A COMPARATIVE STUDY OF OBSTETRIC OUTCOME BETWEEN VACUUM EXTRACTION AND OUTLET FORCEPS DELIVERY

By

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Under the Guidance of

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"A COMPARATIVE STUDY OF OBSTETRIC OUTCOME BETWEEN VACUUM EXTRACTION AND OUTLET FORCEPS DELIVERY"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. MUNIKRISHNA. M**, Professor , Department of Obstetrics and Gynaecology, Sri Devaraj Urs Medical College, Kolar, in partial fulfillment of University regulation for the award "**M.S. DEGREE IN OBSTETRICS AND GYNAECOLOGY**", the examination to be held in April, 2018 by SDUAHER. This has not been submitted by me previously for the award of any degree or diploma from the university or any other university.

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Dr. SHILPI SINGH

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ACOG	American College of Obstetrics& Gynaecology
ANC	Antenatal care
AC	Anteroposterior
BPD	Biparietal diameter
CPD	Cephalopelvic disproportion
DTA	Deep transverse arrest
GDM	Gestational diabetes mellitus
Hb	Haemoglobin
IUGR	Intra uterine fetal growth restriction
IUFD	Intra uterine fetal demise
LOA	Left occipitoanterior
LOP	Left occipitoposterior
LOT	Left occipito transverse
NICU	Neonatal intensive care unit
OA	Occipitoanterior
OP	Occipitoposterior
PPH	Post- partum hemorrhage
ROA	Right occipitoanterior
ROP	Right occipitoposterior

ROT	Right occipito transverse
UK	United Kingdom
UTI	Urinary tract infection
VS	Versus

ABSTRACT

Background: Instrumental delivery is an art that is fading and may disappear in the near future as more and more obstetricians are resorting to caesarean sections.Instrumental vaginal deliveries comprise the use of vacuum assisted devices and /or forceps to assist in delivering a fetus, offering the alternative to accomplish vaginal delivery in properly selected cases thereby reducing maternal morbidity in terms of blood loss and increase hospital stay which is a consequence of cesarean sections.

Aims and Objectives: To compare the maternal morbidity with vacuum and outlet forceps delivery. To compare the neonatal morbidity with vacuum and outlet forceps delivery.

Methodology: A prospective comparative study was conducted in women delivering at Department of obstetrics and gynaecology, in Sri Devaraj Urs Medical College, R L Jalappa Hospital, Kolar from March 2016 - March 2017 for a period of one year.

A minimum of 180 patients was taken up for the study. 90 women delivered by outlet forceps delivery and 90 women by vacuum delivery. Cases which require instrumental vaginal delivery and fulfilling the inclusion criteria for forceps or vacuum were taken up for the study, after taking informed consent.Maternal outcomes including episiotomy and its extension, perineal tear, postpartum hemorrhage, hospital stay and neonatal outcomes including apgar score,facial marks(instrumental marks), cephalohematoma, neurologic injuries, neonatal jaundice,neonatal intensive care unit admission were analyzed and compared .

Results: Mostly forceps and vacuum were applied for age group of 26- 30 years and primigravida, which showed a statistical significance.

The cases which came to our tertiary care centre majority of them were unbooked that is 74.4% in vacuum versus 58.9 % in forceps which was statistically significant.

Extension of episiotomy was more with forceps that is 21.1% and with vacuum being 4.4%.This difference was statistically significant.

Postpartum hemorrhage was also more common in forceps group that is 13.3%compared to vacuum 11.1% but the difference was not statistically significant.

The need for blood transfusion was seen more in cases of forceps that is 11.1% cases whereas in vacuum i.e. 6.7% cases but was not statistically significant.

The Apgar at 1 minute and 5 minutes was almost same in both vacuum and forceps delivery. There was no statistical difference between both the groups.

When parameter for neonatal morbidity was compared it was found that facial marks (instrumental marks)was statistically significant in forceps group constituting 5.6% whereas there were no cases in vacuum group.

There was a significant difference in cephalohaematoma which was 1.1% in vacuum and no cases in forceps.

The neonatal hyperbilirubinemia was compared and was found to be 8.9% in vacuum assisted vaginal delivery compared to 1.1% in forceps delivery concluding there statistical significant.

NICU admission due to various reasons including cephalohaematoma and neonatal hyperbilirubinemia was more in vacuum that is 27.8% than forceps which was 24.4% but there was no significant difference between the two groups when NICU admission was taken into account.

Conclusion:

In present study, maternal and neonatal outcome was assessed amongst vacuum and forceps deliveries. There was evidence of less maternal trauma with vacuum extraction than with forceps delivery. Fetal morbidity was higher in vacuum group compared to

forceps delivery. Hence concluding that the choice of operative vaginal delivery need to be individualized and tailored based on maternal and perinatal indications as one instrument cannot be stated as superior to the other instrument.

With the expertise and appropriate decision on the indication and meticulous handling of the instrument whether outlet forceps or vacuum, especially in a tertiary care centre, the feto-maternal outcome is equally good with both the instruments.

Introduction

INTRODUCTION

Instrumental delivery is an art that is fading and may disappear in the near future as more and more obstetricians are resorting to caesarean sections.In the advent of modern medicine along with the advancement of surgery as an option and simultaneous breakthroughs achieved in the field of anesthesia the science and art of operative deliveries will become a thing of the past and will be reminisced as an anecdote in the history of medicine. Currently in the world, the incidence of operative vaginal deliveries come down drastically due to reasons such as fear of maternal trauma and fetal injuries, litigation, non compliance of patients and lastly diminishing number of experienced obstetricians. The ultimate aim of antenatal care is achieving optimal health of the mother and the neonate at the end and hence the need to reassert the importance of operative vaginal deliveries.

The cornerstones of understanding obstetrics reside in the following factors namely the passenger, the passage and the power.

Max Rosenheim once said and I quote “I do sometimes wonder whether the vast sums of money being spent on research might not produce most rapid and spectacular improvement in health if devoted to the application of what is already known” which goes to show that in spite of all the developments the time tested art of operated deliveries must not be allowed to fade away in history. Delivery and child birth can never be mistaken as easy and should always be handled cautiously.

Instrumental vaginal deliveries comprise the use of vacuum assisted devices and /or forceps to assist in delivering a fetus, offering the alternative to accomplish vaginal delivery in properly selected cases thereby reducing maternal morbidity in terms of blood loss and increase hospital stay which is a consequence of cesarean sections.

Historically various types of forceps such as high forceps, rotational forceps and mid cavity forceps been used but are obsolete in the era of modern obstetrics.

The only accepted form of forceps used today is the outlet forceps.

The rationale behind vacuum assisted delivery is the application of the suction device or cup to a pump in order to create adequate negative pressure allowing traction to be exerted on the fetal head thereby facilitating the delivery via the birth canal.

It has been seen that women with prior history of instrumental delivery in subsequent pregnancy have successfully undergone vaginal deliveries which further highlights the fact that operative options for delivery are reduced resulting in decreased maternal morbidity.

Among the developed countries the rates of instrumental vaginal delivery range between 5-20% of all births. In the U.K incidence is between 10-12%, in United States of America is 3.6% and in India it is documented as 3.1 %.[1, 2, 3]

A successful instrumental delivery not only prevents caesarean section but also ensures unscarred uterus for future pregnancy outcome.

Morbidity in a delivering women range between short term complications such as cervical, vaginal, perineal lacerations, extended episiotomy incisions, traumatic postpartum hemorrhage and long term complications such as anemia, puerperal problems such as sub involution , lactation failure, puerperal sepsis ,urinary and bowel incontinence affecting the quality of life among young women.

Complications in the neonate such as low Apgar score, cephalohaematoma, unexplained seizures, hyperbilirubinemia, scalp and facial injuries, birth asphyxia, neonatal sepsis, use of higher antibiotics, prolonged NICU stay were taken as morbidity.

It has been stated that there is a twofold increase in maternal morbidity rate with cesarean deliveries. These include infection, hemorrhage, thromboembolism, anesthetic complications, and bowel and bladder injury.[1]

Failure of forceps extraction invariably results in a cesarean section however some situations demand the use of forceps rather than vacuum such as preterm IUGR deliveries.Whereas certain situations are better suited for vacuum such as incompletely rotated head, slightly deflexed head. The pros and cons of both vacuum and forceps are known and the indication to use them should be based on individual assessment of the delivering woman.

Hence, the need for this study in today's modern era of elective and repeat cesarean sections where the morbidities to delivering women have increased many fold, simultaneously leading to increase in the incidence of rate of cesarean sections, along with the fact that the expertise and the know-how of instrumental deliveries is diminishing and fading among the younger obstetricians.

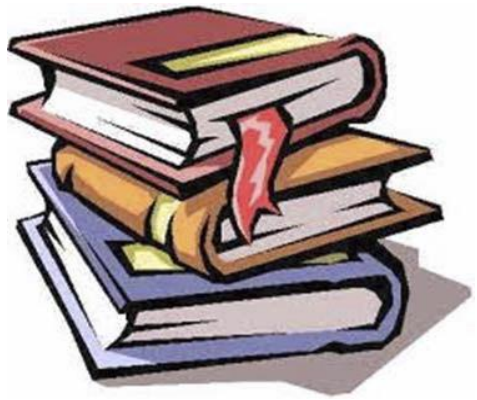
Objectives

AIMS AND OBJECTIVES

The aims and objectives of this study are:

1. To compare the maternal morbidity with vacuum and outlet forceps delivery.

2. To compare the neonatal morbidity with vacuum and outlet forceps delivery.



Review of Literature

REVIEW OF LITERATURE

Even though instrumental deliveries are being conducted for quite sometimes the long term effects have remained unknown. **Siedman DS et al (1991)** [4] studied an intelligence test and medical examination at 17 years of age following various vaginal deliveries and showed that operative vaginal deliveries had a highly significant score than the spontaneous; though the differences that is vision impairment and functional impairment of feet in both the groups were small and were omitted between the two groups. Hence, the results concluded that operative vaginal deliveries babies are not at risk of any functional or cognitive impairment at 17 years of age.

Back in 1992,**Chenoy R et al (1992)** [5] stated the preference of vacuum extractor in developing countries. In situations like small maternal pelvis type, which needs a less traumatic instrument it became the instrument of choice. But with advent of science and technology metal cup which is more traumatic to neonates are being replaced by cups which minimize scalp injuries.

At North Staffordshire Maternity Hospital (NSMH) a vacuum extractor policy was implemented which was studied in a RCT by **Johanson RB et al (1993)** [6] which compared both operative vaginal deliveries.

The policy consisted

a) For straight forward lift–out deliveries, with use of slic –cup exception being deflexed head and head with caput

B) For the well flexed head anterior Bird cup was made.

C) For occipitoposterior, rarely occipitolateral posterior Bird cup was used. Neonatal and maternal morbidity were analyzed in terms of maternal perineal injuries and neonatal facial injuries. As far as vacuum extraction was concerned vaginal extensions and anal sphincter damage was reported. There were significantly fewer women with anal sphincter damage or upper vaginal extensions with vacuum assisted deliveries but cephalohametoma was more. Unexplained neonatal seizures were noted among three babies with forceps delivery. Hence, this study by Johansen R et al showed that vacuum assisted vaginal deliveries are less traumatic compared to forceps deliveries.

Carmona F (1995)[7] using ACOG criteria 1988 guidelines for low forceps application concluded that low forceps delivery is a better option to cut short the second stage of labor without any maternal and neonatal side effects, as the spontaneous vaginal delivery showed longer time interval of delivery and lower mean cord arterial pH.

In a study conducted by **Williams MC (1995)** [8] comparison between operative vaginal deliveries were made concluding that vacuum application is easier compared to forceps which require training and more of analgesia during application, it leads to more of intracranial hemorrhage and scalp trauma compared to facial trauma and maternal soft tissue trauma with forceps. It is said that maternal and neonatal morbidity is a result of inbuilt factors which is particular to every individual. As vacuum extraction has proven to be easier when it comes to application and maternal trauma, therefore, use of vacuum extractor decrease the rates of cesarean delivery.

A study was conducted by **Vintzileos AM et al (1996)**[9]to ascertain whether vacuum assisted deliveries where associated with fetal acid base changes when used electively or

during fetal distress. It was a randomized trial and at the end of the study it was seen that when used electively the pH was lower in both umbilical artery and vein along with lower venous base excess and higher venous carbon dioxide concentration as compared to spontaneous deliveries. Once the duration of second stage of labor was corrected and electively vacuum was applied there was a significant decrease in cord venous pH and increase in venous pCO2,but these cord blood acid base changes neither caused perinatal morbidity and mortality nor caused acidemia in neonates .

In women with suspected fetal distress when vacuum was applied there weren't any detectable cord blood acid base variations as compared to that of spontaneous vaginal deliveries.

Hence concluding that use of vacuum application is especially indicated in cases of fetal distress in second stage of labor rather than using electively.

Bofill JA et al (1997) [10,11]conducted a prospective randomized control trial to identify the risk factors responsible for development of cephalohaematoma and found that asynclitism to be the cause.28% of newborns exhibited this finding when the duration of application exceeded 5 minutes.

He further analyzed two types of application namely continuous vacuum and intermittent vacuum. It was inferred that there was no difference in either the maternal or the fetal outcome among both the groups.

Another study conducted by **Revah A et al (1997)**[12] with an aim to compare the maternal and neonatal morbidity associated with failed trial of instrumental delivery with that of direct cesarean section during second stage demonstrated that in institutions where the

facility to promptly shift the patient for emergency cesarean section after failed trial of instrumentation is present there wasn't any consequent maternal or neonatal morbidity.

Okunwobi-Smith Y et al (2000) [13] conducted a study to assess the duration between time of decision for instrumental delivery to the time of the birth of a neonate under varied clinical situations. In women where forceps were used the time duration was 23.3 minutes and amongst women where vacuum assistance was taken the time duration was 29.2 minutes, concluding that in situations where speedy delivery is requirement forceps fare better than ventouse without compromising the neonate or the mother with respect to perineal trauma at delivery.

In a study conducted by **Gardella C et al 2001**[14]sequential use of instruments where taken in account and was found that it had higher rates of brachial plexus and facial nerve injury, intracranial hemorrhage and low apgar score. This concluded that using a single instrument at a time is better than sequential use of instruments.

An observational population based study was conducted by **Leeuw JW et al 2001**[15] to identify the risk factors for third degree perineal tears during vaginal deliveries. It was found that in women where forceps were used there was a higher risk than with women who had vacuum assistance concluding that vacuum extractor be the instrument of choice with respect to prevention of perineal injury leading to fetal incontinence.

On a similar note **Arya L et al (2001)**[16] conducted a prospective study to determine the incidence of urinary incontinence amongst primiparous women undergoing instrumental vaginal delivery in comparison with women having spontaneous vaginal delivery. They

deduced that there was a higher incidence of incontinence with women following forceps application.

MacArthur C et al in 2001[17]conducted a study to identify obstetric and maternal factors resulting in fecal incontinence at three months postpartum. The results were sharply implying that forceps assistance lead to two fold increase in the risk of development of fecal incontinence conversely vacuum on the other hand was not implicated with incontinence. Furthermore there weren't any associations between other factors such as induction of labor, duration of second stage, episiotomy and lacerations with fecal incontinence at three months postpartum.

Wen SW et al in 2001[18]compared vacuum extracted deliveries versus forceps deliveries of 31,015 and 18,727 respectively and found that vacuum lead to lesser maternal trauma but caused increased risk of cephalohematoma and intracranial hemorrhage.

A study conducted by **Weerasekera DS et al in 2002** [19]on 442 women who underwent instrumental vaginal deliveries amongst which 238 had vacuum assistance and 204 had forceps application to determine whether there was any significant maternal or neonatal outcome. They incurred that there was not any significant difference amongst the neonate requiring resuscitation at birth, NICU admission, neonatal death rates concluding that forceps application when performed under specific well crafted criteria are just as safe as vacuum assisted deliveries with not only lesser failure rate but also lower incidence of cephalohematoma among the neonates as compared to vacuum assisted deliveries.

A study conducted by **Uchil D et al**[20]found that vacuum extracted deliveries led to the occurrence of subgaleal hemorrhage in rare cases but which were quite lethal. Hence it

was advocated that proper training of techniques to the obstetricians is vital component of instrumental deliveries.

Johnson JH et al (2004)[21] compared the effects of use of forceps and vacuum on mother and new born babies. It was found that the rate of use of forceps was higher than vacuum in patients with prolonged second stage of labor. Statistical analysis by multivariate logistics demonstrated that there was an increase in the rate of regional anesthesia (pudendal and epidural), episiotomies, perineal and vaginal lacerations when forceps were used, in contrast there was an increase in incidence of periurethral trauma in women who underwent vacuum assisted deliveries. Instrument marks and bruising, facial injuries were seen with forceps whereas cephalohaemotoma, caput and excessive moulding were resultant of vacuum extractions.

A population based study carried out by **AA Merriam et al between2005 to 2013**[22] in which 22598971 deliveries were enrolled for analysis demonstrated that the total incidence of instrumental deliveries was 5.9% in which 4.8% were vacuum assisted and 1.1% was by forceps extraction. It was observed that there was a steady decline in the use of instrumentation over the study period. These lower rates of instrument assisted deliveries not only led to decrease in the exposure of the residents to these procedures but also denied the access to this expertise as an alternative to cesarean sections. Furthermore this decrease in the use of instruments for assisted deliveries must be highlighted as a budding problem among the younger resident population due to lack of exposure.

In the United States as reported by **BL Shaffer et al(2006)**[23]the rate of delivery by cesarean sections has been increasing with figures of 30.2% of all births in 2005. Primary

cesarean section rate was observed at 20.6% of all deliveries in 2004, with an alarming increasing tread of 5% per year. They analyzed that operative vaginal deliveries had a prevalence rate between 9-12% with a disappointing downward fall in the rate.

A comparative study by **Singh et al(2007)** [24] of feto-maternal outcome between forceps assisted and vacuum assisted deliveries showed that even though there was a lesser incidence of maternal trauma with vacuum application there wasn't any significant difference in the neonatal outcome. The choice of instrument to be used in operative deliveries depended on the skill and expertise of the conducting obstetrician.

A comparative analysis between vacuum and forceps with effect on maternal and fetal outcome done by **Nazish Khalid and Sumaira Asif in 2008**[25] mentioned that the success rate with both were similar. Amongst the women (74%) in the forceps group and (74%)inthe vacuum group were primiparas. Here it was demonstrated that maternal soft tissue injuries were significantly higher, blood loss of more than 500 ml was (8%)and fetal injuries were more with forceps. However, with vacuum there was an occurrence of cephalohaematomas. The indication of prolonged second stage was more common amongst vacuum assisted deliveries (46%) while fetal distress was an indication in (44%)for forceps assisted deliveries. They advocated the preference of vacuum assistance over forceps in this study.

A study conducted in a tertiary care centre by **Constance E Shehuet al (2008-2012**)[26] reported that the incidence of instrumental vaginal delivery was only 1.06% of all deliveries in which 92.1% of that was by vacuum assistance.

There was a persistent decline in the use of forceps assisted deliveries over the years whilst the use of vacuum assistance remained fairly constant.

In Utharakhand **(2009)**[27] a tertiary health centre conducted a comparative study of maternal and fetal outcome in patients undergoing instrumental vaginal deliveries reported that the occurrence of periurethral trauma, second and third degree perineal lacerations were significantly higher with forceps whereas ventouse had minimal soft tissue trauma on the mother .There was an inclination towards the use of vacuum rather than forceps. However the perinatal outcome among both the groups was similar concluding the preference of vacuum.

In a study conducted in Ethiopia by **Solomon Gebre and Assefa Hailu (2013-2015)** [28] the most common indication of instrumental vaginal deliveries was found to be fetal distress. Maximum feto-maternal complications were associated with forceps application. But fetal complications per-say was more with ventouse application concluding that on comparison between both the instrumental vaginal deliveries forceps use for obstructed labor, mid pelvic cavity instrumentation, forceps application was seen more which had various complications.

In an observational study in Delhi by **Akanksha Lamba, Ramanjeet Kaur, Zulaihuma Muzafar (2014-2015)**[29] the most common indication turned out to be fetal distress followed by maternal exhaustion, and the forceps application was done more for primigravida (68.5%)compared to multigravida.

Maternal morbidity in terms of episiotomy extension, uterine rupture, vaginal and cervical lacerations followed by complete perineal tears and PPH was seen.

Neonatal morbidity in terms of low apgar score, NICU admission, still birth and neonatal deaths were seen. This study concluded that forceps application need expertise because

second stage application leads to increased feto- maternal morbidity but still instrumental vaginal delivery can reduce cesarean section rates .

In a retrospective study conducted in Mysore Medical College by **C. Prameela et al in (2014)**[30] out of total 3385 deliveries, there were 24.9% LSCS, 0.9% ventouse, 1.68% low forceps and 0.59% outlet forceps, showing the trend towards decrease in instrumental delivery and need for expertise when it comes to operative vaginal delivery.

In an observational prospective cohort study conducted in Mumbai by **Shameel Faisal, Amarjeet Bava, Y. S. Nandanwar in the year 2015** [31] it reported that use of instruments is more in primigravida (57.19%) in age group between 20-30 years (88%) and prolonged second stage(70.56%) being the most common indication with maternal perineal injuries being (63 cases) ,need for blood transfusion for 2 patients and neonatal morbidity in terms of birth asphyxia seen in 82 cases which required NICU admission .it was hence deduced from this study that operative vaginal delivery is tool for emergency obstetrics where complication can be identified earliest and decision can be taken .

