body mass index (BMI), gestation, diabetes, induction of labour, augmentation of labour, epidural, normal vaginal birth, instrumental birth and type, length of the first stage and second stage of labour perineal trauma and blood loss. Neonatal information included birthweight, APGAR score < 7 at five minutes, brachial plexus injury (BPI), clavicular and humeral fractures, hypoxic ischaemic encephalopathy (HIE) and neonatal unit admission. Cord blood gas analysis results were not readily available during the study period; therefore, they were unable to be collected.

Data were collected onto a Microsoft Excel spreadsheet which was then analysed using the Statistical Package for the Social Sciences (SPSS) version 24 (IBM, Armonk, NY, USA). Demographic and clinical data for the three internal manoeuvre cohorts were compared. Categorical data were compared using χ^2 and Fisher's exact tests. Continuous data were compared using Student's *t*-test (normal distribution) or Mann–Whitney or Kruskall–Wallace test for non-normal distributions. Where differences between the

TABLE 4 Complications associated with internal manoeuvres

	Axillary traction	Posterior arm delivery	Rotational manoeuvres	*P*-value
Neonatal				
APGAR < 7 at 5 min	1 (0.8%)	3 (6.1%)	12 (20.1%)	<0.001†
Brachial plexus injury	17 (14.3%)	10 (20.4%)	10 (17.2%)	0.70
Clavicular fracture	3 (2.5%)	0	0	0.15†
Humerus fracture	1 (0.8%)	1 (2.0%)	3 (5.3%)	0.21†
Hypoxic ischaemic encephalopathy				
Grade 1	2	0	0	0.59†
Grade 2	0	0	0	
Grade 3	0	0	1	
NNU admission	18 (15.1%)	6 (12.2%)	10 (17.2%)	0.7
Maternal				
Blood loss (mL)				
Mean	373	560	546	0.03‡
Perineum				
Episiotomy	28 (22.2%)	21 (43.8%)	14 (24.1%)	0.36†
Second degree tear	24 (20.9%)	13 (22.9%)	16 (27.6%)	
Third/fourth degree tear	9 (7.8%)	3 (6.3%)	4 (6.9%)	

†Fisher exact test.
‡Kruskall–Wallace test.
NNU, neonatal unit

cohorts were noted with categorical data the success rates of the internal manoeuvres were compared using χ^2 tests or Fisher's exact test.

RESULTS

Data were collected for the 422 women whose births were complicated by shoulder dystocia at CMH for the period 1 January 2006 to 31 December 2013 (inclusive). The incidence of shoulder dystocia increased from 0.54% of all vaginal births in 2006 to 1.26% in 2013 with the average rate of shoulder dystocia over the study period being 0.81%.

Of the 422 women who experienced shoulder dystocia, a total of 226 required internal manoeuvres to resolve the problem (53.6%). The first internal manoeuvre used was as follows:

1. axillary traction in 119 women (52.7%)
2. posterior arm delivery in 49 women (21.7%)
3. rotational manoeuvres in 58 women (25.7%).

There were no significant differences in age, BMI, parity, gestation, ethnicity, incidence of diabetes, labour induction rates, syntocinon augmentation rates, epidural use, length of the first stage, and birth weight in the three cohorts (Table 1). The axillary traction cohort was less often preceded by ventouse than the posterior arm delivery and rotational manoeuvres cohort (P 0.03). The overall success rate of the first internal manoeuvre was no different if the ventouse was used or not (P 0.56). Labour induction rates between the cohorts neared statistical significance (P 0.07) but the overall success rate of the first internal manoeuvre was no different if it was preceded by labour induction (χ^2 P 0.59). Only 13 women had forceps deliveries with no statistically significant difference between the cohorts (0.13) and the overall success rate of the first internal manoeuvre was no different if it was preceded by forceps delivery (P 0.71). Length of the second stage of labour was significantly different between the cohorts (P 0.03) with the posterior arm delivery cohort having a median second stage 26 min longer than the axillary traction cohort and 18.5 min longer than the rotational manoeuvres cohort. Again, the distribution of the length of the second stage was no different if the first internal manoeuvre was successful or not (P 0.25). Median length of the first stage was not significantly different for the three cohorts (P 0.19).

Overall there was a highly significant difference (P < 0.001) in the success rates of the first used internal manoeuvres (Table 2). In 119 (52.7%) cases the first internal manoeuvre used was axillary traction. This was successful in 114 cases (95.8%) and no further manoeuvres were required. Of the five which failed with axillary traction as the first internal manoeuvre, three were successfully delivered with the second use of axillary traction by a different practitioner, one with rotational manoeuvres and one with rotational manoeuvre followed by posterior arm delivery. The success rate of axillary traction as a first internal manoeuvre was significantly greater than that for rotational manoeuvres (P < 0.001) and posterior arm delivery (P 0.025).

In 49 (21.7%) cases posterior arm delivery was used as the first internal manoeuvre and was successful in 42 (85.7%) cases. In the seven cases where posterior arm delivery failed, one was delivered with a second attempt of the posterior arm, four with rotational manoeuvres and two with axillary traction. The success rate of use of posterior arm delivery was significantly less than that of use of axillary traction (P 0.025) but much higher than that of rotational manoeuvres ($P < 0.01$).

In 58 (25.7%) cases, a rotational manoeuvre was the first internal manoeuvre attempted and was successful in 28 cases (48.3%) which is statistically less successful than axillary traction ($P < 0.001$) and posterior arm delivery ($P < 0.01$). Of the 28 cases where rotational manoeuvre was unsuccessful as the first manoeuvre, nine were delivered by axillary traction, 10 with posterior arm delivery, three with a further attempt at rotational manoeuvres and six were delivered with a combination of other manoeuvres.

Axillary traction was used as a second internal manoeuvre for 14 women (Table 2), posterior arm delivery as a second manoeuvre for 14 women and rotational manoeuvres for 10 women. Overall there was no significant difference in the success rates of the different second manoeuvres (P 0.71).

A third internal manoeuvre was required for just seven women with again there being no significant difference in success rates (P 0.52).

There were no significant differences in neonatal and maternal complication rates between those managed without internal manoeuvres and those requiring any internal manoeuvres except for BPI. All BPI were Erb's palsies and all but five had recovered before hospital discharge. Axillary traction had been used for only one of these babies and all had recovered completely by three months of age (Table 3).

There were no significant differences in the complication rates (Table 4) of the different first manoeuvres in relation to perineal trauma (P 0.36), total neonatal birth injuries (P 0.39) and neonatal nerve palsies (P 0.70). There were just three recorded cases with HIE.

DISCUSSION

Management of shoulder dystocia involves the use of both internal and external manoeuvres to overcome the problem, yet there is a lack of randomised controlled trials (RCT) to compare their effectiveness. Such trials would not be feasible because of the difficulty in obtaining informed consent from all women for different manoeuvres when managing an uncommon complication of vaginal birth and every measure possible to resolve the problem is required without the restriction of one defined set of manoeuvres as would be required with a RCT. The internal manoeuvres currently used to resolve shoulder dystocia, therefore, have been implemented largely because of case reports, individual practitioner experience and expert opinion.[9,10]

MacKenzie *et al.*[11] report increasing rates of shoulder dystocia with a trend of 0.3% per year. The rates of shoulder dystocia in the study were seen to increase from 0.54% in 2006 to 1.26% in 2013. This is an increasing trend of 0.12% per year, comparable with the study of MacKenzie *et al.*[11]

The average BMI in the study population was 30.87 which is categorised as obese[12] and there is evidence that maternal obesity and fetal macrosomia is associated with shoulder dystocia.[13,14]

The results of this study show that axillary traction was a highly successful manoeuvre when used as the first internal manoeuvre (96.4%) and no further manoeuvres were required. Posterior arm delivery also had a significant success rate (84.8%) when used as the first internal manoeuvre but was not as successful as axillary traction. Posterior arm delivery was significantly more successful than rotational manoeuvres (46.6%) but neither manoeuvre was as successful as axillary traction.