A retrospective study conducted in India **Dr. Chaitra Ramachandra et al in 2016**[32] inferred that the use of instrumental vaginal deliveries was used for primigravida more with 37-40 weeks of gestation. Forceps was applied for more for maternal exhaustion(42%) and vacuum for fetal distress(36%). Maternal morbidity was more with forceps 58% compared to neonatal morbidity which was more in vacuum like cephalohaematoma (12%) except trauma like abrasions and bruises and fractures which was again more in forceps group. Therefore the need of NICU admission when compared was more with forceps 32%.

This study concluded that when it comes to use of instruments vacuum should be preferred over forceps.

OPERATIVE VAGINAL DELIVERY

Operative vaginal delivery comprises the use of vacuum assisted devices and /or forceps to assist in delivering a fetus, offering the alternative to accomplish vaginal delivery.

The instrument either vacuum or forceps is applied to fetal head which is then pulled along with maternal contraction

History of vacuum extraction[33]

Long before Hippocrates a technique of vacuum extraction originated which was called "cupping". In this over an open flame a cup or a meld was heated, and applied over skin puncture or lesion which after cooling created a vacuum and helped in extracting body fluids or blood.

In 1632 Hildanus used a leather sucker for depressed skull fractures in infants which was used again in 1655 Ambrose Pare keeping in mind the same principle.

In 1706 Younge[1] introduced suction for fetal head. Later 1849 James Simpson introduced vacuum extraction of fetal scalp by traction. Hence he was regarded as inventor of obstetrical vacuum extractor.

Tage Malmstorm a Swedish obstetrician in 1950 developed a vacuum cup named as Malmstorm's cup which was modified in 1969 by Bird .In 1973 Kobayashi introduced soft vacuum cup.

O' Neil et al in 1981 developed modifications which had traction directed to the center of the cup at different traction angles. Better performance at angular traction, however, was not confirmed in a laboratory comparison with other types of metal cups.

Designs of vacuum cup

The Malmstrom extractor (1953)[34]:

Four sizes 30 mm, 40 mm, 50 mm and 60 mm are available. Malmstrom's metal cup is a hollow hemisphere with incurved margins. The principle for malmstorm cup is it creates suction on fetal scalp and Chignon (Rossa in 1955 coined this term) or artificial caput, which allows adequate traction.

Bird's modification of Malmstrom cup (1969)[33]:

Bird's cup has similarity to Malmstroms cup, except the location of vacuum tube which is attached to a lateral port which makes it suitable for occipito-posterior positions. The vacuum tube and traction chain are separate and can be adjusted independent to each other. They also have sizes like 40, 50, 60 mm.

Elliot's obstetric bonnet[35]:

This instrument is designed in a way that fits to fetal head and it’s without a suction or vacuum port. The handle flattens the cranium provide forces to assist parturition.

Silc cup[33]:

Two sizes like 50 and 60 mm with inner diameter are available. To enable air to be evacuated to ensure optimal adhesion and minimizing trauma to scalp the lining is by small projections .The silc cup lacks valves so increase or decrease of the partial vacuum is achieved by means of the suction pump itself.

Mity-vac vacuum cup/plastic cups[33]:

An attached handle with polyethylene 60 mm plastic cup in which the cup border is flared and semi rigid. This pump consists of a tube attached to a cup, valve for pressure release and handle for vacuum and pressure gauge. Within 1-2 min it builds pressure. It is handy portable and can be used with use of electricity.

Manipulator cup[33]:

A special plastic device which has low co-efficient of friction to reduce fetal scalp trauma which is a single piece device mainly for deflexed head. Traction cup is a larger cup for delivery of well flexed head.

Kobayashi silastic obstetric vacuum cup[33]:

A device which is funnel shaped and have an elastomere which is 208 mm long with cup diameter of 65 mm with a smooth exterior and internal grooved rims of 1 mm depth and 1.5 mm width starting from 5 mm from edge converging to center of the cup so that fetal head has a grip.

On the sagittal suture in the occiput blue lining mark is used for positional reference so that rotation can be made out. For firmer grip ridges are present which are three in number. Soft elastomere in the cup are present which makes the insertion easy and less traumatic.

Comparison of instruments[35]:

Table1. Various types of vacuum extractor, their Description and Advantages

Type of Instrument	Description	Advantages
Metal cup vacuum Extractor[34,33]	Mushroom shaped metal cup with 40-60 mm diameter with detachable handle at the centre.	Success rate is high. For occipitoposterior position easy to use.
Soft cup vacuum extractor	M cup which is mushroom shaped. The side walls being soft reduces scalp trauma compared to malmstorm cup.	Simple to use. Less scalp trauma. Easy to manipulate.

Analgesia[32]:

Epidural analgesia acts by causing vasodilatation in turn leading to maternal hypotension, and interferes with nerve transmission by blocking the process.

Operative vaginal delivery and cesarean section incidence have increased with epidural analgesia use.

Epidural analgesia has its own disadvantages like prolongation of second stage of labour, inference with head descent and use of instrumental vaginal delivery.

After excluding cephalopelvic disproportion, oxytocin should be used for augmentation in second stage.

If use of epidural analgesia is precluded due to some reasons vacuum delivery can be conducted with pudendal block.

Clinical evaluation of pelvic adequacy:

For gauging the extent of CPD Philpott and Vacca[36] described a method for estimating degree of cranial moulding with the cranial bones overlap at occipito-parietal and parieto-parietal junction.

Instrumental vaginal delivery is usually avoided if moulding is advanced or extreme like after overlapping if it can't be reduced with simple pressure.

Method of cleaning and sterilization[33]:

Sterilization of the metal cup is advocated after breaking it down to its component parts. The components should be cleaned with soap and warm water immediately after use to remove any blood or vernix attached to it. The cup, traction chain, handle, pressure tubing may be autoclaved or boiled.

The silastic cup and the silc cup should also be cleaned immediately after use. Fluid and particulate matter should not be allowed to dry and plug the orifices. Sharp instrument should not be used to clean the channels.

To clean, immerse the cup in a pan of hydrogen peroxide or a dilute aqueous solution of acetic acid. When channels and parts are clean, cleanse with mild soap and rinse thoroughly.

Sterilization can be done by placing the cup on a clean open tray and autoclaving in a standard gravity sterilizer for 30 minutes at 120°C or also by vapour sterilization with formaldehyde tablets or by placing the cup in a dilute solution of betadine lotion for 20minutes. The silc cup can alternatively be sterilized by boiling in water for 15 minutes.

Table2. Proposed classification for vacuum extraction procedures according tofetal station and cranial position

Type of operation	Description of classification
Outlet vacuum	The scalp is visible at the introitus without separating the labia; the fetal skull has reached the pelvic floor.
Low vacuum operation	The position/station of the fetal head does not fulfill the criterion for an outlet operation; the leading edge of the fetal skull is at station. > + 2/5cm, but has not reached the pelvic floor.
Subdivisions	1. Position is occiput anterior (OA, LOA, ROA) 2. Position is occiput posterior (OP, LOP, ROP) or transverse (LOT, ROT)
Mid -vacuum operation	Station < +2/5 cm. The fetal head is engaged but the criterion for outlet or low operations are not fulfilled.
Subdivisions	1. Position is occiput anterior (OA, LOA, ROA) 2. Position is occiput posterior (OP, LOP, ROP) or transverse (LOT, ROT)

Vacuum –assisted caesarean delivery	This includes all vacuum-assisted caesarean delivery, unspecified technique.
Special vacuum operation	This includes vacuum extraction operations not specified.
High vacuum operation	Such procedures are not included in this classification.

Station (+5 to -5) is defined as the distance in cm between the leading bony portion of the fetal skull and the plane of maternal ischial spine and is recorded in the medical record as: ±5cm.

Indication for the use of vacuum extractor:

1. Prolonged Second Stage:

Second stage labor of more than 2 hours without a regional or epidural anesthetic or 3hours with such an anesthetic is considered prolonged for nulliparous women. For parous women, these time intervals become 1 and 2 hours respectively. Any instrumental assistance for the indication of a prolonged second stage demands caution. Failure to descend normally in the second stage is an important clinical sign, suggesting the possibility of malpresentation, cranial deflection or other malposition.[32]

2. Shortening of second stage:

On occasion, shortening the II stage of labour is appropriate in maternal disorders (e.g. cardiac, cerebrovascular, neuromuscular conditions) in which voluntary expulsive efforts are contraindicative/impossible exist. Additional situations that may lead to intervention

include the vastly over diagnosed condition of maternal exhaustion theuncommon instances of overly dense epidural analgesia or limited ability to cooperate.[37]

3. Fetal distress/Presumed fetal jeopardy:

While a potentially distressed infant is a classic indication for operative intervention, prompt evaluation is indicated and emergent delivery may be required. Fetal scalp sampling or acoustic stimulation, especially in the presence of an equivocal electronic monitor tracing, can be helpful in reaching a management decision.[38]

4. Inadequate maternal expulsive efforts.

5. Prolapse of the umbilical cord:

Few studies have reported the use of the vacuum extractor in the delivery of infants with prolapsed cord in cases when the cervix was greater than 6 cm dilated. They did not interfere with rapid uncomplicated application of cup and extraction.

Only in case when the prolapsed cord interfered with the application of the suction cup, reposition attempted. Their overall perinatal mortality was 10% as compared with1.7% perinatal mortality rate for infants with prolapsed cord delivered by caesarean section. Over 75% of the infants were delivered within 20 minutes of the diagnosis of prolapsed cord-the time that would be taken when the patient is taken for caesarean section. Thus, vacuum extraction was found to be useful in cases of prolapsed cord.[32]

Contraindications[32]**:**

Absolute:

- When trail of labor is inadequate.
- Inability to have a proper application.
- Uncertain about fetal position/station.
- Fetal head is high.
- Cephalo -feto-pelvic disproportion suspected.
- Prior failed forceps.
- Lack of expertise.

Relative:

- Gestational age < 36 weeks (Prematurity)
- Prior scalp sampling.
- Fetal scalp trauma.
- Active bleeding or suspected fetal coagulation defects.
- Suspected macrosomia.
- Non vertex presentation.
- Delivery requiring rotation or excessive traction.
- Inadequate anesthesia.

Causes of vacuum extraction failure[32]**:**

Fails if:

No advancement in the head descent with each pull or if with maximum negative pressure and proper direction also cup slips off the head.

Rules of three:

3 pulls, over 3 contractions, no progress.

3 pop-offs, without obvious cause.

30 minutes elapsed time.

If cup slips:

Second application at same place.

No sequential use of instrument.

Causes:

- Faults in equipments: leaks somewhere.
- Improper application or traction.
- Improper selection of cases: undiagnosed CPD, high station, like brow presentation.
- Incomplete cervical dilatation.
- Uterine constriction ring.
- Uterine retraction or Bandl's ring.
- Malpresentation.

i. Cranial deflection,

ii. Occipitoposterior position asynclitism.

- Cup displacement:

i. Oblique traction or incorrect force vector.

ii. Traction not co-ordinated with maternal efforts.

iii. Inadequate vacuum.

iv. True cephalopelvic disproportion.

Prerequisites for vacuum extraction operations[32]:

1. Informed consent

2. Cephalic presentation of fetus; standard obstetric indication for instrumental delivery.

3. Occipital, midline application of vacuum cup; centered over the cranial pivot orflexing point.

4. Analgesia (if required):

Pudendal nerve block

Saddle block

Epidural analgesia.

5. Operator confirmation of fetal station and position: Repeat pelvic examination to establish the station, position, and deflexion of the fetal head just prior to the attempted procedure.

6. Empty maternal bladder.

7. Full cervical dilatation.

8. Ruptured membranes

9. Operator decision to abandon the operation if it does not progress easily.

Conduct of procedure[33]:

Ghosting:

A ghost/phantom application is performed prior to cup insertion. Here the surgeon holds the vacuum cup in front of the perineum in the same angle and position expected once the extractor has correctly been applied to the fetal head. The phantom application/ghosting procedure forces an additional check of fetal position and station, establishes the correct instrument orientation and demands that the surgeon mentally review the planned operation.[37]

Insertion:

The cup is lubricated with sterile lubricant/surgical soap. If a soft cup is employed, it is partially collapsed by the hand of the operators and then introduced through the labia. Rigid cups are turned sideways, the labia are gently spread, and the device is slipped into the vagina.

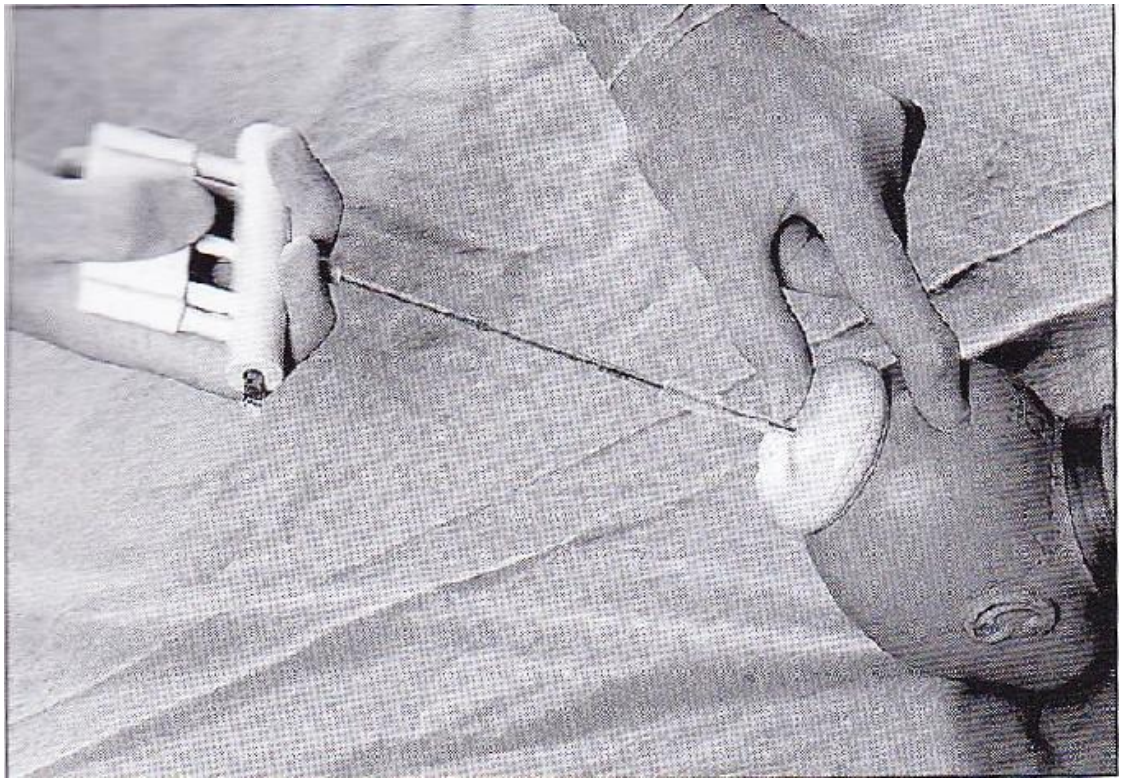


Figure1. Technique of Vacuum extraction

To ensure precise application to the fetal head, the following check pointsare important[32]:

The cup is positioned mid-sagittaly with the edge of a 60 mm standard cup approximately 3 cm or two finger breadth from the center of the anterior fontanelle.

The vacuum port of the metal cup, the handle of a soft-cup extractor, or the Kobayashi blue line is directed to parallel the sagittal suture.

No maternal tissue is included under the cup margin.

When correctly applied, the vacuum cup is positioned centrally over the point of cranial flexion or the pivot point when the vector of traction force is directed through this pivot point, the fetal head is flexed.

Anatomically, the pivot point is an imaginary spot over the sagittal suture of the fetal skull, located approximately 6 cm posterior to the center of the anterior fontanelle or1-2 cm anterior to the posterior fontanelle.

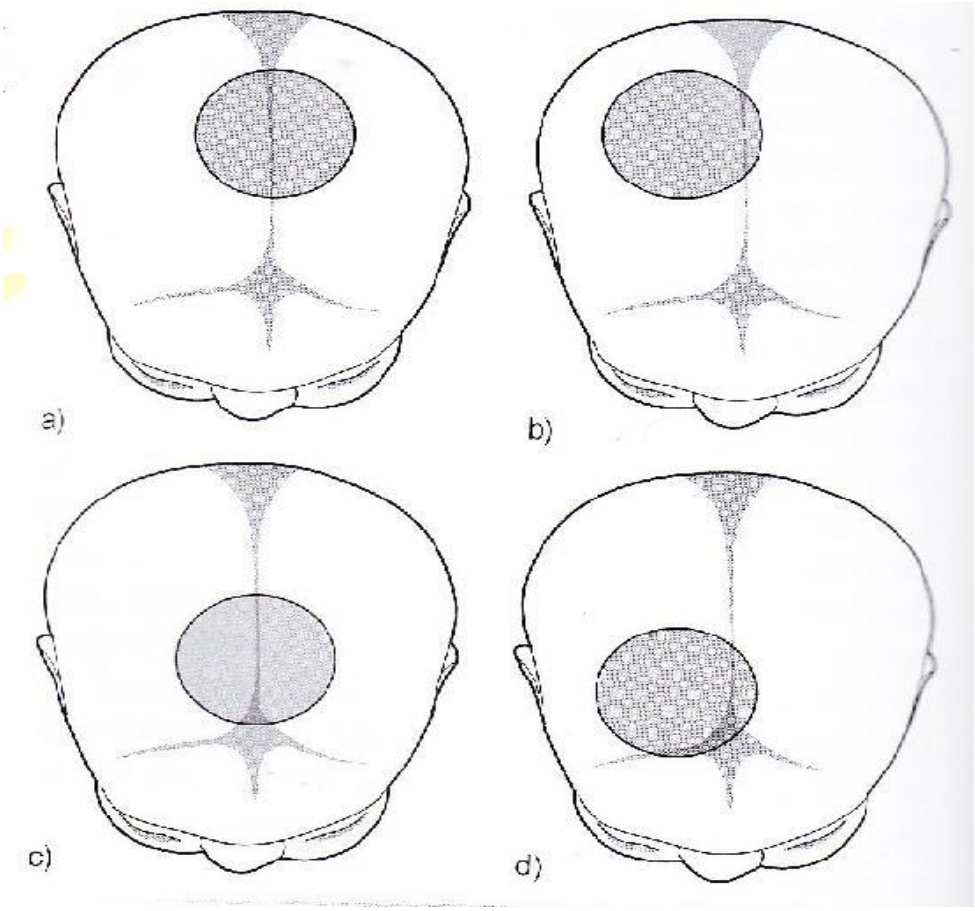


Figure 2.The four potential vaccum cup applications. a) Flexing median. b) Flexing paramedian. c) Deflexing median. d) Deflexing paramedian

The safety and success of the operation depend upon maintaining cranial flexion during the extraction. Cranial flexion presents the smallest possible diameter of the presenting part to the birth canal. In order to follow cranial rotation, either the handle of a disposable vacuum cup, the blue line of the Kobayashi device, or the vacuum port of the O'Neil or Bird cup is positioned to lie parallel to the sagittal suture, either toward or away from the fetal occiput at the operator's convenience.

Vacuum pressure conversion[1]

mm Hg	**inches Hg**	**lb/m^2**	**kg/cm^2**
600	23.6	11.6	0.82
500	19.7	9.7	0.68
400	15.7	7.7	0.54
300	11.8	5.8	0.41
200	7.9	3.9	0.27
100	3.9	1.9	0.13

Traction[32]**:**

Once a correct cup application is established, full vacuum is applied (0.8kg/cm2, 550-600 mm Hg, 11.6 lb/in2). When a soft (kobayashi or other plastic extractor) cup is used, the vacuum may be promptly raised to 0.8kg/cm2 (550-600mmHg) by an electric or hand pump. If a bird, O'Neil, or Malmstrom rigid cup has been applied, it has been traditionally taught that the vacuum is best raised by 0.2 kg/cm2 every 2 min until the working pressure of 0.8 kg/cm2 is generated.

The pull on the traction handle must follow a specific vector of force, causing the fetal head to traverse the normal pelvic curve. Traction efforts are timed to coincide with

uterine contractions. The vacuum pump is actuated until the appropriate degree of vacuum is present. Tension on the extractor handle is allowed to build gradually, paralleling the uterine contractions. As the contraction wanes, the tension on the discretion of the surgeon, the vacuum can either be maintained/ reduced to less than 200mm Hg/10.2 kg/cm2 between contractions. Both techniques are acceptable.

The higher the presenting part, the lower the extractor handle must be and greater the requirement for early episiotomy. As the head crowns, a Ritgen maneuver secures the chin. The vacuum is then released, the cup is removed and the delivery completed.