The choice of the first internal manoeuvre used was not affected by ethnicity, maternal age, BMI, maternal diabetes, gestation, labour induction, syntocinon augmentation, epidural, length of the first stage, forceps delivery or birthweight. Posterior arm delivery was significantly more likely to be the first manoeuvre used in women who had a longer second stage or ventouse delivery.

Shoulder dystocia is associated with birth injuries such as BPI, skeletal fractures, birth asphyxia and neurological injury.[1,15] It is likely that the higher rate of BPI seen in the group managed by internal manoeuvres was due to the use of multiple manoeuvres and/or the severity of the shoulder dystocia.

In this study, axillary traction had been used for a large number of women with no evidence of increased adverse effects on the neonate. There was a slightly lower incidence of birth injuries in the axillary traction group, but this was not statistically significant. There were no statistical differences in the number of Erb's palsies and total birth injuries in any of the groups. From this case series, there is no indication that axillary traction increases the risk of BPI. Shoulder dystocia is associated with higher rates of BPI[16] and is possibly related to excessive traction on the fetal head rather than the internal manoeuvres used to resolve the problem.[17] The amount of traction applied to the fetal head in all cases in the study population was unable to be assessed due to lack of documentation.

The results of this study show that axillary traction is a very effective manoeuvre for resolving shoulder dystocia with no increased adverse outcomes to the neonate and should be considered as the first-line management when an internal manoeuvre is required.

Benefits and limitations of the study

One of the main benefits of this study is that there were multiple ethnicities and high average BMI in the study population which means that the results are applicable to most women.

The limitations of the study are acknowledged. There was no consistency in the definition of shoulder dystocia and diagnosis was based on clinical judgement. However, as the cases of

shoulder dystocia in the study population all required an internal manoeuvre to resolve the problem, there is an assumption that the shoulder dystocia was significant. The head-to-body delivery time intervals were seldom recorded so this measure, often used in diagnosis and assessing severity of shoulder dystocia[18] is not available. However, this measure of severity may not be applicable to this study population as it is usual practice to wait for the next contraction following birth of the head before attempting delivery of the shoulders.

Data collection was difficult because there was no formal method for documenting shoulder dystocia. It is possible that not all of the manoeuvres used may have been recorded, with only the manoeuvre that resolved the shoulder dystocia being recorded. Even when a proforma was introduced in 2010 to capture the order of the manoeuvres used and the length of time each manoeuvre was attempted, it was often not completed and methods of management were extracted from the written clinical notes.

It is also unclear as to why the practitioner chose a particular manoeuvre as there were no clinical criteria as to when to use each manoeuvre. This may be related to individual practitioners who manage shoulder dystocia depending on their training and experience or to the perceived difficulty of the shoulder dystocia. Resident Medical Officers who had worked in other hospitals may not have been exposed to axillary traction and may, therefore, have been more likely to use delivery of the posterior arm or rotational manoeuvres.

CONCLUSION

This retrospective study showed a significant increase in the rate of shoulder dystocia for women in the study period (0.54–1.26%). The reason for this increase is unknown but may be related to the high level of diabetes and obesity in the study population.

Axillary traction is found to be a highly successful manoeuvre when used as the first internal manoeuvre (95.8%). Removal of the posterior arm also had a significant success rate (84.8%) when used as the first internal manoeuvre but was not as successful as axillary traction but significantly more successful than internal rotation. There were slightly less birth injuries in axillary traction group and although not statistically significant warrants further investigation.

This study, therefore, provides good evidence that axillary traction has a high success rate and a low complication rate and can be used for all women. Axillary traction should be recommended as the first internal manoeuvre attempted when shoulder dystocia occurs.