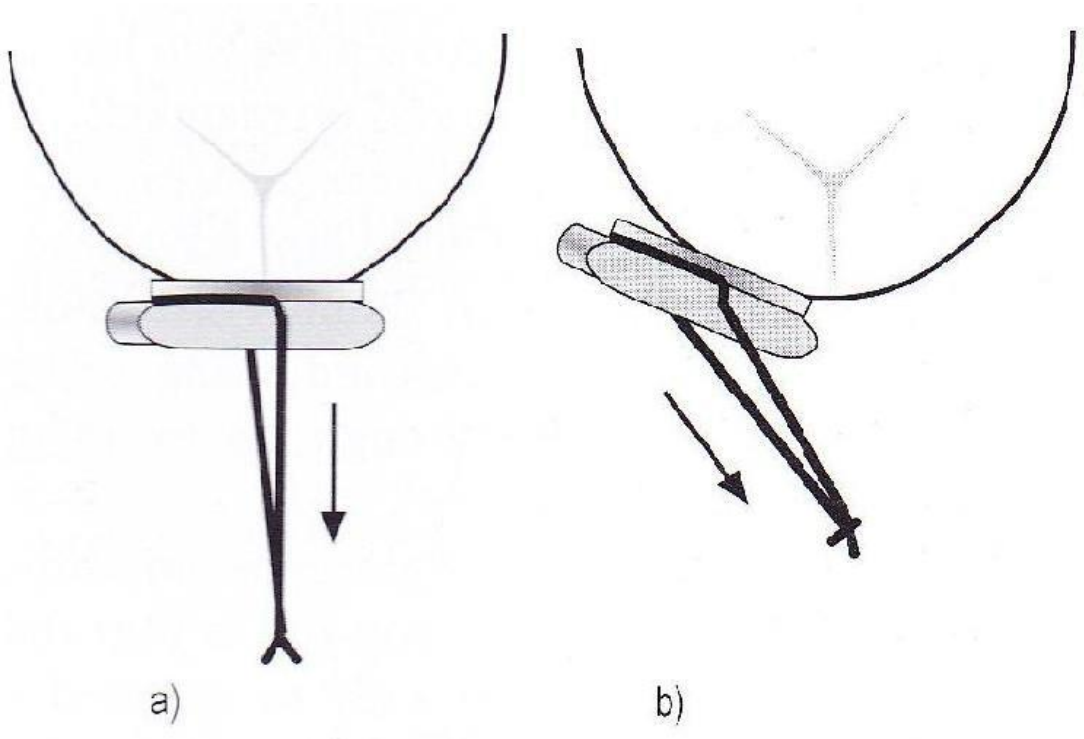


Figure 3. Cup Placement and traction. a) Correct perpendicular traction within the circumference of the cup diameter. b) Oblique traction and/or paramedian application predisposes to cup detachment.

Sequential instrument use[14]**:**

That is forceps operations followed by vacuum extraction or vice versa when one type of instrument fails. No absolute prohibition to trying a different device exists. However such application to be restricted to highly experienced physicians. This is associated with increased risk of both neonatal and maternal injury.

Compressive forces[39]**:**

It will be noted that when a pull of 22 pounds is exerted, the calculated compressive forces is 20 times greater with forceps than with the vacuum extractor. Mishell and Kelly (1962) found that the average single pull with Simpson forceps was 27.2 pounds, which was greater than on the vacuum extractor, being 17.0 pounds. This resulted in a total traction force for delivery by forceps of 67.5 pounds (approximately 40% greater than the 38.8 pounds by the vacuum extractor).

Two possible explanations exist as to why less traction is required with the vacuum extractor. (i) The vacuum extractor does not affect the diameter of the presenting vertex, whereas with forceps the thickness of the blades increases the transverse diameter by 8%. More pull is thus required to overcome the resultant additional resistance. (ii) By virtue of its scalp traction, the vacuum extractor may be mechanically more efficient than the obstetric forceps and its molar eminence traction.

Theoretical compressive forces in vacuum extraction and forceps delivery[39]

Instrument	Theoretical compressive force (g/cm^2)
Simpsons forceps	1500
Vacuum extractor	75

Positions requiring rotation[32]:

Vacuum extraction technique is the same for the cranial positioning that classically requires instrumental rotation (ROA, LOA, LOT, ROT etc). The cup is applied; the fetal head will spontaneously rotate as the presenting part descends. Some operator's assist this spontaneous rotation by accompanying the vacuum extraction with digitally applied cranial pressure to gently direct the head in the correct direction. However, this is usually unnecessary and may prove counter-productive. Attempts to rotate the vacuum cup are usually to no avail and this procedure is not recommended. Cup rotation usually just promotes cup displacement and if performed with a rigid metal cup may promote scalp laceration. Cranial rotation will occur as the fetal head follows the normal mechanism of descent, assisted by the combined efforts of the woman (in expulsion) and the surgeon (in traction).

Maternal and fetal complications of vacuum extraction[32]:

Fetal injuries:

1. Scalp bruising/lacerations:

Most of these injuries occur when the recommended limits to total cup application are exceeded (30 min is the max).

2. Sub- aponeurotic hemorrhage (Subgaleal hemorrhage) [20,40]:

Incidence: Approximately one half of subgaleal haemorrhage follows vacuum extraction i.e., 59 of 10,000 vacuum-assisted deliveries and 4 of 10,000 spontaneous vaginal deliveries. Earlier studies had suggested that the incidence of subgaleal haemorrhage with the vacuum extraction could be as high as 1 to 3.8%.

The sub-aponeurotic space contains large emissary veins which are at risk of severance when intense shearing forces are applied to the scalp. This is not restricted by the periosteum at the cranial sutures. Bleeding into this space may not be apparent at birth and may continue unabated for many hours without being recognized even in a neonatal intensive care unit, until there has been sufficient blood loss to cause hypovolemic shock.

Neonatal subgaleal haemorrhage is an infrequent but potentially lethal condition that is associated with vacuum extraction. Traction that does not cause descent of the head (negative traction) could pull the aponeurosis from the cranium and injure the underlying veins.

3. Cephalohematoma:

The periosteal limitations with definite palpable edges differentiate the cephalohaematoma from caput succedaneum. It may not appear for hours after delivery, often growing larger and disappearing only after weeks or even months.

Incidence: 2.5% according to the 10 year review by Thacker and colleagues (1987).

On examination a soft to firm well circumscribed cranial swelling that doesn't move with the scalp when palpated. Occasionally, neonatal anemia or hyperbilirubinemia results from a cephalohaematoma or its subsequent resorption. These lesions are more common in prolonged extractions of large infants especially where there has been cup displacement.[10,]

4. Chignon:

The chignon is easily identified by direct observation as an area of localized scalp edema moulded to the shape of the extractor cup. The chignon itself is less an injury than an accentuation of the normal process of caput formation and usually disappears within 12-

24 hours. The formation of chignon of some degree is an unavoidable part of vacuum extraction but is more common with the rigid metal extractors.[41]

5. Intracranial hemorrhage[14]:

Incidence: Intracranial hemorrhage is an uncommon but feared complication of vacuum extraction. In collected series the incidence is reported to vary from 0.2 to 8%.

Avoidance of heroic procedures, eschewing vacuum procedures on premature infants, and strict adherence to protocol will reduce the risk to a minimum.

Towner et al showed a significantly increased incidence of subdural/cerebral hemorrhage in the neonates who had vacuum /forceps delivery and the incidence was greater which the combined use of instruments.[42]

6. Skull fracture caused by vacuum extraction:

The majority of linear skull fracture is asymptomatic and is detected only when radiologic procedures are performed. Fracture of parietal bone occurs in 10-25% of infants with cephalhaematoma.[43]

7. **Vesicular neonatal rash at the site of vacuum application[44]:**

According to the inventor of the Mity-vac, there has been one similar "outbreak", in which it was concluded that use of high vacuum between uterine contractions contributes to the development of the rash.

8. Shoulder dystocia[45]:

It appears that vacuum/forceps assistance carries the same risk for shoulder dystocia that was seen in unassisted births to diabetic mother.

9. Retinal injury:

The hypothesis of Egge and co-workers is that vacuum extraction causes temporary impairment of blood flow in the cavernous sinus and to the bridging veins which subsequently leads to venous stasis and resultant retinal bleeding [33].

10. Nerve injuries[46, 47]:

Diagnosis: Nerve injuries are diagnosed by physical examination.

Facial nerve injury: The risk of facial nerve injury for infants was 13 fold greater than the risk for infants delivered spontaneously. Relative risk of facial nerve injury was 9.3 fold greater among infants delivered by forceps alone but was not significantly elevated among infants delivered by vacuum extraction alone.

Brachial plexus injury: The risk was 3 times greater among infants delivered by vacuum extraction and forceps than that by spontaneous vaginal delivery, after adjustment for birth weight and parity.

Spinal injuries: overstretching the spinal cord and associated hemorrhages may follow excessive traction.

Abducens palsy: Is diagnosed when failure of lateral eye abduction is noted during elicitation of the doll's-eye reflex.

Phrenic nerve involvement: Involvement of the phrenic nerve accompanies shoulder dystocia/brachial plexus injury and is manifested by respiratory embarrassment.

Maternal injuries:

1.Periurethraltears[48]: Periurethral tears were seen in the vacuum-assisted group even with the performance of an episiotomy, suggesting the performance of the episiotomy

was not protective. Bofill et al found more periurethral tears in the women delivered by vacuum, although the difference was not statistically significant.

Postpartum urinary incontinence was more common after vacuum delivery (9.1%)compared with spontaneous delivery (6.2%).[49]

Third degree perineal rupture of the perineum involving anal sphincter muscle is1.94%. Mediolateral episiotomy appeared to protect strongly against damage to anal sphincter complex during delivery.

2. The postpartum infections[50]**:** included endometritis, UTI and episiotomy infection.

3. Perineal and vaginal lacerations[51]**:** Lacerations were more common among nulliparous than among multiparous women. Vaginal and cervical lacerations occurred more commonly with vacuum extraction and forceps than spontaneous delivery.

Postpartum hemorrhage: Delivery by a vacuum extraction and/ forceps was also associated with an increased risk of postpartum hemorrhage.

Septic pelvic thrombophlebitis, pyelonephritis or necrotizing fascitis are rare but potentially fatal infections demanding early diagnosis and aggressive management.

4.Puerperal complications[33]**:**

Most authors agree that there are fewer puerperal complications following vacuum extraction than after forceps delivery. Schenker and Serr (1967), in their review of 600 cases of operative delivery, found that 5.6% of women after vacuum extraction had postpartum fever of genital tract origin in comparison with 15.3% following forceps delivery.

Two hundred patients or 66.6% of women, after forceps delivery in Schenker's series received prophylactic antibiotics, as opposed to 14.6 to 48.6% after vacuum extraction deliveries.

Days of hospitalization after confinement have also been studied as an index of maternal morbidity. In present days hospital stay is about 50% less than in the review of Sjostedt[52]. With less maternal trauma, patients delivered by the vacuum extractor are likely to be home earlier than patients delivered by forceps.

History of obstetric forceps:

Forceps is a word derived from Latin with probable origin from the word "Ferriceps" which when means 'the iron with which one ceases something hot'.

The colorful and complex evolution of forceps can be divided in to four important stages.

1. The invention
2. Introduction of the pelvic curve
3. Introduction of the axis traction devices.
4. Return to a straight forceps for low transverse applications.

1. The invention of Forceps

Modern forceps are descendants from the instruments developed by Huguenot refugee to England. The original Chamberlain family consisted of William Chamberlain, his wife and three children. One of the sons Peter Chamberlain (about 1600) gets the credit for the invention of the precursor of the modern forceps to be used on live infants.

Modifications have led to accurate application to the occiput, rather than to the pelvis, regardless of the position of the head. This special Chamberlain secret delivery instrument was transported by two men in a massive, gilt wooden chest. The Chamberlain used a special carriage for its transport so the arrival of "the secret" would be the more spectacular. When the secret was used, other attendants were excluded from the room and the eyes of the laboring woman were blindfolded so even the mother could not later tell exactly what had transpired to achieve delivery.

2. Introduction of Pelvic curve

This is attributed justly to Levert, though some give Smellie the honour. It is mentioned that Smellie was the first to recommend forceps for the delivery of after coming head in breech and hence the introduction of pelvic curve.

3. Introduction of Axis traction

The safe and effective application of forceps was advanced by the Danish obstetrician Matthias Saxtorph (1740-1800), a noted master of clinical medicine and a student of themechanism of labor. He was among the first to demonstrate the importance of traction in the pelvic axis. In 1772 he proposed a combined two-handed traction technique for instrumental delivery later described by Osiander and Charles P. Pajot and now commonly termed the "Saxtorph-Pajot maneuver".[33]

4. The return to straight forceps

Sir James Simpson designed a forceps in 1845 that was scientifically calculated to the appropriate cephalic and pelvic curvatures.

In 1902, Joseph De Lee further modified that instrument and advocated prophylactic forceps delivery.

Anatomy of obstetric forceps[1]:

Consists of 2 matched metallic halves called blades that articulate with one another at the lock. The blade that goes to the right side of the maternal pelvis is called the right blade and the one that goes to the left side is called the left blade.

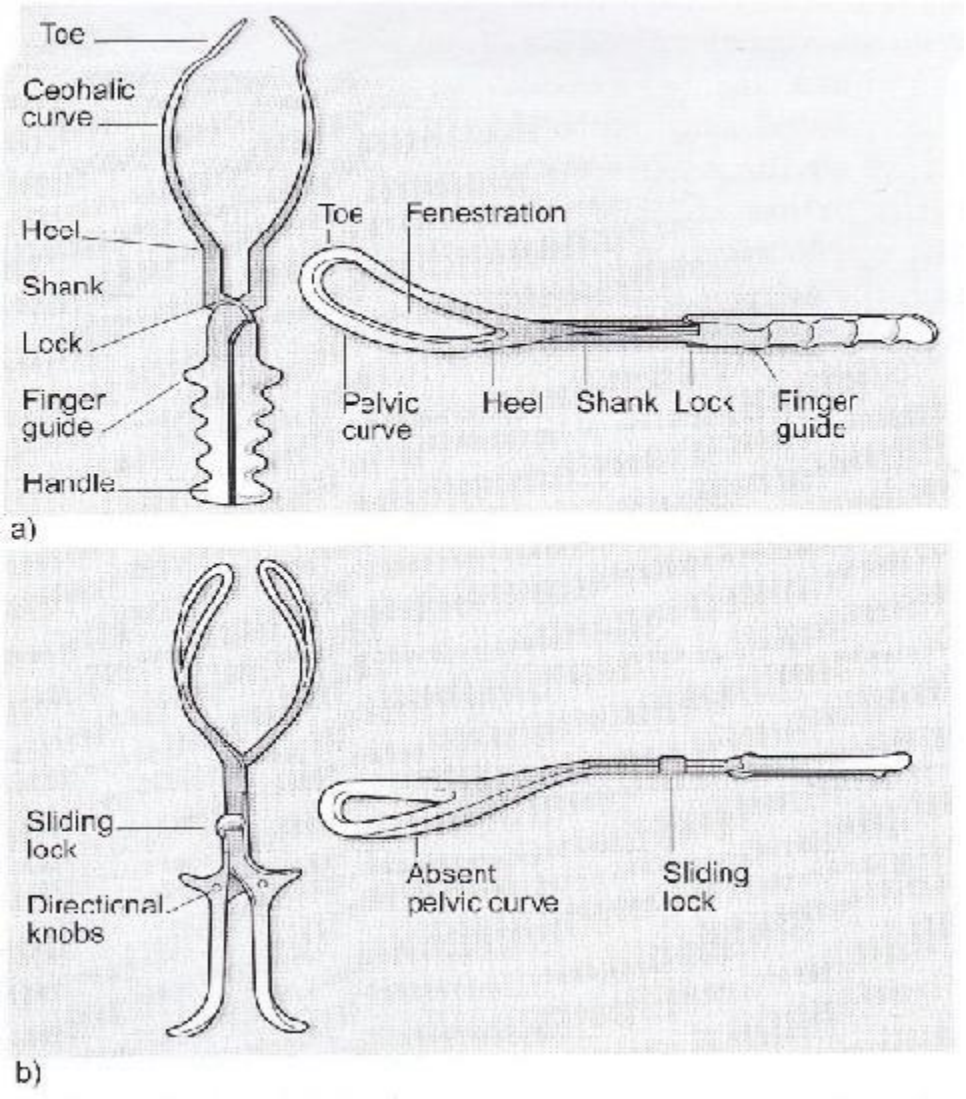


Figure 4. Anatomy of the forceps. a) Simpson's classical forceps. b) Kielland's rotation Forceps.

Blade:

Figure.5. Wrigleys forceps

Designed to grasp the head firmly but without excessive compression. The obstetric forceps has 2 blades, called right or upper blade and left or lower blade according to the side of the pelvis to which they are applied.

Types of blade:

Solid: Solid blades are used for rotation: however their compression force is more. Eg:Tucker's, Mclane Fenestrated: Eg: Simpson's Pseudo fenestrated: Eg: Luikart's blades. The solid blades may cause less trauma, but the fenestrated blades are lighter, grip the fetal head better, and are less likely to slip and causes less compression hence can be used for traction, however it is not good for rotation.

Shanks:

The shank connects the handle and the blade; adds length to the instrument and thereby, facilitates locking of the blades outside the vulva. When the blades are articulated the shanks are not opposed together.

Lock:

The lock holds the forceps together. It is so constructed that the right one fits on over the left. For this reason, unless the particular situation necessitates doing otherwise, the left blade should be applied first. Various types of lock are:

1. English Lock:

Eg: Simpson's forceps introduced by William Smellie: Slot in each branch easy to engage and lock and does not slip.

2. French lock:

Eg: Tarnier's, Dewees has a pinion and Screw. The left shank bears a pivot, which fits into a notch on the right shank. After articulation screwing it home tightens the pivot.

3. German lock:

Is a combination of English or French lock at the shanks with an additional lock across the handles: a wing nut and screw.

4. Sliding lock:

E.g. Kielland's: Midway on the left shank is a raised L shaped clamp. The right blade slides over the left.

5. Pivot lock:

The pivoting action of the lock allows the blades to open and close in an arc. In place of the handles there are simple finger girdles E.g. Laufe's modification of Piper's forceps.

6. Heister's Lock:

He improved the function of Palfyn's parallel forceps by a S shaped metal strip which looped over the branch and beneath the other.

7. Chamberlain's:

There is a rivet to unite the branches.

Handle:

The handles are opposed when the plates are articulated. There is a finger guard to facilitate during traction. These are used to grip the forceps.

Identification of blades:

When articulated:

Place the instrument in front of the pelvis with the tip of the blades pointing upwards and the concave side of the pelvic curve forwards. The blade which corresponds to the left of the maternal pelvis is the left blade and that to the right side is the right blade.

When isolated:

1. The tip should point upwards.
2. The cephalic curve is to be directed inwards and the pelvic curve forwards.

Functions of forceps:

1. Traction and extraction: Traction should be applied through traction handle keeping traction rod parallel to the shank.

2. Compression

3. Rotation of the head

4. Protective cage: In premature baby or to control the delivery of the after coming head to lessen the danger of sudden decompression.

5. One forceps blade may be used as a vectis to assist delivery of the head in **Cesarean section**- lever action.

6. stimulates uterine contractions.

Forceps classification[33]:

Several hundred different forceps designs have been invented. These are broadly divided into:

1. Classic instruments.

2. Modified classic instruments.

3. Specialized instruments

4. Divergent blade instruments

5. Axis traction devices

Classic instruments:

They are originally invented by James Young Simpson and George L. Elliot Jr in the mid19th century. Both instruments incorporate cephalic and pelvic curves but differ in several respects.

The major differences between the instruments concern the shape of the cephalic curve, the position of the shanks, and the construction of the handle. Simpson forceps have a more elongated and flattened cephalic curve combined with the non-overlapping or parallel shanks. When Simpson forceps are fully articulated, there is no truly effective

means of controlling cranial compression unless a towel or sponge is placed between the handles to separate them - a technique routinely practiced by some accoucheurs.

The elongated cephalic curve and the wide shanks make Simpson forceps best suited for well moulded heads of term-size infants. The widely separated shanks of the Simpson forceps are least traumatic in traction through a multiparous introitus but are less desirable for major rotations or in use in women with a narrow introitus than Elliot-design instruments because of separation of the shanks.

Elliot forceps have overlapping shanks and a more rounded cephalic curve. The instrument includes a finger-activated screw mechanism in the handle to help limit the extent of cranial compression when the blades are articulated and traction is applied, eliminating the need for a folded towel. The modifications to the blades and shank make Elliot's instrument better suited than Simpson's for rotational deliveries.

The Elliot forceps is less ideal than Simpson's design for application to heavily moulded fetal head because the ends of the blades produce pressure points on the fetal scalp at the narrower distance between the tips of the blades.

Modified classic instruments:

The Tucker-Mclane; which is an elliot type forceps design with, extended shanks, non-fenestrated and solid blades. Occasionally blades are pseudofenestrated (Luikarts modification). Tucker Mclanes are commonly used as mid pelvic rotators.

Specialized instruments:

They are designed for specific obstetric indications, like Barton, Keilland and Pipers.

Bartons forceps: Transverse arrest in a platypelloid pelvis.

Keillands forceps: Mid pelvic rotation, when correction of asynclitism is required.

Piper forceps: Delivery of the after coming head in breech presentation.

Divergent or parallel blade instruments:

Laufe and Shute forceps are the examples. These forceps were developed to limit fetal cranial compression by restricting the delivery forces by specialized design.

Axis traction instruments:

They are less commonly used in modern practice but were once quite popular. If axis traction is desired, it is to attach a traction handle (Bills handle) to a standard forceps.In some instruments, such as in the Hawk Dennen, Dewees forceps, Kedaranath Das forceps axis traction is an integral part of design.