REFERENCES

1. **Dajani NK, Magann EF. Complications of shoulder dystocia.** *Semin Perinatol* **2014; 38: 201–204.**
2. **Gherman RB. Shoulder dystocia: an evidence based evaluation of the obstetric nightmare.** *Clin Obstet Gynecol* **2002; 45: 345–362.**
3. **Royal College of Obstetricians and Gynaecologists (RCOG). Shoulder Dystocia, Guideline No. 42. London: Guidelines and Audit Committee of RCOG; 2012.**
4. **Camune B, Brucker MC. An overview of shoulder dystocia: the nurse's role.** *Nurs Women's Health* **2007; 11: 488–498.**
5. **Advanced Life Support in Obstetrics (ALSO). Advanced Life Support in Obstetrics. Course Syllabus Part I. USA: American Academy of Family Physicians; 2000.**
6. **American College of Obstetrics and Gynecology (ACOG). Shoulder dystocia. ACOG Practice Pattern No. 7.** *Int J Gynecol Obstet* **1998; 60: 306–313.**
7. **Simpson KR. Shoulder dystocia: nursing interventions and risk- management strategies.** *Am J Matern Child Nurs* **1999; 24: 305–311.**
8. **Ansell Irving L, McAra-Couper J, Smythe E. Shoulder dystocia: a qualitative exploration of what works.** *Midwifery* **2012; 28: 461–468.**
9. **Taddei E, Marti C, Capoccia-Brugger R, Brunisholz Y. Posterior axilla sling traction and rotation. A case report of an alternative for intractable shoulder dystocia.** *J Obstet Gynaecol* **2017; 37: 387–389.**
10. **Schramm M. Impacted shoulders – a personal experience.** *Aust N Z J Obstet Gynaecol* **1983; 108: 755–757.**
11. **MacKenzie IZ, Shah M, Lean K** *et al.* **Management of shoulder dystocia: trends in incidence and maternal and neonatal morbidity.** *Obstet Gynecol* **2007; 110: 1059–1068.**
12. **Ministry of Health (MoH). Report on Maternity 2015. Wellington: Ministry of Health; 2017.**
13. **Zhang C, Wu Y, Li S, Zhang D. Maternal pre-pregnancy obesity and the risk of shoulder dystocia: a meta-analysis.** *Br J Obstet Gynaecol* **2018; 125: 407–413.**
14. **Dodd JM, Catcheside B, Scheil W. Can shoulder dystocia be reliably predicted?** *Aust N Z J Obstet Gynaecol* **2012; 52: 248–252.**
15. **Iffy L, Brimacombe M, Apuzzio JJ** *et al.* **The risk of shoulder dystocia related permanent fetal injury in relation to birth weight.** *Eur J Obstet Gynecol Reprod Biol* **2008; 136(1): 53–60.**
16. **Gherman RB, Chauhan S, Oh C, Goodwin M. Brachial plexus palsy.** *Fetal Matern Med Rev* **2005; 16(3): 221–243.**
17. **Sentilhes L, Sénat MV, Boulogne AI** *et al.* **Shoulder dystocia: guidelines for clinical practice from the French College of Gynecologists and Obstetricians (CNGOF).** *Eur J Obstet Gynecol Reprod Biol* **2016; 203: 156–161.**
18. **Spong CY, Beall M, Rodriques D, Ross MG. An objective definition of shoulder dystocia: prolonged head-to-body delivery intervals and/or use of ancillary obstetric maneuvers.** *Obstet Gynecol* **1995; 86: 433–436.**

Appendix D: Acceptance of article for publication in *Australia and New Zealand Journal of Obstetrics and Gynaecology*

The Australian and New Zealand Journal of Obstetrics and Gynaecology - Decision on Manuscript ID ANZJOG-2018-0289.R2

From: Caroline de Costa

Sent: Saturday, 1 June 2019 12:49 AM

To: lesley.ansell@xtra.co.nz

Cc: anzjog.eo@wiley.com

Subject: The Australian and New Zealand Journal of Obstetrics and Gynaecology - Decision on Manuscript ID ANZJOG-2018-0289.R2

31-May-2019

Dear Mrs. Ansell:

It is a pleasure to accept your manuscript entitled "Axillary Traction: an effective method of resolving shoulder dystocia" (ANZJOG-2018-0289.R2) in its current form for publication in The Australian and New Zealand Journal of Obstetrics and Gynaecology.