Forces exerted by forceps[1]:

According to Joulin (1867), a pull in excess of 60 kg might damage the fetal skull.

Force produced by the forceps on the fetal skull is a complex function of pull and compression by the forceps and friction produced by maternal tissues.

Indications of obstetrics forceps[52]:

According to ACOG committee opinion, the indications for the forceps operation, including the position and station of the vertex at the time of application of the forceps, should be specified in a detailed operative description in the patient's medical record.

- **Fetal distress:**

  The more serious signs are:

Non-reassuring fetal heart rate pattern.

Prolapse of the umbilical cord.

- **Premature baby:**

To protect the fetal head by forming a protective cage around fetal skull, this prevents sudden compression and decompression of the fetal skull and thereby prevents tentorial tears and intracranial hemorrhage.

- **Shortening the second stage of labour:**

  When there is maternal disease - cardiac disease, pulmonary injury or compromise, intrapartum infection, certain neurological condition, tuberculosis, toxemia, or any debilitating condition-forceps can be used to shorten the second stage.

- **Prolonged second stage**
- **Maternal distress or exhaustion:**

  Maternal distress or exhaustion is shown by dehydration, concentrated urine and pulse and temperature above 100. These patients are not in shock, they are simply becoming exhausted.

- **Lack of co-operation:**

  During the second stage due to labor analgesia (e.g. epidural anesthesia blocks the sensory bearing down reflex).

Contraindications of forceps[52]:

1. Absence of proper indication.
2. Any contraindication to vaginal delivery.
3. Uncertainty of fetal position and station.
4. Marked cephalopelvic disproportion.

5. Inadequate anesthesia or analgesia.

6. Inadequate trial of labor.

7. Unsuccessful trial of vacuum extraction.

8. Operator inexperience or inadequate facilities and staff.

Analgesia for forceps delivery[53, 54]:

- Local analgesia
- Perineal infiltration
- Pudendal nerve block
- Epidural anaesthesia.

Pudendal nerve block:

Simultaneous perineal and vulval infiltration is needed to block the perineal branch of the posterior cutaneous nerve of the thigh and the labial branches of the ilio-inguinal and genito-femoral nerves.

Technique: The pudendal nerve may be blocked by either the transvaginal or the transperineal route.

Complications:

Intravascular injection of a local anesthetic agent may cause serious systemic toxicity characterized by stimulation of the cerebral cortex leading to convulsions.Hematoma formation from perforation of a blood vessel. Severe infection at the injection site.

Classification of forceps delivery:

I. Forceps classification according to station of head in pelvis: (Dennen)[55]

High forceps delivery:

The biparietal diameter is in the plane of inlet, leading bony point is at or just above ischial spines (the plane of inlet is bounded by the sacral promontory and the upper inner border of the symphysis pubis).

Mid forceps delivery:

Biparietal diameter is in plane of greater pelvic dimensions leading bony point is at spines or below +2 station. The hollow of the sacrum is not filled. (The plane of greatest pelvic dimension extends between the middle of inner border of symphysis and junction of the fused 2, 3 sacral vertebrae having crossed the obturator foramen.

Low forceps delivery:

Biparietal diameter is in plane of least pelvic dimensions, leading bony point is below +2 station ; hollow of the sacrum is filled.

The plane of least pelvic dimensions is bounded anteroposteriorly by the lower,inner border of the symphysis and the sacrococcygeal joint and laterally by the ischial spines.

Outlet forceps delivery:

Biparietal diameter is in plane of outlet, leading bony point is +4 station or lower, the plane of the outlet is quadrilateral in shape is bounded by the sacro-coccygeal joint posteriorly. The ischial tuberosities laterally and the inferior border of the symphysis anteriorly.

II.Reids classification:

a. High forceps operation

b. Mid forceps operation

c. Low mid forceps

d. Low forceps operation

Table. 3. Various types of Obstetric forceps and their description

Type of forceps	**Description**
Long curved obstetric forceps	It consists of 2 blades each of them is 15 inches (37.5 cm) long,crossing each other and lock at the site of crossing. Each is composed of: The blade proper (7.5 inches): has 2 curves; • pelvic curve adapted with the maternal pelvic axis, • cephalic curve adapted to the fetal head. • The blade is fenestrated to; - prevent compression of the head, -prevent its slippage as the parietal eminences are -protruding through the fenestration. -make its weight lighter. • The 2 blades are separated by one inch at the tip and 3.5inches at the centre. • The shank (2.5 inches): -It is the part between the blade proper and the handle giving a length for the forceps sufficient to be locked easily

	Outside the vagina. • Lock: there are 4 types of lock; -English type: double slot lock. -French type: screw lock. -German type: combination of both. -Sliding lock: present in Kielland's and Barton's forceps. • Handle (5 inches): It may be serrated or smooth. A projecting shoulder may be present to facilitate traction. • Axis traction piece: In mid forceps delivery, a separate piece is attached to the forceps to direct the traction in the direction of pelvic axis i.e. downwards and backwards till the perineum. • There are 2 common types of axis traction piece: -Neville- Simpson- Barnes: is the commoner one composed of a single bar attached to the handle just behind the lock. -Milne-Murray's: It is composed of 2 bars and a handle to be attached to the blade proper. • Pajot'smanoeuvre: is an alternative to the use of axis traction piece. Traction on the handle is made by the right hand while the left hand pulls downward on the shank or pushes on the shank from above (Modified Pajot'smanoeuvre).
Wrigleys forceps	It is a short curved forceps of 11 inches length and used for low and outlet forceps delivery.

Kielland's forceps	It is a long forceps characterised by: Minimal pelvic curve which is again nullified by a slight bend between the blade proper and the shank so it is nearly a straight forceps allowing rotation and extraction of the head by a single application. A sliding lock: to allow application on asynclitic head. Knobs on the handle: on the side of the minimal pelvic curve and should be directed toward the foetal occiput during application. Bevelled inner surface of the blades: to minimize foetal head injury. Light in weight.
Pipers forceps	It has a perineal curve to allow application to the after-coming head in breech delivery
Barton's forceps	A long forceps characterized by: The blade of the posterior branch joins the shank at an obtuse angle corresponding to that between the inlet and outlet pelvic planes. A 90 degrees hinge joint between the blade and the shank of the anterior branch. A sliding lock. Indication: transverse arrest especially in a platypelloid pelvis with a flat sacrum.

Table. 4. Varieties of Obstetric forceps

Conventional traction forceps	Short forceps	-Wrigley
	-Short Simpson	
	Long forceps	-Das
		-Simpsons
	Long forceps with	-Milne Murray's
	axis traction	-Haig-Ferguson
	-Neville Barnes	
Rotation forceps	Kielland's	
	Moolgaokar's	
	Barton's	
	Hay's	
Forceps for special use	After coming head in	-piper's
	breech	

III. ACOG Classification[1]:

Classification of forceps delivery adopted by the American College of Obstetricians and Gynecologists (2010)based on station and rotation.

Outlet forceps:

The application of forceps when

1. Scalp is visible at the introitus without separating the labia.

2. The fetal skull has reached the pelvic floor.

3. Sagittal suture is in the antero-posterior diameter or right or left occipitoanterior or posterior position.

4. The fetal head is at or on the perineum.

5. Rotation does not exceed 45 degree.

Low forceps:

Leading point of fetal skull is at station > +2cm, and not on the pelvic floor.

- Rotation is 45 degrees or less (left or right occiput-anterior to occipitoanterior, or left or right occiput posterior to occiput posterior).
- Rotation is greater than 45 degrees.

Mid forceps:

Station above +2cm but head is engaged.

High forceps:

Not included in classification.

Trial forceps[33]:

It is the application of forceps in borderline cephalopelvic disproportion with the idea that only 2 or 3 tentative pulls are given. If descent occurs, baby is delivered vaginally by forceps, otherwise resort to other methods of delivery like cesarean section. The

procedure should be conducted in an operation theatre keeping everything ready for caesarean section. The conduct of trial forceps requires great deal of skill and judgement. If moderate traction leads to progressive descent of the fetal head, the delivery is completed vaginally; if not caesarean section is done immediately.

Prophylactic outlet forceps (Elective)[54]:

Delee (1920) recommended delivery by prophylactic outlet forceps, because it was held widely at the time that prolonged pressure of the fetal head against a rigid perineum might result in fetal brain damage. There is no evidence that use of prophylactic forceps is beneficial in the other normal term labor and delivery. Prophylactic outlet operations may be associated with increased perineal trauma in nulliparous women.

After complete dilatation of the cervix and when the head has come well down to the level of the pelvic floor in complete anterior rotation of the occiput, the fetus is delivered by outlet forceps. The reason given for such a procedure is that it reduces the muscular and nervous strain of the second stage, saves the pelvic floor from over stretching and preserve the baby's head from prolonged compression. The results of this procedure, under the strict conditions laid down, is as satisfactory as a spontaneous delivery.

Prophylactic forceps should not be applied until the criteria for outlet forceps has been fulfilled that is the fetal head must be on the perineal floor with the sagittal suture in the anteroposterior diameter of the outlet.

Failed forceps[33]:

When a deliberate attempt in vaginal delivery with forceps has failed to expedite the process, it is called failed forceps. Maternal causes of failed forceps are:

1. Gross cephalopelvic disproportion (CPD); contracted pelvis.

2. Application before full dilatation of cervix.

3. Inexperienced obstetrician.

4. Contraction ring grasping the fetus.

5. Generalized tonic contraction of uterus.

6. Non dilatation of paravaginal tissues.

Fetal causes:

1. Malposition

2. Deflection

3. Large baby

4. Shoulders impacted at the brim.

Types of application of forceps blades[33]:

Cephalic application:

It is made to fit baby's head. The blades are applied along the sides of the head grasping the biparietal diameter in between the widest part of the blades. It is the ideal method of application as it has got a negligible compression effect on the cranium.

Pelvic application:

A pelvic application is made to fit the maternal pelvis, regardless of how the forceps grip the fetal head. The best pelvic application is achieved,

1. The left blade is next to the left side of the pelvis.

2. The right blade is on the right side of the pelvis.

3. The concave margin is near the symphysis pubis.

4. The convex margin is in the hollow of the sacrum.

5. The diameter of the forceps is in the transverse diameter of the pelvis.

Perfect application:

A perfect application is achieved when both the cephalic and pelvic requirements have been fulfilled. When the occiput has rotated under the symphysis pubis and the sagittal suture is in the anteroposterior diameter, an ideal application is possible.

Check list[1]:

After the handles are locked satisfactorily, the application is checked. This is done in three ways (three important check points):

The posterior fontanelle should be located midway between the sides of the blades and one finger's breadth above the plane of the shanks.

The sagittal suture should be perpendicular to the plane of the shanks throughout its length.

The fenestrations of the blades should barely be left, if at all. Not more than the tip of a finger should be able to be inserted between them and the head.

The amount of fenestration left on each side should be equal.

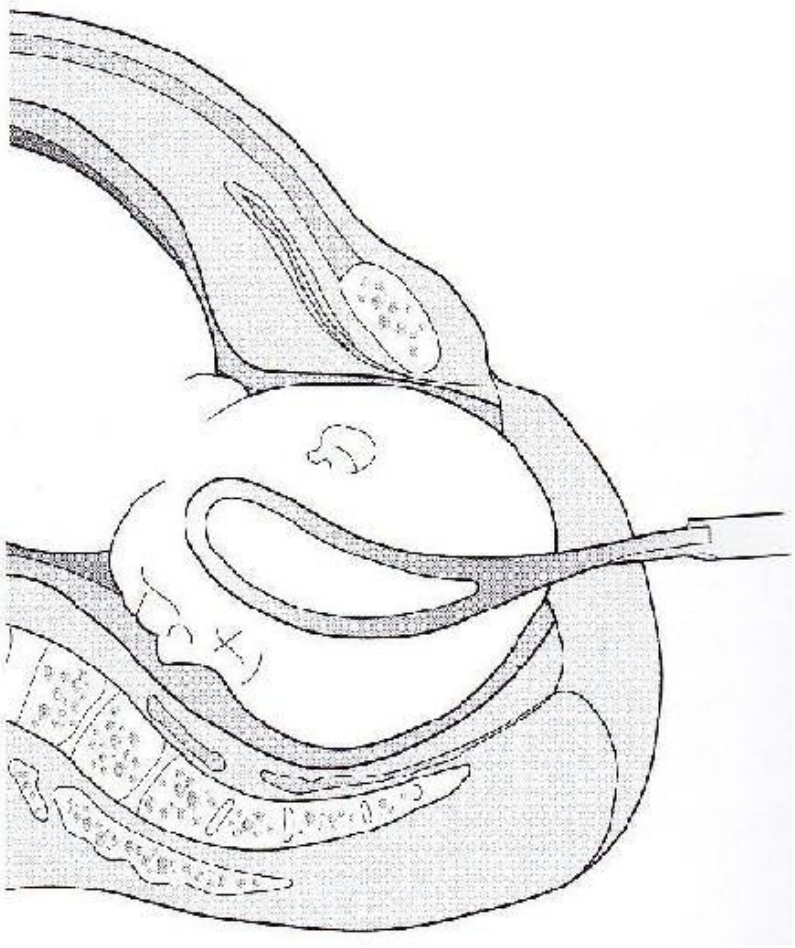


Figure 6. The Ideal biparietal bimalar application of the forceps blades to the fetal head

Outlet forceps operation: consists of following steps

1. **Identification of the blades and their application.**

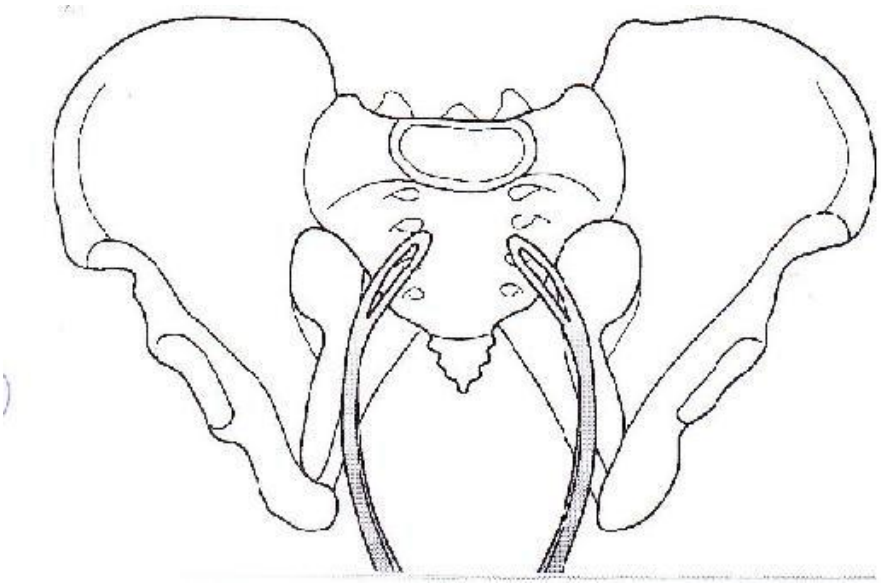


Figure7. The ideal position of the forceps blades relative to the maternal pelvis

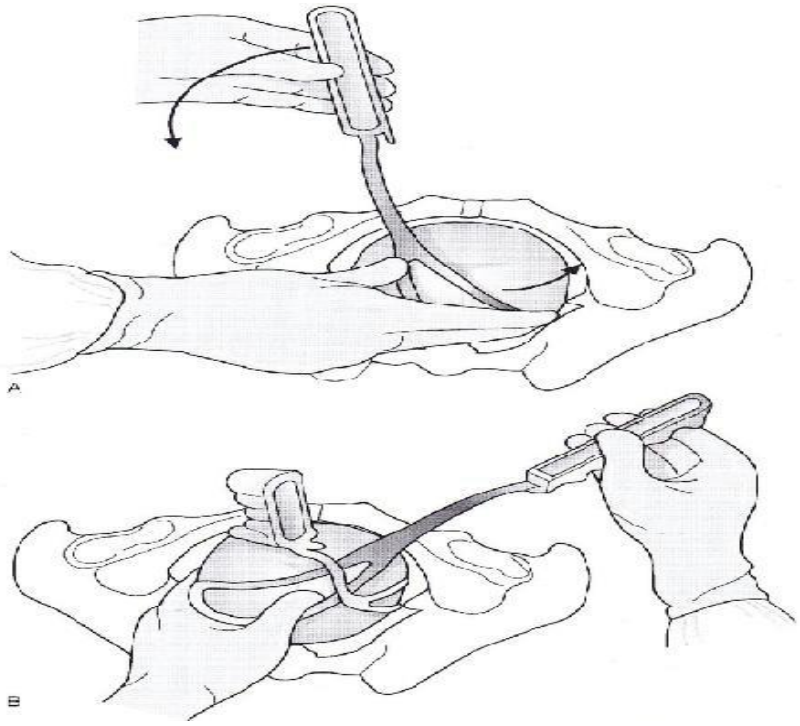


Figure 8 . a) Insertion of left blade. The fingers and thumb of the right hand guide the blade in to correct position while the left hand rotates the handle in a downward arc. b) The same procedure is carried out for insertion of the right blade using the opposite hands.

2. **Locking of blades**

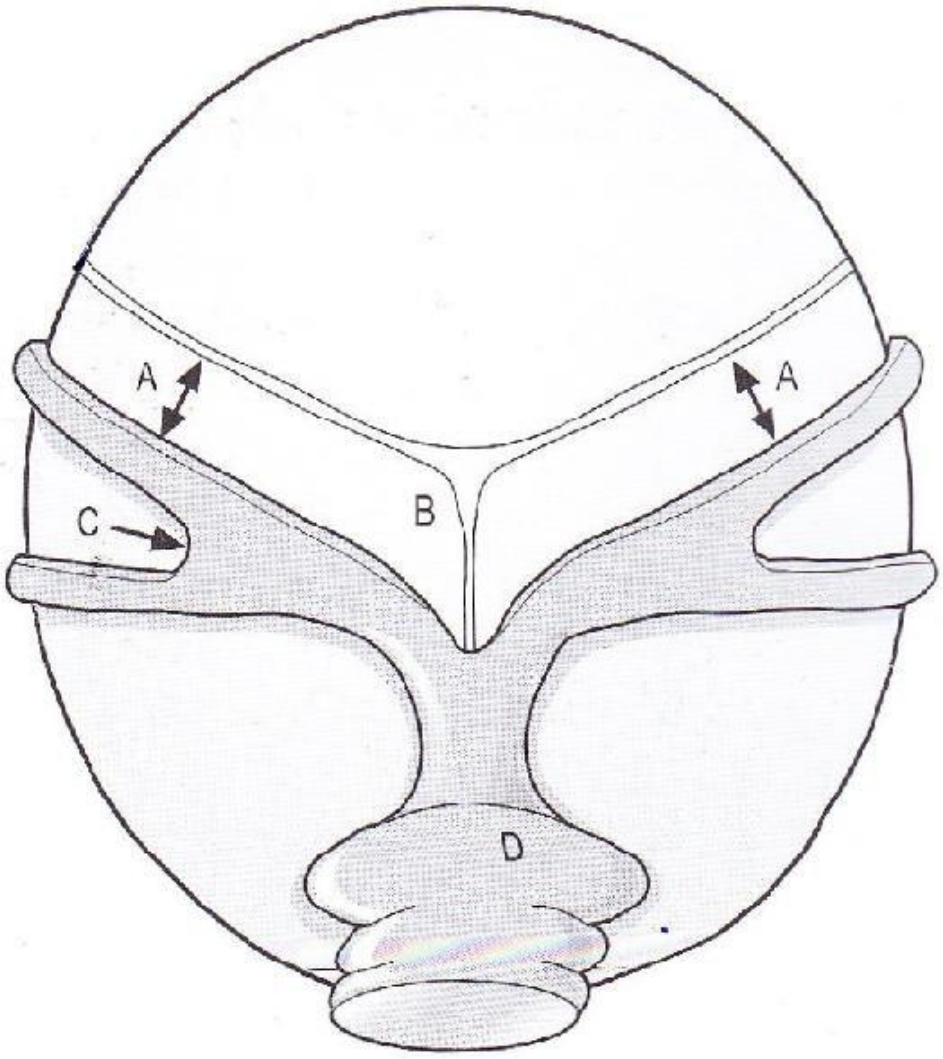


Figure 9. Checks for correct position of forceps relative to the head. A) Blades equidistant from lambdoid sutures. B) Posterior fontanelle one finger – breadth above plane of shanks. C) At most one finger breadth fenestra and head. D) Shanks perpendicular to sagittal suture.

3. **Traction:**

When it is certain that the blades are placed satisfactorily, then gentle, intermittent, horizontal traction is exerted until the perineum begins to bulge.

With traction, as the vulva is distended by the occiput, an episiotomy may be performed if indicated. More horizontal traction is applied, and the handles are gradually elevated, eventually pointing almost directly upward as the parietal bones emerge. As the handles are raised, the head is extended. During upward traction, the four fingers should grasp the upper surface of the handles and shanks, while the thumb exerts the necessary force on their lower surface. During the birth of the head, spontaneous delivery should be simulated as closely as possible.

Traction should therefore be intermittent, and the head should be allowed to recede in intervals, as in spontaneous labor. Except when urgently indicated, as in severe fetal bradycardi a, delivery should be sufficiently slow, deliberate, and gentle to prevent undue head compression. It is preferable to apply traction only with each uterine contraction.