Please note although the manuscript is accepted the files will now be checked to ensure that everything is ready for publication, and you may be contacted if final versions of files for publication are required.

Your article cannot be published until the publisher has received the appropriate signed license agreement. Once your article has been received by Wiley for production the corresponding author will receive an email from Wiley's Author Services system which will ask them to log in and will present them with the appropriate license for completion.

Thank you for your fine contribution. The Editorial Board of The Australian and New Zealand Journal of Obstetrics and Gynaecology look forward to your continued contributions to the Journal.

Sincerely,

Prof. Caroline de Costa

Editor, The Australian and New Zealand Journal of Obstetrics and Gynaecology

anzjog.eo@wiley.com

Editor's note: I apologise again for the extreme delay in the reviewing of your manuscript. This is largely because we have been hoping that one of the reviewers would write an accompanying editorial, as this is such an important topic. This may still happen but meanwhile I am accepting your article and it will appear in the October hard copy of ANZJOG, and on EarlyView as soon as the proofreading process has been completed.

Appendix E: Letter to the editor

Shoulder Dystocia
Journal: *The Australian and New Zealand Journal of Obstetrics and Gynaecology*
Manuscript ID ANZJOG-2019-0493
Manuscript Type: Letter to the Editor

Shoulder Dystocia

Dear Editor,
Am I the only reader who notices the disparate quality of articles in ANZJOG? The most recent issue, October 2019, for example.

The statistical analysis in the article by Hsieh et al (1) is robust I am sure, but the conclusions drawn by the authors seem irrational. They briefly admit that children with major intellectual handicap would not have taken part in any NAPLAN testing, "our methodology may miss children with severe developmental impairments as they may not be attending school". Yet the authors go on to claim their conclusion, that no intellectual harm is done by instrumental delivery, is unlikely to include any selection bias. Is ignoring this group of children, potentially those most effected, not a selection bias? Such an enormous selection bias makes it difficult to draw any conclusion at all from the study.

At the other end of the spectrum is the article by Ansell et al (2). The study design is extremely simple and the results are probably poorly controlled for confounders. Yet to my mind, this is one of the best articles that the journal has published in years. I can only suspect the editors thought so too, having invited the editorial by Robson. Shoulder dystocia is an important clinical problem identified later in the same issue of ANZJOG by Sadler et al (3), as the second commonest peripartum cause of neonatal encephalopathy. The axillary traction technique promoted by Ansell could not be called novel, having been practised by many of us for decades. Still the authors, like whistle blowers, draw our attention to an undocumented idea. I congratulate them on a very valuable clinical contribution to obstetrics and more than that I admire them. It takes
courage to challenge the norms set by your peers.
Yours,
Author

References
(1) Hsieh D., Smithers L., Black M., Lynch J., Dekker G., Wilkinson C., Strack M., and Moi B. 2019. "Implications of vaginal instrumental delivery for children's school achievement: A population-based linked administrative data study. " ANZJOG 59 (5) 677-683
(2) Ansell L., Ansell D., McAra-Couper J., Larmer P., and Garrett N. 2019. "Axillary traction: An effective method of resolving shoulder dystocia. " ANZJOG 59 (5) 627-633
(3) Sadler L., Masson V., Belgrave S., Bennett H., van den Boom J., Miller S., and Battin M. 2019. "Contributory factors and potentially avoidable neonatal encephalopathy associated with acute peripartum events: An observational study." ANZJOG 59 (5) 699-705

Appendix F: Letter from Dr. Steven Grant

From: Steven Grant
Sent: Monday, 9 March 2020 3:24 PM
To: lesley.ansell@xtra.co.nz
Subject: Regarding your article in the recent AJOG re Shoulder Dystocia - clarification appreciated.
Importance: High

Dear Lesley,

I read with interest your recent article published in the October 2019 AJOG regarding Axillary Traction, and its success rate in dealing with the problem of shoulder dystocia.

As an Obstetrician I found it very informative and helpful.