4. Removal of blades.

Timing of episiotomy:

It may be done prior to the introduction of the blades or during traction when the perineum becomes bulged and thinned out by advancing part.

The blades are removed one after the other, the right one first and the left one next.

Causes of application failure[33]:

1. Incomplete dilatation of cervix.

2. Position of fetal head: The process of labour on the fetal head normally results in cranial moulding and formation of scalp edema. In dystocic labor it is impossible to insert blades or to be certain of the accuracy of their application.

Extraction failure[33]:

In failure of extraction, instrument is correctly applied as initiated, but delivery does not occur.

Slipping forceps[33]:

The forceps may slip when traction is applied.

1. Faulty application: When the forceps is applied too low on the head, it never grasps the head properly so the blades may slip.
2. In undiagnosed occipito-posterior or transverse position if pelvic application is used.
3. When applied to a hydrocephalic head which is too big for the forceps to be applied properly, as grip over a small position, or the cephalic pole only is obtained.
4. Occasionally in cases of rupture of uterus forceps may tend to slip, the head recedes.
5. When applied to a small head or a macerated fetus, the forceps tend to slip. Slipping of the forceps causes sudden stretching of the vaginal walls, causing severe lacerations of the vagina and perineum and increased incidence of intracranial hemorrhage in the fetus.

Maternal and fetal complications in forceps application[35]:

Maternal complications[51, 56]:

Immediate:

- Episiotomy extension: Mediolateral episiotomy appears to protect strongly against damage to the anal sphincter complex during delivery. It may even extend to involve rectum or its upward extension up to the vault of vagina.
- Vaginal lacerations.
- Cervical tear: especially when applied through an incompletely dilated cervix.
- Bladder, paraurethral, or urethral injuries.
- Vaginal hematoma.
- Increased blood loss.
- Uterine rupture.
- Rupture of the symphysis pubis.
- Incontinence: urinary or faecal.
- Fracture or subluxation of coccyx
- Nerve injuries

  Sural Iliac
- Vessel injuries

Delayed complications:

- Faecal incontinence[57]: Third degree tears (involving the anal sphincter) incur a higher risk of faecal incontinence but these are rare occurring in 0.5-1% of vaginal births. Overall prevalence of faecal incontinence as ascertained was 9.6%.
- Urinary incontinence[58]: It is estimated that 10% of deliveries are by forceps whereas 3.3% are by vacuum extraction.

- Anal sphincter defects and symptoms of anal incontinence[57]: To be more common after forceps delivery. It has been shown that structural damage to the anal sphincter has been significantly more common with forceps.
- Pelvic organ prolapse: Due to prolonged second stage of labour.
- Nerve injuries[47]: Forceps are associated with facial nerve injury, brachial plexusinjuries.
- The majority of brachial plexus injuries resulting from delivery resolve spontaneously, with permanent injury rates ranging between 5% and 25%. One way to reduce the risk of injury is to limit lateral traction after the head is delivered, especially after instrument delivery.
- Infection:

  Cellulitis or local abscess

  Necrotizing fasciitis

  Uterine atony
- Fistula formation:

  Rectovaginal

  Vesicovaginal

  Vesicouterine
- Bladder atony, inability to void

Fetal complications of forceps application:

- Transient facial forceps marks, bruising, lacerations and cephalohaematomas are possible.
- Facial nerve injuries.
- Skull fracture, intracranial haemorrhage with falx or tentorial lacerations.

- Shoulder dystocia and brachial plexus injury.
- Subgaleal haematoma
- Retinal haemorrahge.
- Spinal cord injury.
- Fracture clavicle.
- Cerebral palsy, mental retardation and behavioral problems may be related to the hypoxic episodes that mandates emergent delivery.

Materials & Methods

METHODOLOGY

A prospective comparative study was conducted in women delivering at Department of Obstetrics and Gynaecology, R L Jalappa Hospital, attached to Sri Devaraj Urs Medical Academy, Kolar from March 2016 -March 2017 for a period of one year.

A minimum of 180 patients was taken up for study. 90 women delivered by outlet forceps and 90 women by vacuum. Cases which require instrumental vaginal delivery and fulfilling the inclusion criteria for forceps or vacuum were taken up for the study, after taking informed consent.

Forceps or Vacuum application will be done using American College of Obstetrics and Gynaecology (ACOG guidelines 2010).

Indication for forceps or vacuum application will be noted in each case.

Inclusion criteria:

	Vacuum delivery		**Outlet Forceps delivery**
1.	Term pregnancy >37 completed weeks	1.	Term pregnancy >37 completed weeks
2.	Full dilatation	2.	Full dilatation
3.	Station +4 and more (fetal head is at or on perineum)	3.	Station +4 and more (fetal head is at or on perineum)
4.	No CPD	4.	No CPD
5.	Vertex presentation	5.	Vertex presentation
6.	Ruptured membranes	6.	Ruptured membranes

EXCLUSION CRITERIA:

	Vacuum delivery		**Outlet Forceps delivery**
1.	Malpresentation – brow,face,breech	1.	Malpresentation – brow,face ,breech
2.	True CPD	2.	True CPD
3.	Premature infants	3.	Premature infants
4.	High fetal station less than +4	4.	High fetal station less than +4
5.	Cervical dilation <10cms	5.	Cervical dilatation <10cms
6.	Presence of severe caput	6.	IUFD
7.	Anomalous babies and IUFD	7.	Anomalous babies
8.	Birth weight <2.5 kg and > 4kg	8.	Birth weight <2.5 kg and > 4kg

Maternal morbidity in terms of episiotomy extension**,** need for episiotomy, perineal tears, vaginal tears, hospital stay, postpartum haemorrhage, anemia, need for blood transfusion will be documented.

Fetal outcome in terms of Apgar score at 1 min and 5 min**,** Instrumental marks, scalp injuries, facial marks (instrumental marks)**,** neurological injuries , cephalohaematoma, jaundice, need for NICU admission will be documented.

Comparative study was done to analyze the data.

A detailed history was taken with regard to the period of amenorrhea, onset of labour pain, history of leaking and any problems during pregnancy. Whether patient had antenatal checkups, whether immunized or not, patient was a booked or unbooked case.

The obstetric history was elicited as to whether the patient was a primigravida or a multigravida and what was her past obstetric performance in detail.

The menstrual history was noted with special reference to the last menstrual period and as to whether the patient had regular cycles to determine the gestational age of the fetus. The patient was asked for any significant past and family history.

Clinical examination:

A detailed general examination was done for built, nutritional status, height and weight.

The blood pressure and the pulse rate were noted along with the presence/absence of anemia and pedal edema. The central nervous system, cardiovascular system and respiratory system were examined.

A **per abdominal examination** was done for the height of the uterus in weeks, the lie of the fetus, the position of the back, the type of presentation and position and fetal heart rate. It was noted whether the head was engaged or not.

A detailed **pelvic examination** was done to determine the consistency, effacement and dilatation of the cervix. The presence or absence of membranes was noted. The station of the vertex with its position was specifically noted along with the presence of caput and moulding. The colour of the liquor and assessment of CPD was noted.

Procedures:

The soft vacuum cup was applied only in those cases when it was indicated with the cervix being fully dilated.

The forceps was applied in this study with indication of prolonged second stage, fetal distress, anemia and results were compared for maternal complication, fetal morbidity and mortality.

Pre-requisites for application of vacuum and forceps delivery are as below[37]:

1. Good uterine contractions should be present.
2. Bowel and bladder should be emptied before application.
3. Cervix must be fully dilated.
4. Membranes must be ruptured.
5. The presentation must be vertex except for after coming head in breech for forceps.
6. The presenting part should be at spines for vacuum and for forceps-it should reach below spines.
7. Pelvis must be adequate.
8. Suitable anesthesia must be given.

Vacuum delivery:

For all the cases the silc cup of 6 cms diameter was used in the present study. Patient was put in lithotomy position, perineum cleaned and draped then the bladder wasc atheterized, local infiltration of 2% xylocaine 5-10ml was made into the perineum. If the introitus was lax enough to allow the introduction of the soft cup the episiotomy was deferred till the head was crowning. But episiotomy was given prior to application.

The presence of good uterine contraction is mandatory, so if patient is not getting good contraction start syntocinon drip.

The soft rubber cup was inserted into the introitus by pressing it side to side and introducing it in its long axis. The posterior portion of the cup was inserted first, partially introducing the cup and then the cup was allowed to flare out in the vagina and it was simultaneously rotated. With this movement the entire cup entered the introitus.

The indicator on the cup should point toward the occiput. The cup was then pressed against the vertex and a check was made to assure that no maternal soft tissue was included inside the cup.

The electric vacuum suction apparatus was then switched on, the vacuum allowed to rise within about a minute to 550-600mm of Hg. With this the cup flattened itself onto the head. With the right hand, traction was applied while the left hand must maintain contact with the traction cup and the fetal head, not only to exert posterior pressure but to be able to follow the movements of the head and to note and correct any tendency of the cup to get detached. In this way exact knowledge of the movements of the fetal head was obtained and the direction of the traction was adjusted accordingly.

If vacuum was applied at outlet, direction of traction was upward and forwards. If the level of application was low midcavity, then the direction of traction was downwards and backwards initially then horizontal till the head crowned and finally upwards and forwards.

If the introitus was so lax as to allow the head to come through without a tear then one need not give episiotomy. Traction on the cup was only applied during a uterine contraction and with maternal bearing down efforts. The time of vacuum extraction was never allowed to exceed 10 minutes. If the cup slipped once then the suction apparatus was switched off and the cup was reapplied. The cup was not allowed to slip more than 3 times. If so this was considered a failure of vacuum extraction.

After the head was delivered the cup was allowed to get released by itself with the help of a valve to release the vacuum and the suction was switched off.

On completion of the delivery of the baby the cord clamped and cut, and an assessment of the apgar score made at birth and 5 minutes after birth. The location of chignon was noted and its size. If any scalp injuries, note was made.

The mother was then examined for any laceration of the vaginal mucosa, extension of episiotomy or cervical tear. The episiotomy sutured in layers.

Mother observed for any complications like PPH, shock. Mother and child were observed during their stay in hospital for any complications.

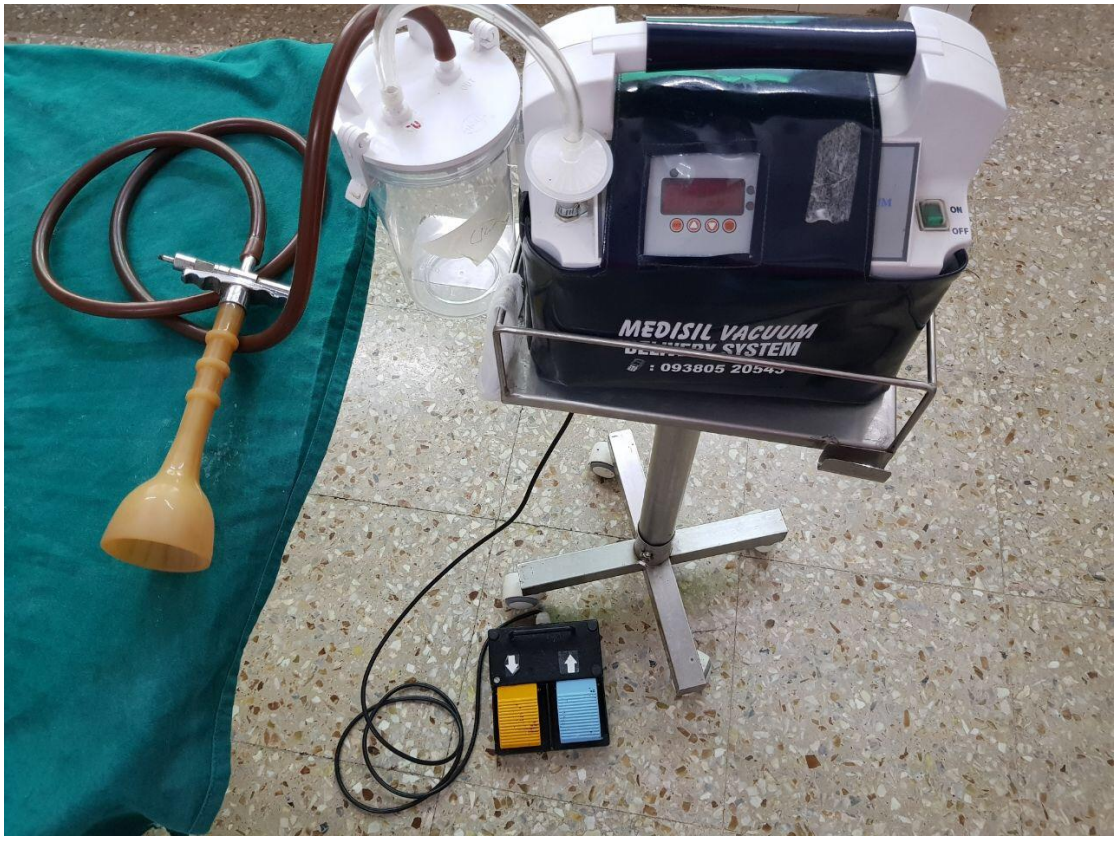


Figure 10. Vacuum extraction machine in RLJH.

Outlet Forceps delivery:

Patient was put in lithotomy position, bladder emptied. Vaginal examination was done to reassess the cervical effacement, dilatation, position and station of the head, colour of liquor, if any caput and moulding present. Ghost application of blades was done and then the blades are applied.

In LOA position the middle and index finger of the right hand are introduced into the vagina, lubricated left blade is introduced into the vagina when the whole of the cephalic position of the blade has been introduced around the fetal head it was gently rotated laterally. The same is done on right side and then blades are locked.

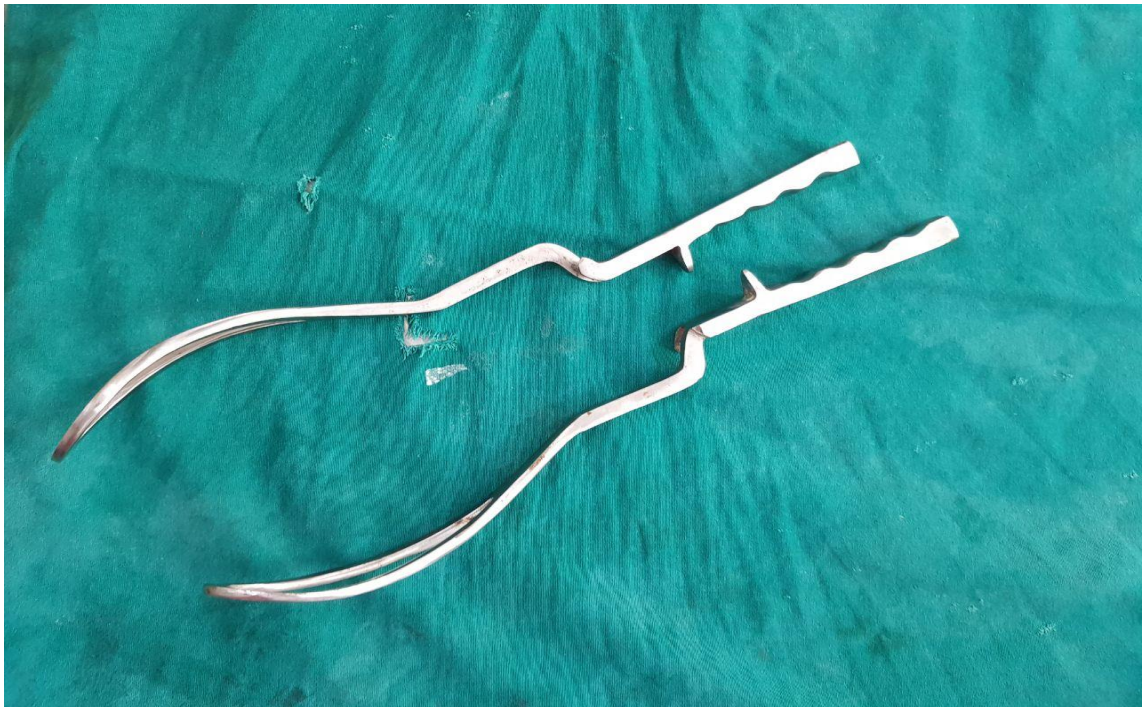


Figure.11. Outlet forceps in RLJH (Wrigleys forceps)

Application is checked by 3 things.

1. Posterior fontanalle.

2. Sagittal suture.

3. Fenestration.

Episiotomy may be given after correct application. Gentle horizontal traction is exerted until the perineum begins to bulge. Till that time downward traction following forward traction has to be given. As the vulva is distended by the occiput the handles are gradually elevated, eventually pointing directly upwards as the parietal bones emerge. As the handle is raised the head is extended.

After the delivery the same procedure is followed as in vacuum delivery. Special note is made on blade marks on the baby and injuries to the maternal soft tissues. The perinatal outcome was assessed by Apgar scoring at 1 and 5 minutes.

After the delivery of the placenta, the speculum examination was done routinely to rule out high vaginal tears, cervical tears, extension of episiotomy. The episiotomy was then sutured in layers.

Observations & Results

STATISTICAL ANALYSIS

Study design:

Comparative study

Sample Size:

Was estimated based on the difference in proportion of maternal morbidity (episiotomy) at term in two types of Instrumental deliveries which gave the maximum sample size for all the morbidities.

By using the formula:

$$\text{Sample size} = \frac{r+1}{r}\frac{(p^*)(1-p^*)(Z_\beta + Z_{\alpha/2})^2}{(p_1 - p_2)^2}$$

r = Ratio of control to cases, 1 for equal number of case and control
p^* = Average proportion exposed = proportion of exposed cases + proportion of control exposed/2
Z_β = Standard normal variate for power = for 80% power it is 0.84 and for 90% value is 1.28. Researcher has to select power for the study.
$Z_{\alpha/2}$ = Standard normal variate for level of significance as mentioned in previous section.
$p_1 - p_2$ = Effect size or different in proportion expected based on previous studies. p_1 is proportion in cases and p_2 is proportion in control.

From the Study by Singh Abha , Rathore Prathiba in 2011, p1 = 80%, p2 = 93.3% at 90% confidence level (α = 0.10) and 80% power, with equal ratio in both groups.

$$N = \frac{2 \times 0.866 \times 0.134\ (1.64 + 0.84)^2}{(0.133)^2} = 81 \text{ in each group}$$

P* = 80 + 93.3 / 2 = 86.65 or 0.866

Considering Non response rate of 10% 81 + 81 = 90 patients in each group was included.

Statistical analysis:

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. **Chi-square test** was used as test of significance for qualitative data.

Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software: MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyze data. EPI Info (CDC Atlanta), Open Epi, Med calc and Medley's desktop were used to estimate sample size and reference management in the study.

In all the tables n = number of outlet forceps applied and vacuum applied that is n = 90 for outlet forceps and vacuum.

Table 1: Age distribution between two groups of study

Age(years)	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
<20	20	22.2	17	18.9
21-25	29	32.2	32	35.6
26-30	36	40.0	39	43.3
>31	5	5.6	2	2.2

$\chi 2 = 1.79$, df = 3, p = 0.616

In the Forceps and Vacuum group majority i.e. 36 (40%)and 39 (43.3%) were in the age group 26 to 30 years respectively. There was no significant difference in age distribution between two groups.

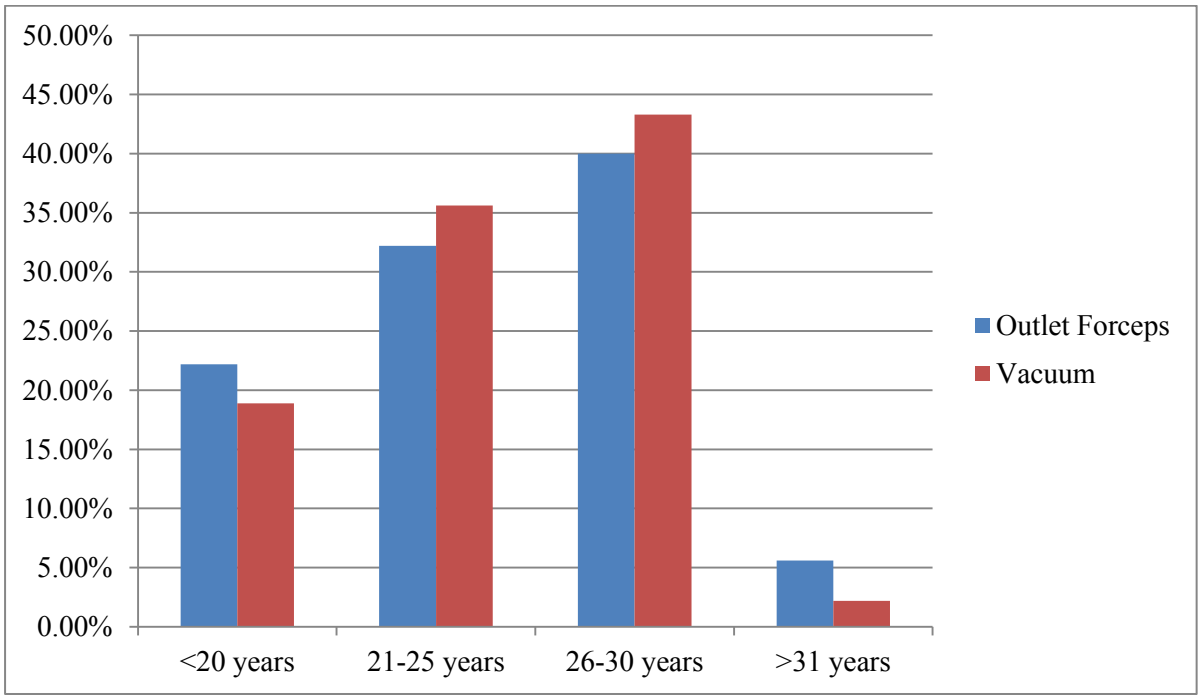


Figure 1: Bar diagram showing Age distribution between two groups of study

Table 2: Parity distribution between two groups of study

Parity	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Primigravida	59	65.6	38	42.2
Gravida 2	22	24.4	46	51.1
Gravida 3	6	6.7	6	6.7
>Gravida 3	3	3.3	0	0.0

$\chi 2 = 16.01$, df = 3, p = 0.001*

In the Forceps group majority 59(65.6%) were Primigravida and in Vacuum group majority 46(51.1%) were Gravida 2. There was significant difference in parity distribution between two study groups.

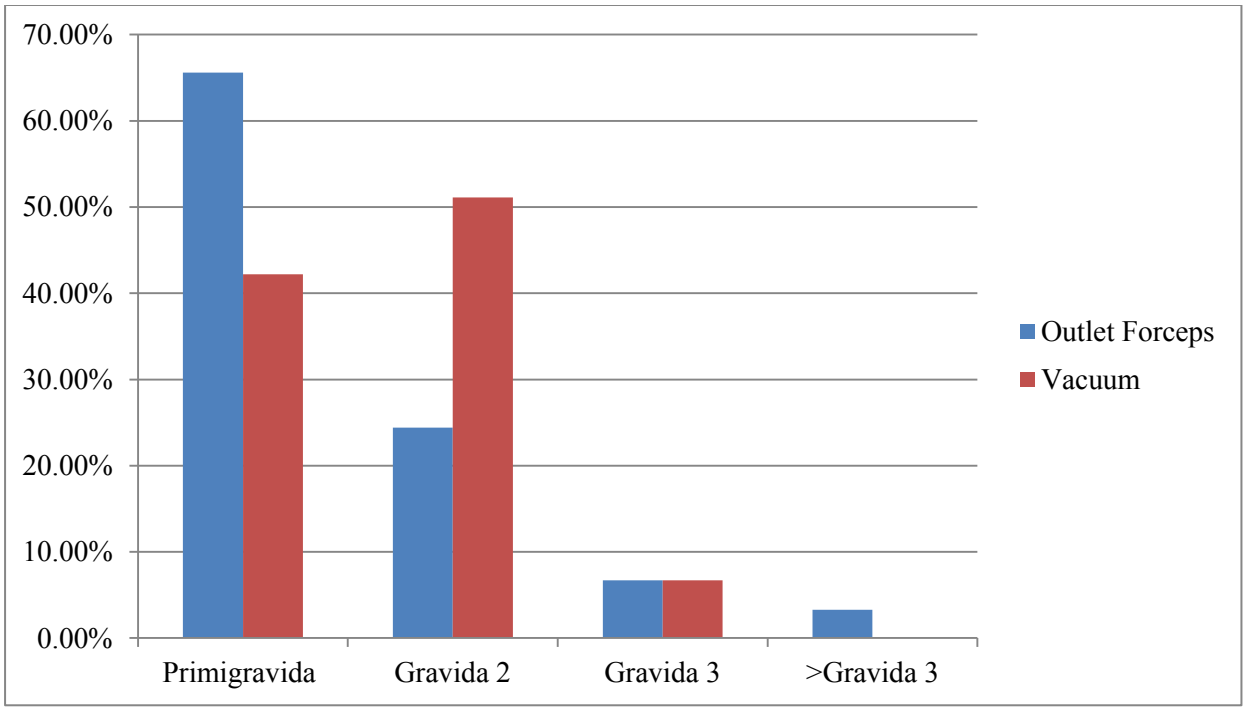


Figure 2: Bar diagram showing Parity distribution between two study groups

Table 3: Gestational Age distribution between two study groups

Gestational Age (weeks)	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
37 0/7 - 40	46	51.1	47	52.2
40 1/7 – 42	40	44.4	36	40.0
>42 1/7	4	4.4	7	7.8

$\chi 2 = 1.039$, df = 2, p = 0.595

In the Forceps and Vacuum group majority i.e. 46(51.1%) and 47(52.2%) were in the term gestational age respectively. There was no significant difference in gestational age distribution between two groups.

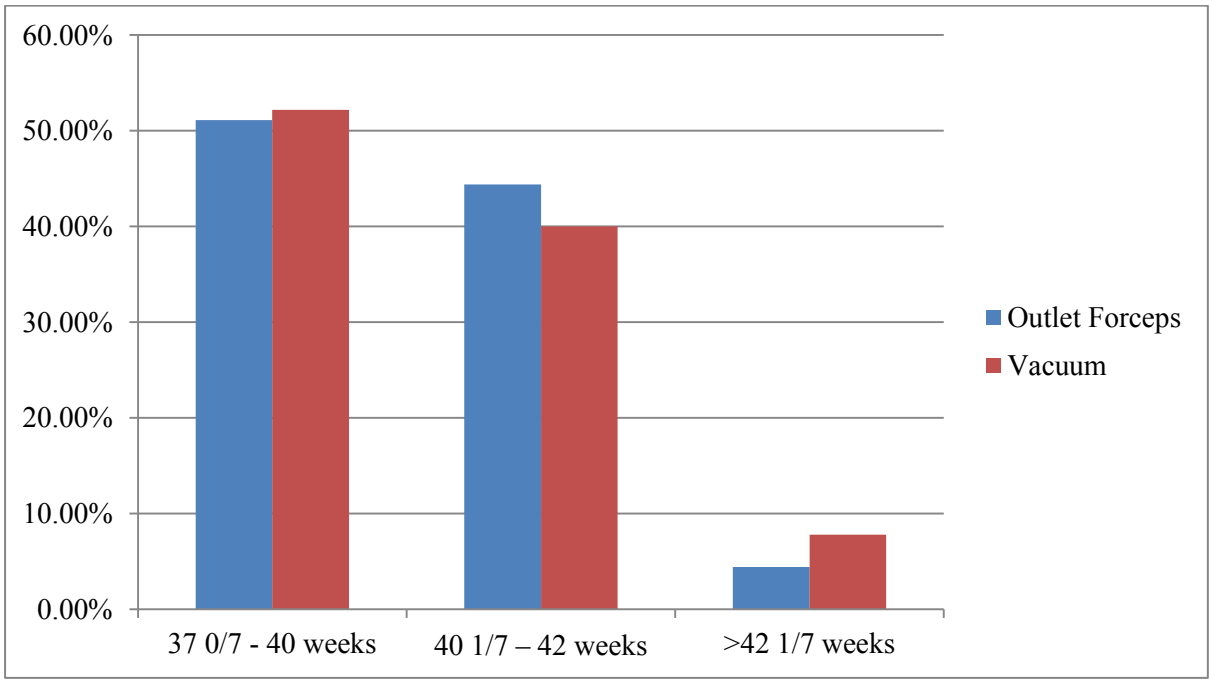


Figure 3: Bar diagram showing Gestational Age distribution between two study groups

Table 4: ANC distribution of subjects between two study groups

ANC	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Booked	37	41.1	23	25.6
Unbooked	53	58.9	67	74.4

$\chi 2 = 4.90$, df = 1, p = 0.027*

In Outlet Forceps group 37(41.1%) were booked cases and 53(58.9%) were unbooked cases. In Vacuum group 23(25.6%) were booked cases and 67(74.4%) were unbooked cases. This difference in ANC bookings between two groups was statistically significant.

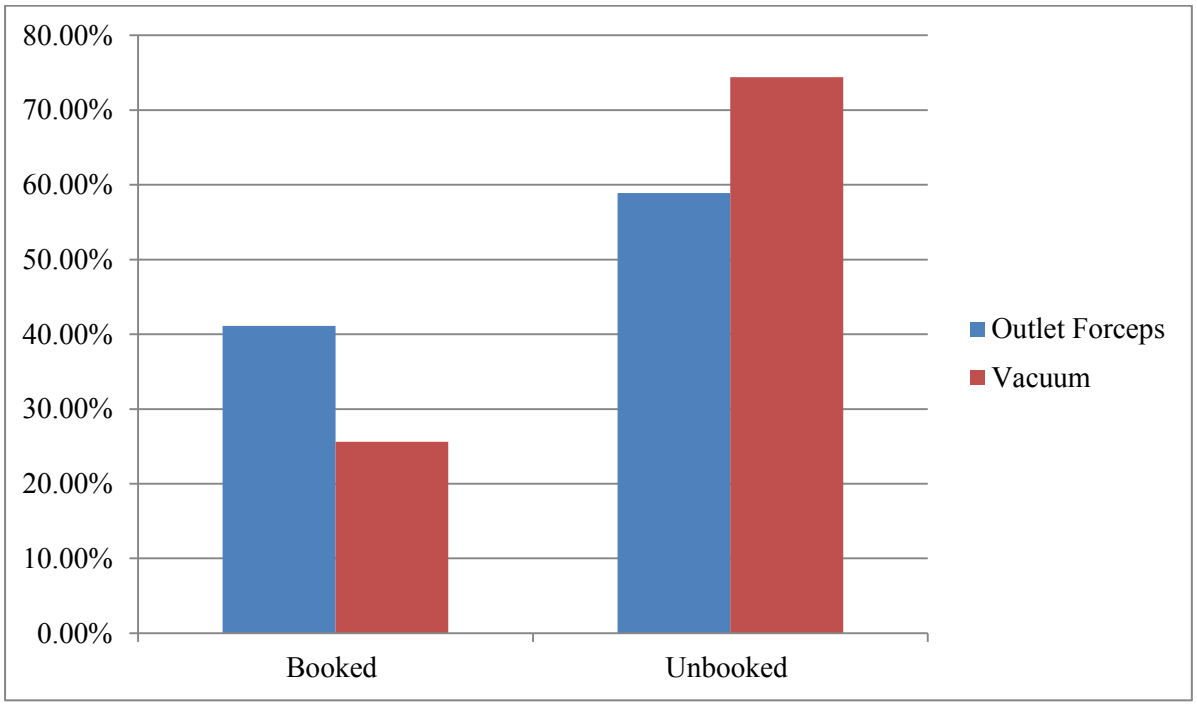


Figure 4: Bar diagram showing ANC distribution between two study groups

Table 5: Comparison of Indications between outlet forceps and vacuum study groups

Indications	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Prolonged second stage	18	20.0	14	15.6
Severe pre eclampsia	14	15.6	19	21.1
GDM	1	1.1	2	2.2
Fetal distress	11	12.2	9	10.0
Prolonged second stage + fetal distress	5	5.6	3	3.3
Severe pre eclampsia + fetal distress	2	2.2	4	4.4
Poor maternal bearing down efforts	30	33.3	34	37.8
Poor maternal bearing efforts+fetal distress	7	7.8	5	5.6
Maternal heart disease	2	2.2	0	0.0

$\chi 2 = 5.541$, df = 8, p = 0.699

Most common indication in Forceps and Vacuum groups was Poor maternal bearing down efforts in 30(33.3%) and 34(37.8%) respectively. Next common indication for forceps was prolonged second stage in 18(20%) and in Vacuum group Severe Preeclampsia in 19(21.1%). There was no significant difference in indications between two groups.

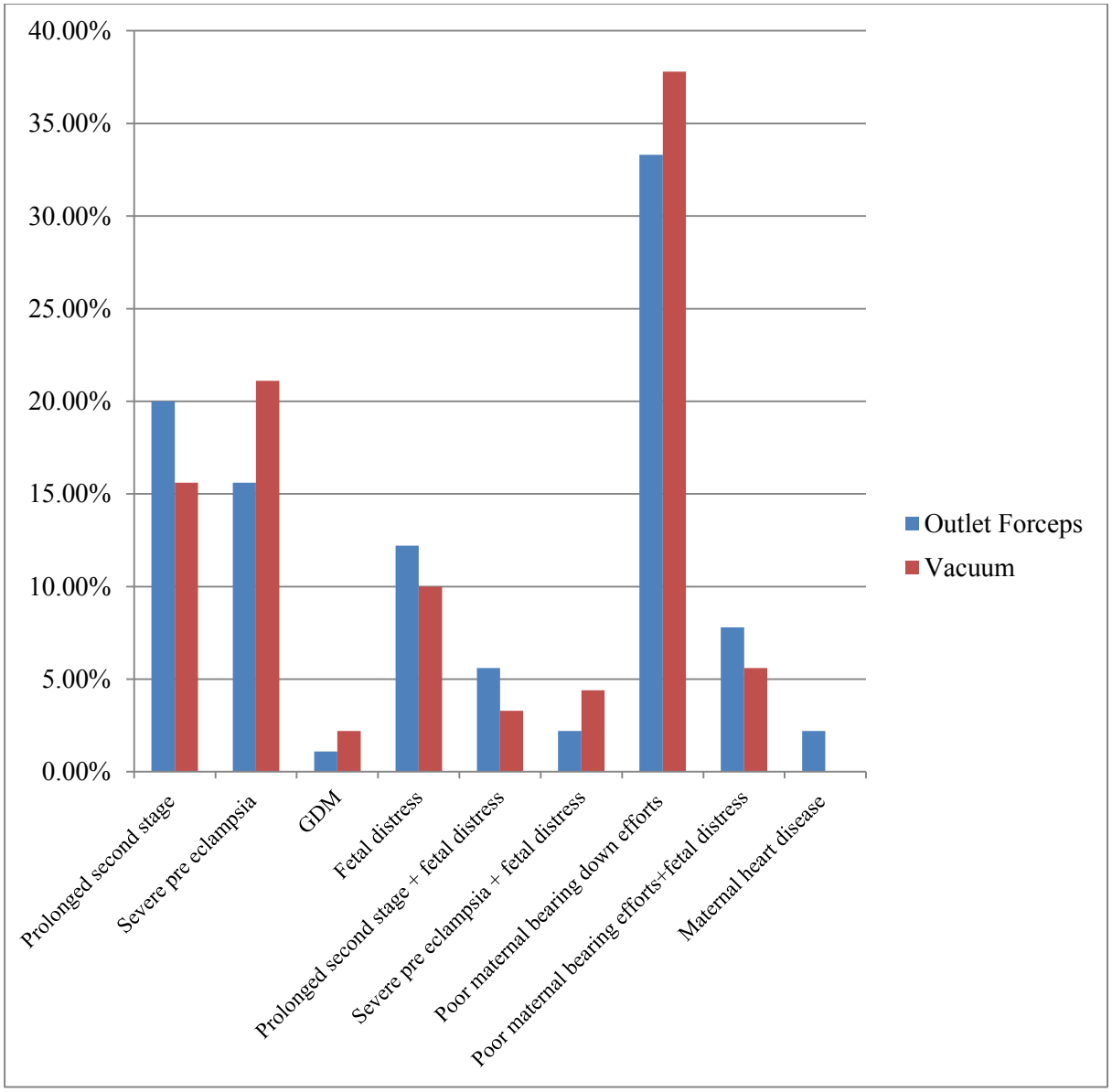


Figure 5: Bar diagram showing Comparison of Indications between two study groups

Table 6: Comparison of Episiotomy between outlet forceps and vacuum study groups

Episiotomy	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Required	90	100.0	81	90.0
Not required	0	0.0	9	10.0

$\chi 2 = 9.474$, df = 1, p = 0.002*

In Forceps group 90(100%) were given episiotomy and in vacuum group 81(90%) were given episiotomy and 9(10%) were not given Episiotomy. There was significant difference in episiotomy given between two groups.

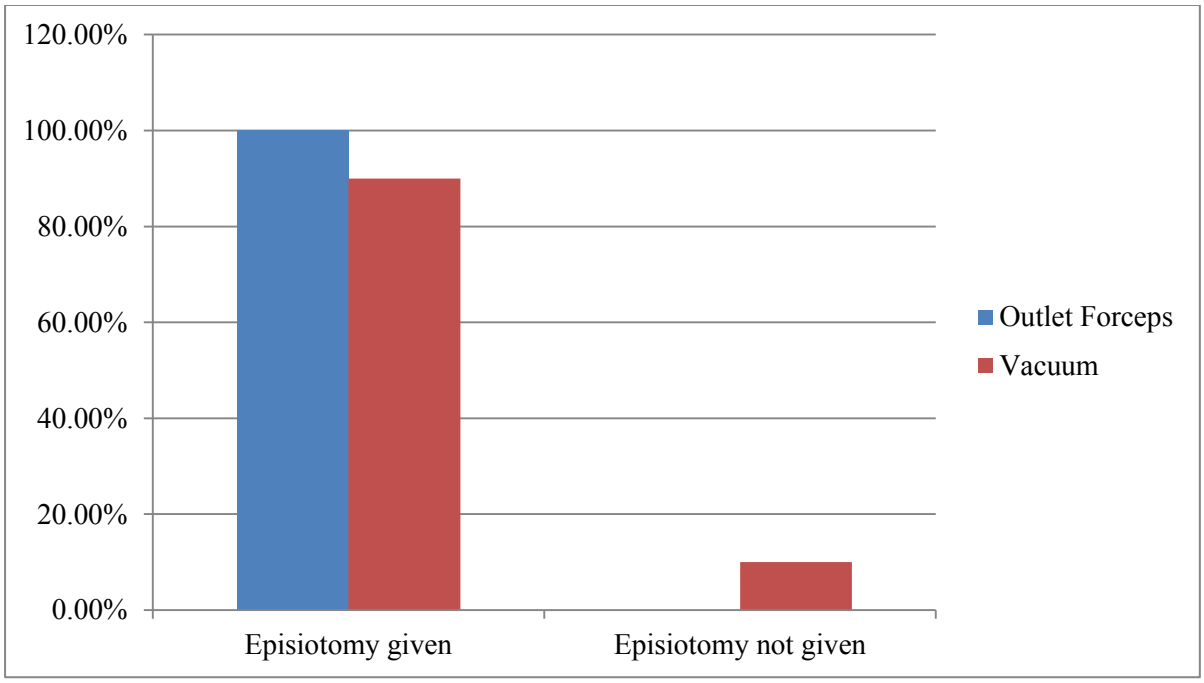


Figure 6: Bar diagram showing Comparison of Episiotomy between two study groups

Table 7: Comparison of Episiotomy extension and perineal tear between outlet forceps and vacuum study groups

Episiotomy Extension	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
No extension	71	78.9	86	95.6
3rd Degree Perineal Tear	15	16.7	4	4.4
Complete Perineal Tear	4	4.4	0	0.0

$\chi 2 = 11.80$, df = 2, p = 0.003*

In the outlet forceps groups Episiotomy was extended up to 3rd degree in 15(16.7%), complete Perineal tear was seen in 4(4.4%) and in Vacuum group 4(4.4%) had 3rd degree and 0(0%) had complete Perineal tear. This difference in Episiotomy extension between two groups was statistically significant.

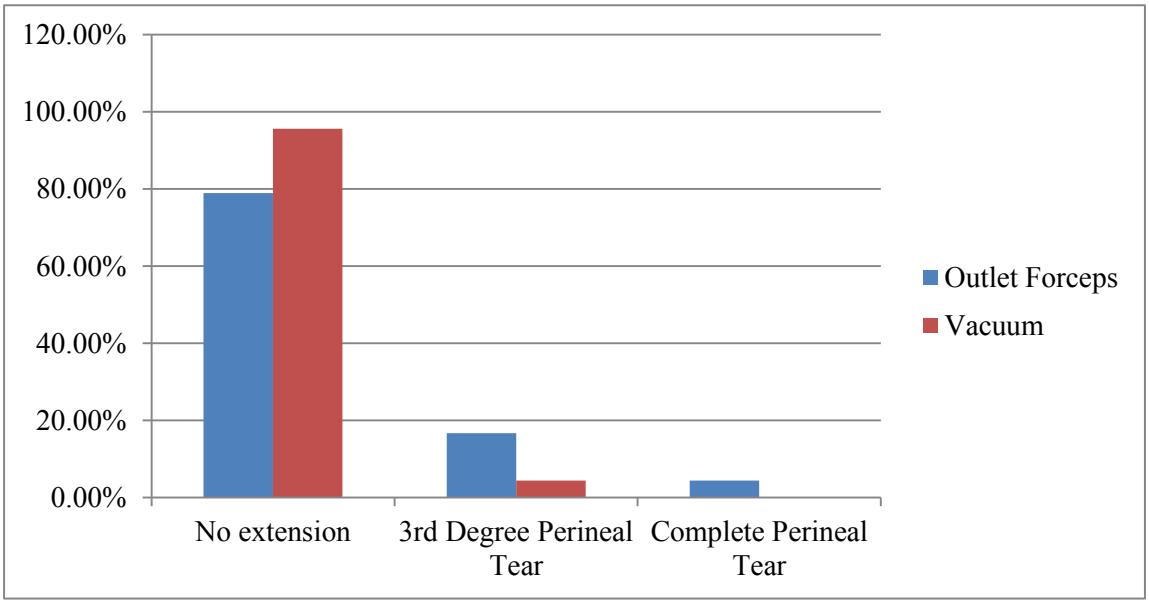


Figure 7: Bar diagram showing Comparison of Episiotomy extension between two study groups

Table 8: Comparison of Blood Transfusion between outlet forceps and vacuum study groups

Blood Transfusion	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Required	10	11.1	6	6.7
Not required	80	88.9	84	93.3

$\chi 2 = 1.098$, df = 1, p = 0.295

In Forceps group 10(11.1%) required blood transfusion and in Vacuum group 6 (6.7%)required blood transfusion. There was no significant difference in blood transfusion between two groups.