I am emailing to ask two questions though.

1. On the second page of the article (page 628), alongside the photographs demonstrating the technique, you state "… Traction may need to be **very** significant". Are you able to quantify exactly how significant the traction may need to be? I appreciate this may be akin to stating how long is a piece of string, but for those of us who would like to incorporate this technique into our armamentarium, I would greatly appreciate some guidance. I note that on the 5th page of the article (bottom of page 631) you comment that of those who had an unsuccessful initial attempt at axillary traction, 3 out of 5 were successfully delivered by the same technique when a different practitioner took over. Do you think this was (perhaps partially) due to them applying significantly more traction than the original accoucheur?
2. Do you recommend an episiotomy if this has not already been performed to increase success of the procedure, and to try and reduce the incidence of third/fourth degree tears?

Thank you for any clarification you can provide. It seems an 'easy' technique to use in an emergency situation, and so I would like to educate our Registrars and Midwives in it. Naturally they are going to ask, how much traction is 'significant', hence my reaching out to you for your thoughts and advice.

Kindest Regards

Steven Grant

Consultant O&G

New Plymouth.

From: David Ansell
Sent: Tuesday, 10 March 2020 12:55 PM
To: Steven Grant
Subject: RE: Regarding your article in the recent AJOG re Shoulder Dystocia - clarification appreciated.

Dear Steven

Many thanks for your email and we appreciate your positive comments.

1. With regard to the **very** significant traction simply use as much as you need to move the baby. Unlike applying lateral traction to the fetal head which can cause significant damage to the baby – you can use as much traction as is needed to create movement in the shoulder (I personally have suffered strain symptoms in the muscles of my forearm after doing this with a severe shoulder dystocia so I know I have pulled extremely hard!). The most important thing is to make sure that the second finger keeps the fetal arm firmly against the body and **all** of the traction is driven through the axilla and not against the arm otherwise the humerus is likely to fracture. When the same technique was used by another practitioner I think there was significantly more traction applied but also the second practitioner was more experienced and therefore more confident with the use of axillary traction.
2. There was no evidence from this study that there was any overall difference in perineal trauma with any of the internal manoeuvres. When episiotomy was performed it was nearly always done prior to delivery of the fetal head. Nevertheless, I have personally had an experience where it was extremely difficult to move the posterior shoulder despite having a firm grasp and it appeared that the perineal muscles were impeding progress of the shoulder. In that case episiotomy resolved the problem immediately. My advice would be not to hesitate to do so if required but not as a routine procedure.

I hope this is of help and please don't hesitate to contact me if you require any further clarification.

Kind regards

Lesley Ansell

Sent from Mail for Windows 10

Appendix G: Ethics Committee application

Health and Disability Ethics Committees

Health and Disability Ethics Committees
C/- MEDSAFE, Level 6, Deloitte House
10 Brandon Street
PO Box 5013
Wellington

0800 4 ETHICS
hdecs@moh.govt.nz

20 October 2014

MS Lesley Ansell
209 E St Andrews Road
Epsom Auckland 1003

Dear MS Ansell

Re:	**Ethics ref:**	**14/STH/154**
	Study title:	Shoulder Dystocia:A retrospective observational review to assess the effectiveness and any complications of axillary traction compared to other internal manoeuvres for resolving shoulder dystocia.

I am pleased to advise that this application has been *approved* by the Southern Health and Disability Ethics Committee. This decision was made through the HDEC-Expedited Review pathway.

Conditions of HDEC approval

HDEC approval for this study is subject to the following conditions being met prior to the commencement of the study in New Zealand. It is your responsibility, and that of the study's sponsor, to ensure that these conditions are met. No further review by the Southern Health and Disability Ethics Committee is required.

Standard conditions:

1. Before the study commences at *any* locality in New Zealand, all relevant regulatory approvals must be obtained.

2. Before the study commences at *a given* locality in New Zealand, it must be authorised by that locality in Online Forms. Locality authorisation confirms that the locality is suitable for the safe and effective conduct of the study, and that local research governance issues have been addressed.