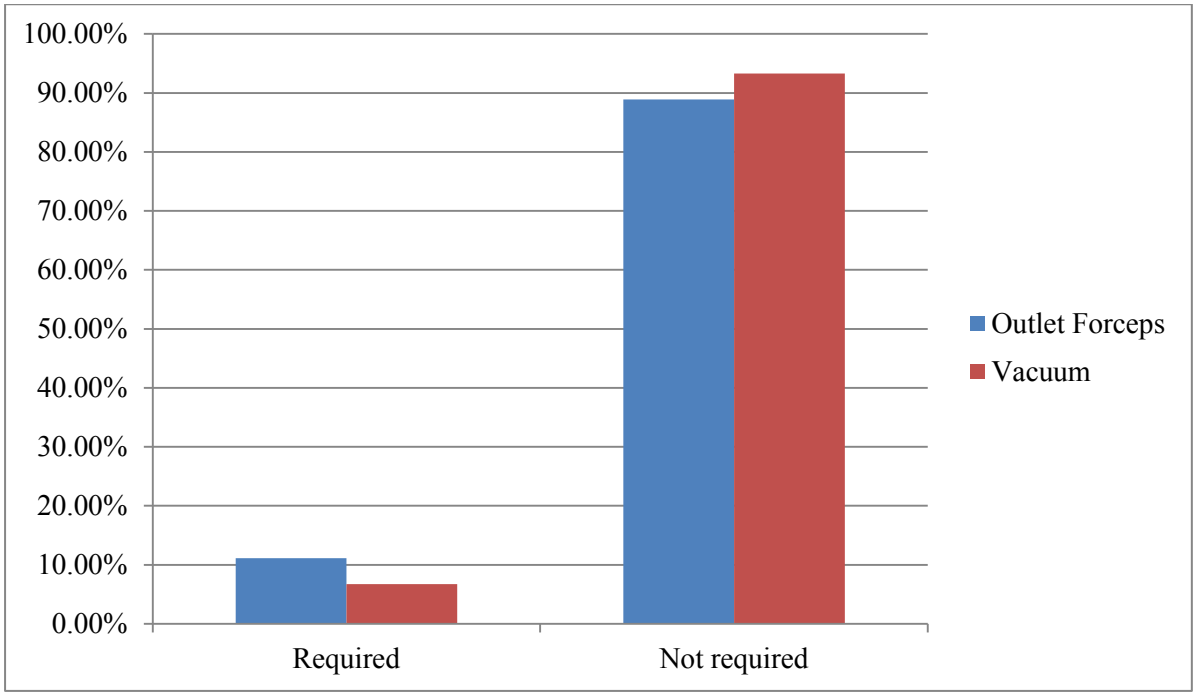


Figure 8: Bar diagram showing Comparison of Blood Transfusion between two study groups

Table 9: Comparison of presence of anemia between outlet forceps and vacuum groups before delivery

Anemia	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Anemia absent on admission (Hb>10 gm%)	35	38.9	25	27.8
Anemia present on admission	55	61.1	65	72.2

$\chi 2 = 2.5$, df = 1, p = 0.113

In Forceps group 55(61.1%) had anemia on admission and in Vacuum group 65(72.2%) had anemia on admission. There was no significant difference in anemia between two groups on admission.

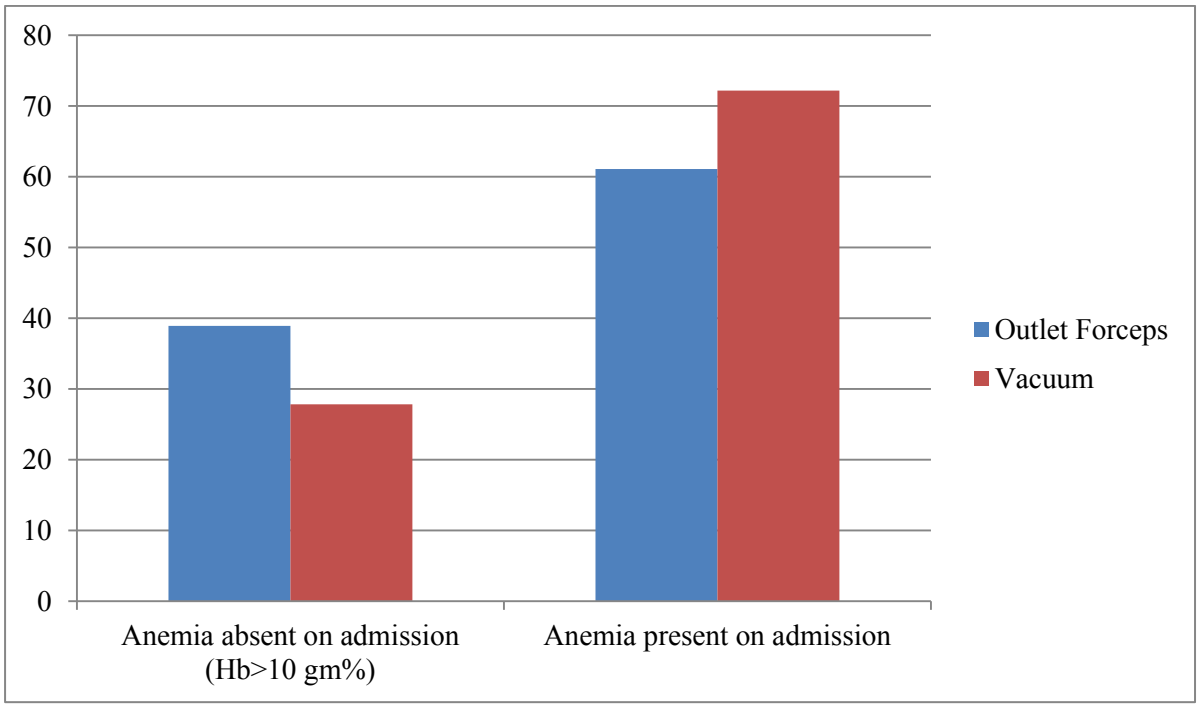


Figure 9: Bar diagram showing Comparison of presence anemia between two study groups before delivery

Table 10:Comparison of anemia after delivery between groups which were previously non anemicbefore delivery

Anemia	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=35	%	n=25	%
After delivery no Anemia	29	82.8	22	88
After delivery Anemia present	6	17.2	3	12

$\chi 2 = 0.302$, df = 1, p = 0.582

In outlet Forceps group 6(17.2%) and in Vacuum group 3(12%) had anemia after delivery in the subjects which were previously non anemic on admisssion. There was no significant difference in anemia between two groups after delivery.

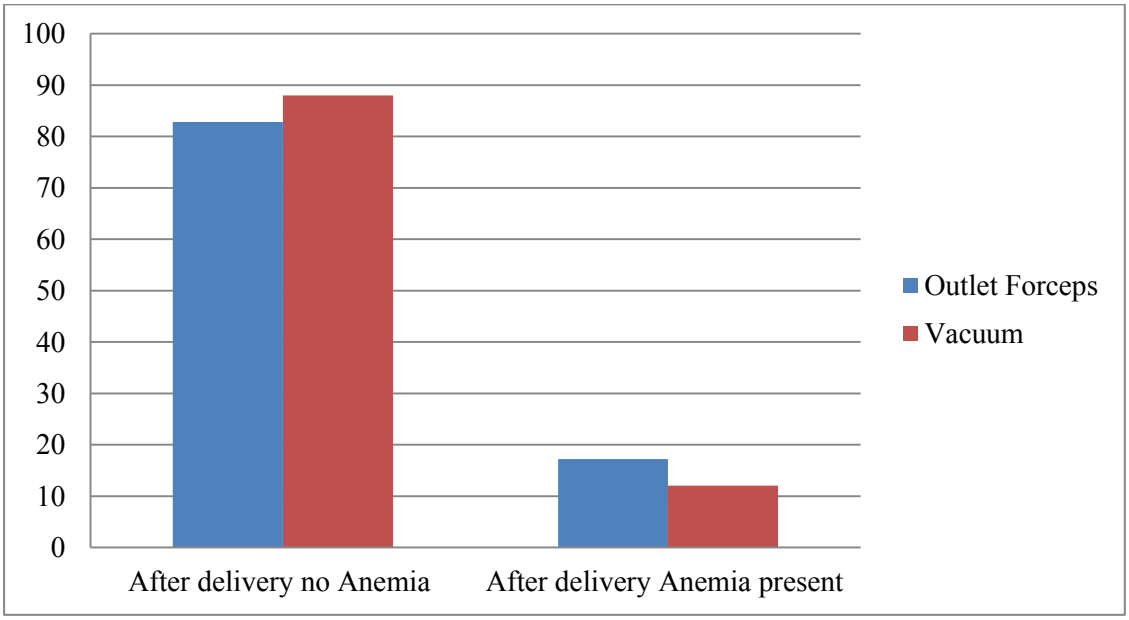


Figure 10: Bar diagram showing comparison of anemia after delivery between groups which were previously non anemic before delivery

Table 11: Comparison of PPH between two study groups

PPH	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
No PPH	78	86.7	80	88.9
Atonic PPH	8	8.9	10	11.1
Traumatic PPH	4	4.4	0	0.0

$\chi 2 = 4.24$, df = 2, p = 0.120

In Outlet Forceps group 78(86.7%) had no PPH, 8(8.9%) had Atonic PPH, 4(4.4%) had Traumatic PPH. In vacuum group 80(88.9%) PPH was absent, 10(11.1%) had Atonic PPH and 0% had Traumatic PPH. There was no significant association of PPH between two groups.

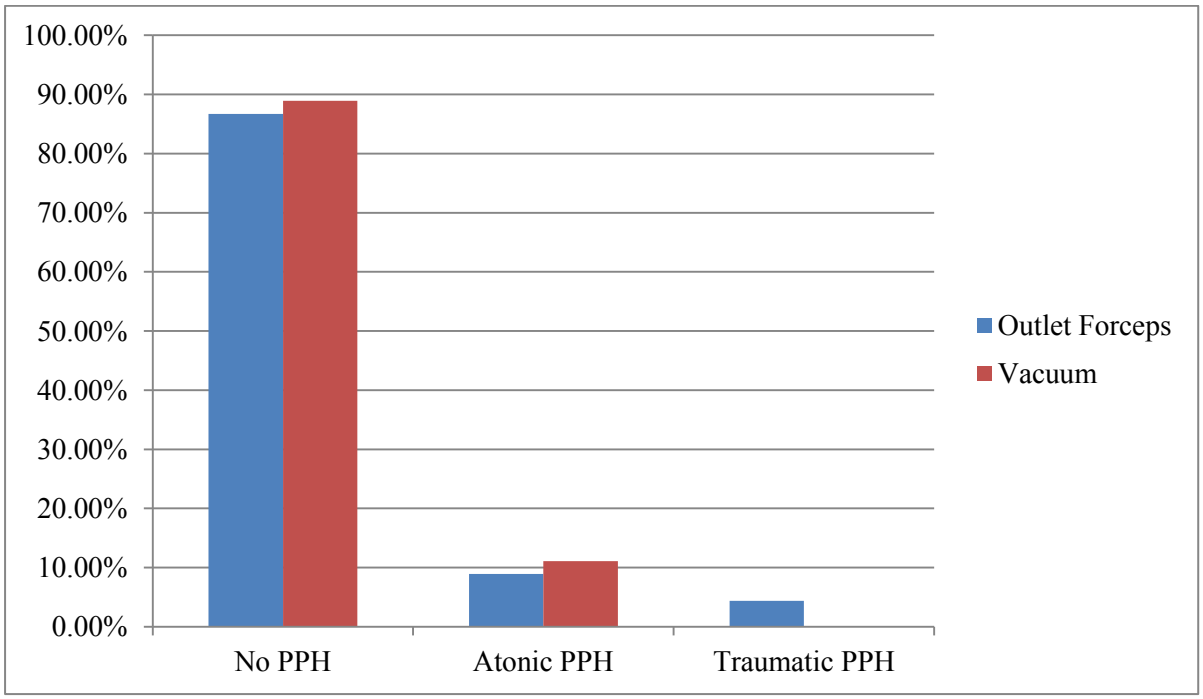


Figure 11: Bar diagram showing Comparison of PPH between two study groups

Table 12: Comparison of Need for Hospital Stay >5 Days between two study groups

Need for Hospital Stay >5 Days	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Discharged at 5th day	80	88.9	84	93.3
Hospital stay> 5 days -Due to Maternal factors	4	4.4	4	4.4
Hospital stay > 5 days-Due to Perinatal factors	6	6.7	2	2.2

$\chi 2 = 2.098$, df = 2, p = 0. 350

In Outlet Forceps group 80(88.9%) were discharged at 5th day, and 4 patients had hospital stay > 5 days (4.4%) due to maternal factors and 6(6.7%) due to Perinatalfactors. In Vacuum group 84(93.3%)were discharged at 5th day, 4(4.4%) had hospital stay > 5 days due to maternal factors and 2(2.2%) due to Perinatal factors. This difference in need for hospital stay >5 days between two groups was not statistically significant.

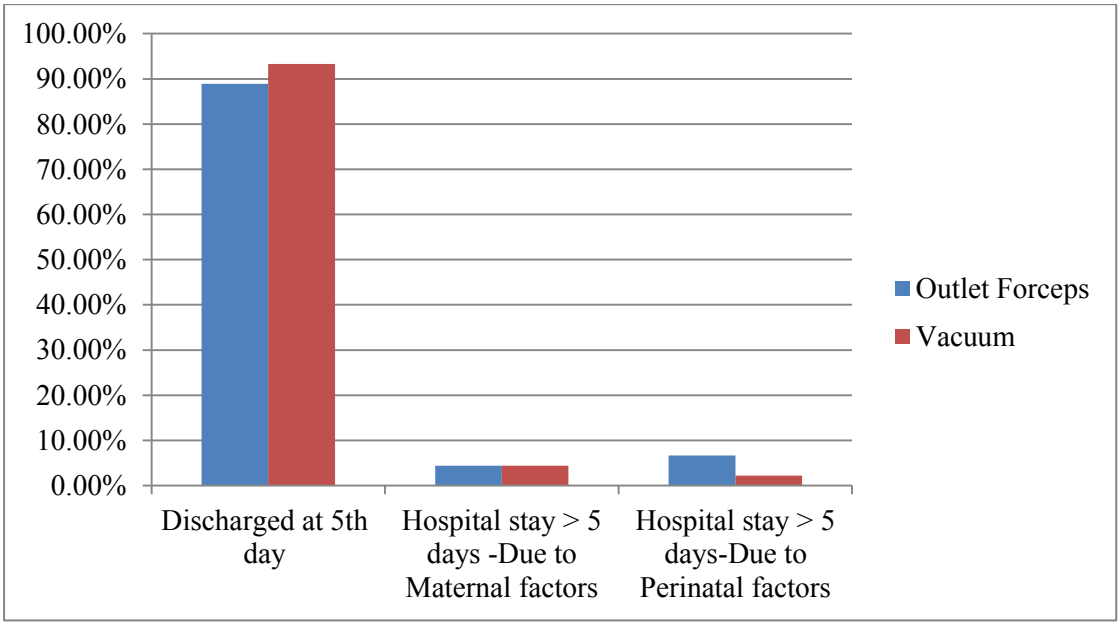


Figure 12: Bar diagram showing Comparison of Need for Hospital Stay >5 Days between two groups

Table 13: Comparison of Apgar score between two study groups

Apgar Score	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Normal 1'-7/10, 5'-9/10 and more	82	91.1	78	86.7
Low APGAR 1'- 6/10, 5'- 7/10 and less	8	8.9	12	13.3

$\chi 2 = 0.900$, df = 1, p = 0.343

In the Forceps group 8(8.9%) had low Apgar and in Vacuum group 12(13.3%) had low Apgar score. There was no significant difference in Apgar score between two groups.

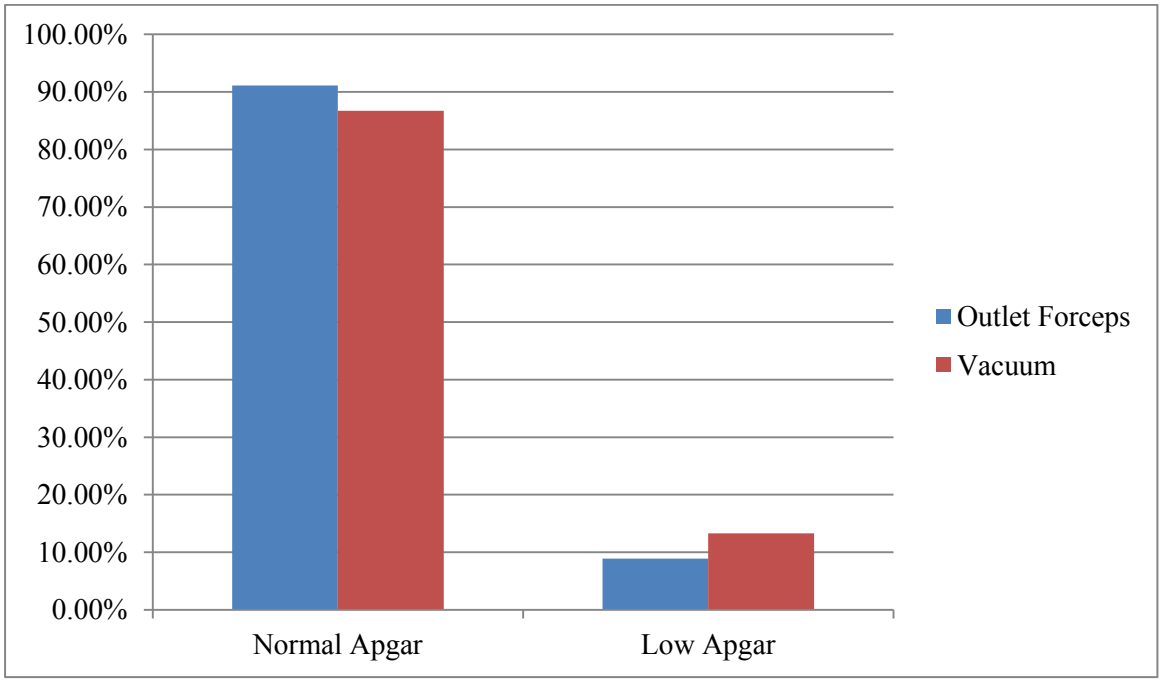


Figure 13: Bar diagram showing Comparison of Apgar score between two study groups

Table 14: Comparison of Scalp and FacialInjuries(instrumental marks) in newborn between two study groups

Scalp and Facial Injuries	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Present	5	5.6	0	0.0
Absent	85	94.4	90	100.0

$\chi 2 = 5.143$, df = 1, p = 0.023*

In the Forceps group 5(5.6%) had scalp and facial injuries (instrumental marks) and in vacuum delivery none of them had scalp and facial injuries. This difference in Scalp and facial injuries between two groups was statistically significant.

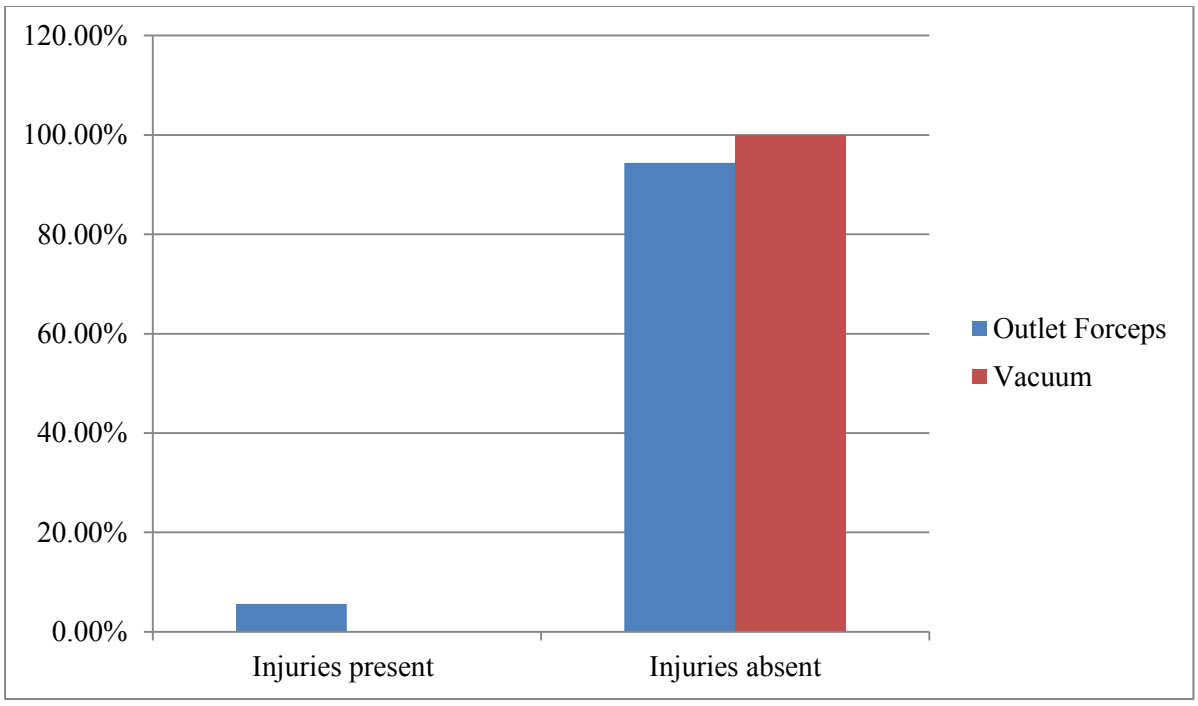


Figure 14: Bar diagram showing Comparison of Scalp and Facial Injuries in newborn between two study groups

Table 15: Comparison of Cephalohematoma in newborn between two study groups

Cephalohematoma	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Present	0	0.0	1	1.1
Absent	90	100.0	89	98.9

$\chi 2 = 1.006$, df = 1, p = 0.316

In Forceps group 0% had Cephalohematoma and in Vacuum group (1)1.1% had Cephalohematoma in newborn. There was significant difference in incidence of Cephalohematoma between two groups.