After HDEC review

Please refer to the *Standard Operating Procedures for Health and Disability Ethics Committees* (available on www.ethics.health.govt.nz) for HDEC requirements relating to amendments and other post-approval processes.

Your next progress report is due by 20 October 2015.

Participant access to ACC

The Southern Health and Disability Ethics Committee is satisfied that your study is not a clinical trial that is to be conducted principally for the benefit of the manufacturer or distributor of the medicine or item being trialled. Participants injured as a result of treatment received as part of your study may therefore be eligible for publicly-funded compensation through the Accident Compensation Corporation (ACC).

Please don't hesitate to contact the HDEC secretariat for further information. We wish you all the best for your study.

Yours sincerely,

Ms Raewyn Idoine
Chairperson
Southern Health and Disability Ethics Committee

Encl: appendix A: documents submitted appendix B: statement of compliance and list of members

Appendix A
Documents submitted

Document	*Version*	*Date*
CV for CI	1	28 September 2014
Evidence of scientific review: This is part of the university review process of the doctoral proposal	1	09 July 2014
Evidence of scientific review: This is the next step of the scientific review when all the reviewers comments have been responded to by doctoral student	1	19 September 2014
Protocol	1	30 September 2014
Application	1	-
Other (No Description Entered)	1	07 October 2014

Appendix B
Statement of compliance and list of members

Statement of compliance

The Southern Health and Disability Ethics Committee:

- is constituted in accordance with its Terms of Reference
- operates in accordance with the *Standard Operating Procedures for Health and Disability Ethics Committees*, and with the principles of international good clinical practice (GCP)
- is approved by the Health Research Council of New Zealand's Ethics Committee for the purposes of section 25(1)(c) of the Health Research Council Act 1990
- is registered (number 00008713) with the US Department of Health and Human Services' Office for Human Research Protection (OHRP).

List of members

Name	*Category*	*Appointed*	*Term Expires*
Ms Raewyn Idoine	Lay (consumer/community perspectives)	01/07/2012	01/07/2015
Mrs Angelika Frank-Alexander	Lay (consumer/community perspectives)	01/07/2012	01/07/2015
Dr Sarah Gunningham	Non-lay (intervention studies)	01/07/2012	01/07/2015
Assc Prof Mira Harrison-Woolrych	Non-lay (intervention studies)	01/09/2014	01/09/2015
Dr Fiona McCrimmon	Lay (the law)	01/09/2014	01/09/2015
Dr Nicola Swain	Non-lay (observational studies)	01/07/2012	01/07/2015
Dr Devonie Waaka	Non-lay (intervention studies)	01/07/2013	01/07/2016
Dr Mathew Zacharias	Non-lay (health/disability service provision)	01/07/2012	01/07/2015

http://www.ethics.health.govt.nz

Appendix H: Email from Wiley re publication

From: Wiley

Sent: Thursday, 30 April 2020 11:04 PM

To: lesley.ansell@xtra.co.nz

Subject: Congratulations — your article is one of the top downloaded!

Congratulations — your work was one of the top downloaded in recent publication history!

Dear Lesley,

We are excited to share that your research, published in *Australian and New Zealand Journal of Obstetrics and Gynaecology*, is among the top 10% most downloaded papers!

- **Axillary traction: An effective method of resolving shoulder dystocia**

What this means for you:

- Among work published between January 2018 and December 2019, yours received some of the most downloads in the 12 months following online publication.
- Your research generated immediate impact and helped to raise the visibility of *Australian and New Zealand Journal of Obstetrics and Gynaecology*.

In recognition of your work, we're pleased to offer you a certificate of achievement.

Download your certificate

Please note that your certificate download link will only work for your email address. Your co-authors can request their own certificate here.

Thank you for helping to grow our profile so that work like yours is more discoverable.

Best wishes,
Australian and New Zealand Journal of Obstetrics and Gynaecology

Share this delightful news on social media using #TopDownloadedArticle

If you've published open access, your research is free for anyone, anywhere to read, download, and share.

W26CS