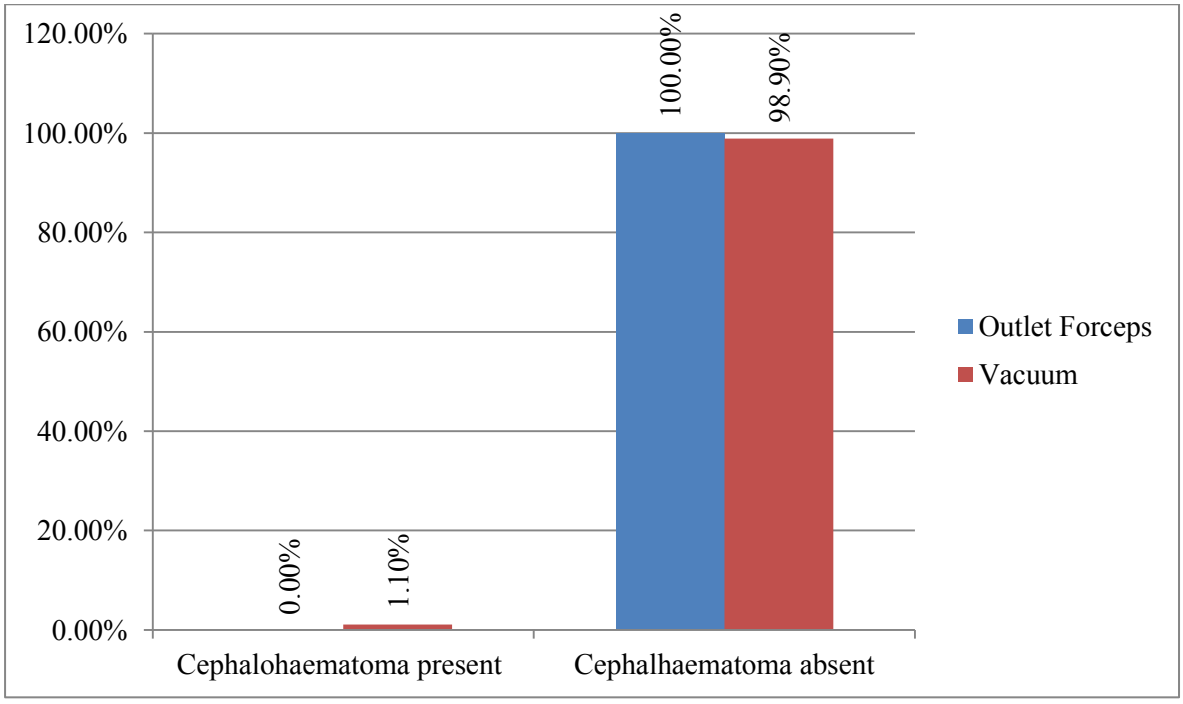


Figure 15: Bar diagram showing Comparison of Cephalohematoma between two study groups

Table 16: Comparison of Jaundice in newborn between two study groups

Jaundice	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	Number (n=90)	%	Number (n=90)	%
Present	1	1.1	8	8.9
Absent	89	98.9	82	91.1

$\chi 2 = 5.731$, df = 1, p = 0.017*

In Forceps group 1(1.1%) had jaundice and in Vacuum group 8(8.9%) of newborn had jaundice. There was significant difference in incidence of jaundice between two groups.

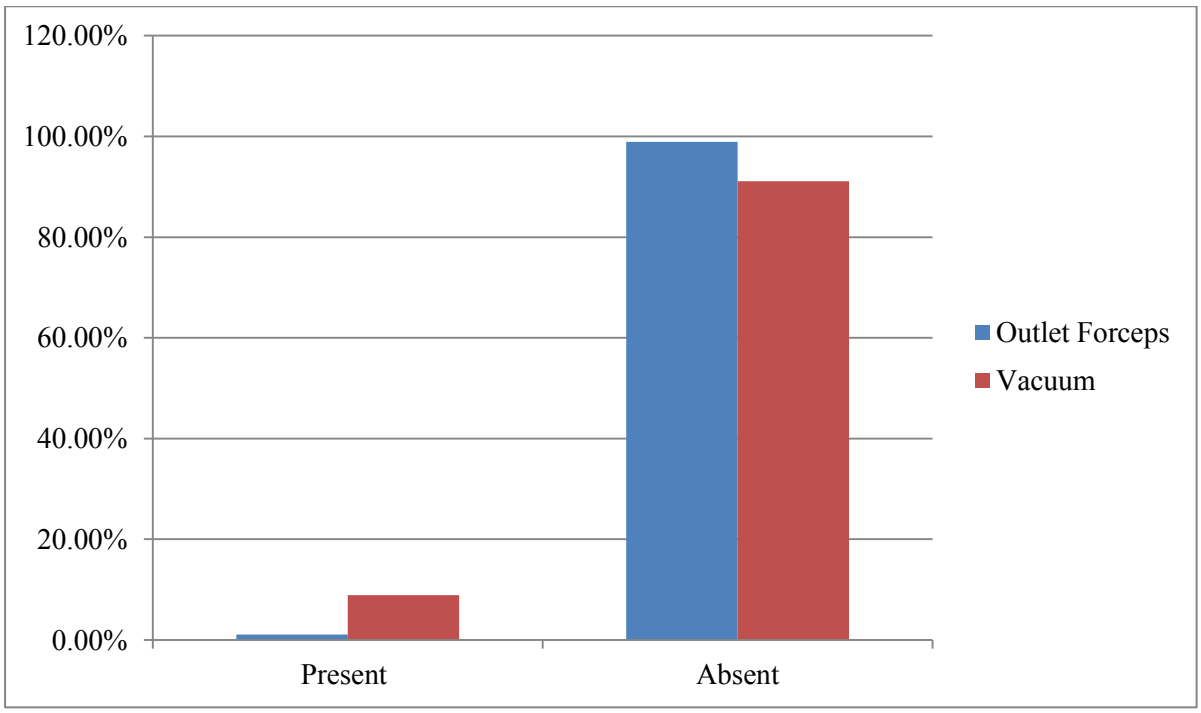


Figure 16: Bar diagram showing Comparison of Jaundice between two study groups

Table 17: Comparison of Neurological Injuries in newborn between two study groups

Neurological Injuries	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Absent	90	100.0	90	100.0

In the present study none of the newborn had neurological injuries in both the groups.

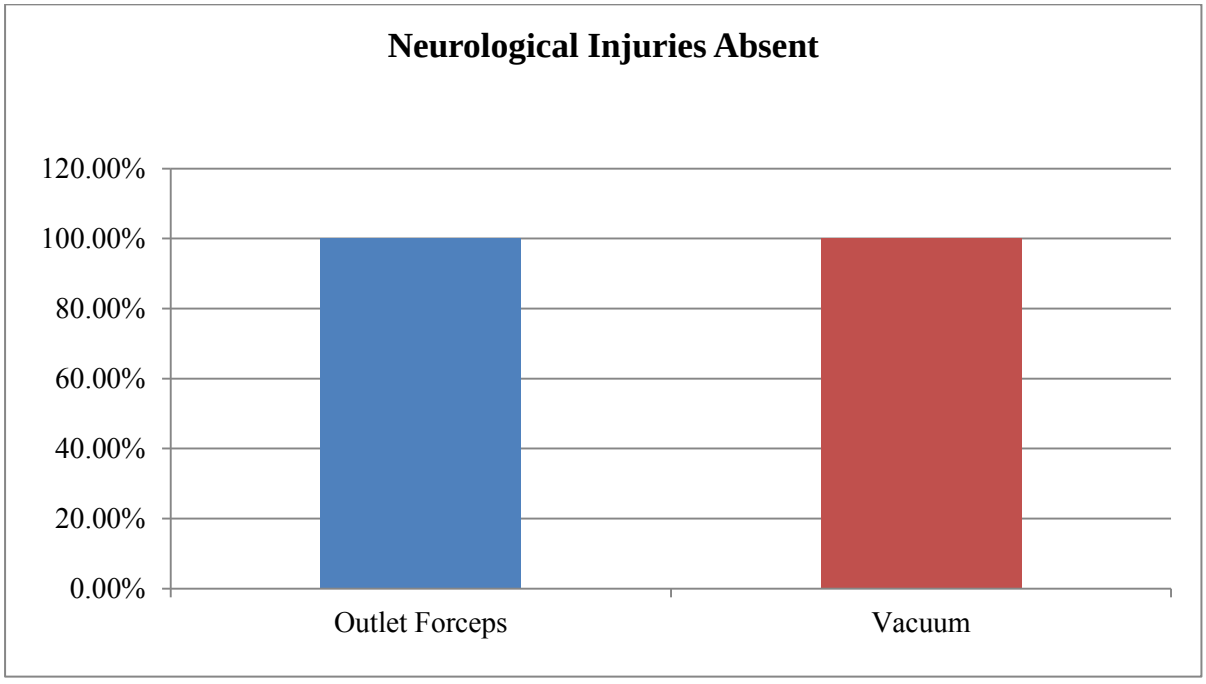


Figure 17: Bar diagram showing Comparison of Neurological Injuries in newborn between two study groups

Table 18: Comparison of NICU Admission for Fetal Distress on Admission between two study groups

NICU Admission	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
No need for NICU admission	65	72.2	68	75.6
Fetal distress present on admission as shown by CTG	19	21.1	20	22.2
Fetal distress was indication for application of instrument	6	6.7	1	1.1
Distress immediately after application and delivery	0	0.0	1	1.1

$\chi 2 = 4.665$, df = 3, p = 0.198

In the Outlet forceps group 19(21.1%) had fetal distress on admission and for 6(6.7%) Fetal distress was indication for application of instrument. There was no distress seen in the newborn immediately after application in outlet forceps group.

In Vacuum group 20(22.2%) had Fetal distress on admission and in 1(1.1%) subject fetal distress was indication for application of vacuum instrument. It was seen that 1(1.1%) newborn had distress immediately after application and delivery. There was no significant association between two groups with respect to NICU admission.

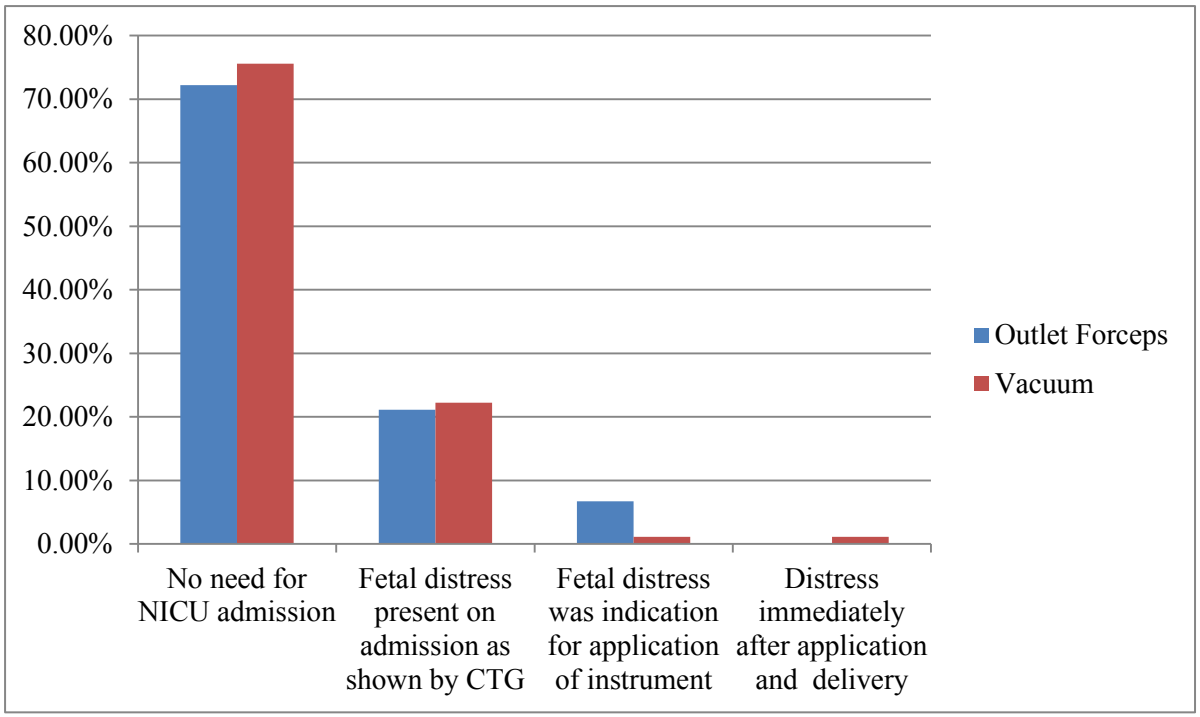


Figure 18: Bar diagram showing Comparison of NICU Admission for fetal distress on Admission between two study groups

Table 19: Comparison by failed instrumentation who were taken for caesarean section between two study groups

Failed instrumentation who were taken for caesarean section	Instrumental Vaginal Deliveries			
	Outlet Forceps		Vacuum	
	n=90	%	n=90	%
Successful Instrumentation	87	96.7	89	98.9
Failed Forceps	3	3.3	0	0.0
Failed Vacuum	0	0.0	1	1.1

$\chi 2 = 4.023$, df = 2, p = 0.134

In Outlet forceps group, 87(96.7%) had successful instrumentation, 3(3.3%) had failed forceps and in Vacuum group, 89(98.9%) had successful instrumentation and 1(1.1%) had failed vacuum instrumentation. There was no significant difference in failed instrumentation who were taken for caesarean section between two groups.

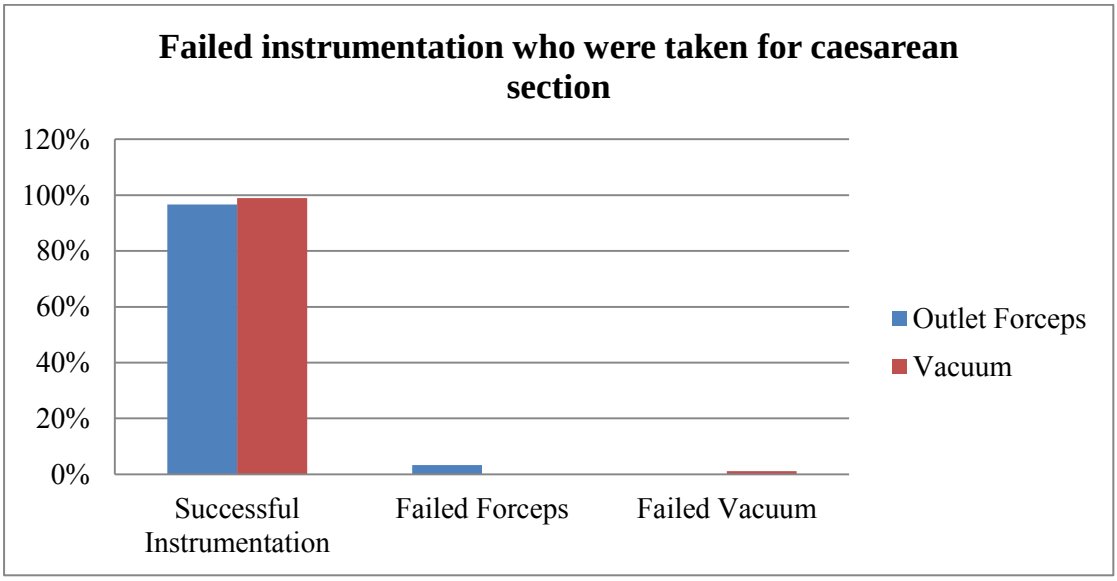


Figure 19: Bar diagram showing failed instrumentation who were taken for caesarean section between two study groups

Discussion

DISCUSSION

Neonatal and maternal morbidity and the superiority of vacuum and forceps is a controversial topic. Many studies reviewed by the Cochrane database 2000[59] concluded that vacuum extractor appeared to reduce the maternal morbidity while there is a reduction in cephalohaematoma and retinal hemorrhages with Forceps.

However the effect of Vacuum or Forceps when used exclusively in an outlet setting is not highlighted by any of these studies.

In the current study the use of forceps and vacuum exclusively at the outlet only was studied using 90 patients in either group.

Table 20:Comparison of Outlet Forceps and Vacuum among various studies according to age.

Study	Outlet Forceps (mean age)	Vacuum(mean age)
Gardella C 2001[14]	Mean age 26.4 years +- 5.8 years	Mean age 26.8 years +- 5.9 years
Singh Abha 2007[24]	Mean age 23.8+- 3.6 years	Mean age 23.8+- 3.6 years
Prameela R.C 2014[30]	Mean age 24.1 years	Mean age 22.2
Shameel F 2016[31]	Mean 24.5 years	Mean age 25.6 years
Present study 2016-17	Mean age 24.1 years	Mean age 24.1 years

In a study by Gardella C in 2001 mean age of use of forceps and vacuum were 26.4 years and 26.8 years respectively[14]. Similar type of study done by Prameela R.C in 2014 showed mean age to be 24.1 years which was similar to our study[30].

In the Present study, the mean age was 24.1 years for both groups and it was seen that 32.2% in outlet forceps group and 35.6% in vacuum group belong to age group of 21- 25 years.

Table 21: Comparison of Outlet Forceps and Vacuum among various studies according to parity (Primigravida)

Study	Outlet Forceps (%)	Vacuum(%)
Johanson RB 1993[6]	78	82
Williams MC 1995[8]	76	74.76
Gardella C 2001[14]	75	68
Prameela R.C 2014[30]	75.7	70
ShameelF2016[31]	57	66.6
Present study 2016-17	65.6	42.2

In a study by Johanson R.B, use of vacuum was 82% compared to forceps which was about 78% in primigravida[6].In a study by Gardella C, use of forceps 75% was high compared to vacuum 68% in primigravida[14].This is similar to our study where use of forceps is more than vacuum in primigravida.

In the Present study, there was high use of forceps 65.6% compared to vacuum 42.2% in primigravida. Incidence of instrumental deliveries was high in primigravida due to fetal distress, prolonged 2nd stage and failure of secondary forces that is poor maternal bearing down efforts.

Outlet forceps was commonly used in Primigravida and Vacuum deliveries were conducted among Gravida 2 subjects reason being poor maternal bearing down efforts which substantiate its use more in primigravida.

Table 22: Comparison of Outlet Forceps and Vacuum according to indication for application among various studies

Indications	Shihadeh[60] 1995		Gardella C[14] 2001		Singh A[24] 2007		Prameela R.C[30]2014		Shameel F[31] 2016		Present study 2016-17	
	F(%)	V(%)	F(%)	V(%)	F(%)	V(%)	F(%)	V(%)	F(%)	V(%)	F(%)	V(%)
Failure of maternal forces	37.3	45.24	25	19	3	8.3	22.5	7.5	--	--	33.3	37.8
Prolonged 2nd stage	10	4.76	3	3.5	13.3	20	22.5	7.5	70.2	100	20	15.6
Fetal distress	44.67	38.1	11	9	35	8.3	30	57.5	11.1	0	12.2	10
Prophylactic	10	4.76	9	10	33.3	33.3	15	27.2	16.2	0	17.8	21.1

In a study by Shihadeh, failure of secondary forces was the most common indication for both forceps and vacuum extraction[60].Prameela R.C, found that forceps was used more often for prolonged 2nd stage of labor and failure of secondary forces whereas vacuum was used more frequently for fetal distress and prophylactically[30]. It is found that instrumentation was mainly done for unbooked cases which further more substantiate the second most common indication being prolonged second stage of labour.

In present study, poor maternal bearing down efforts was the most common indication for both forceps and vacuum application. Prophylactic application as an indication of instrument application was high in forceps group than in vacuum deliveries (21.1%). Study by Shihadeh correlates with our study[60].

Table 23: Comparison of Outlet Forceps and Vacuum according to episiotomy and episiotomy extension in various studies.

Study	Outlet Forceps (%)	Vacuum (%)
K R Damania 1988[41]	12	4
Johanson RB 1993[6]	8	5
Achanna S 1994[61]	1	0
Shihadeh1995[60]	4	1.19
Gardella C 2001[14]	6.4	6.5
Singh Abha2007[24]	40	13.3
Prameela R.C 2014[30]	10	18.1
Shameel F 2016[31]	9.1	0
Present study 2016-17	21.1	4.4

In a study by Shihadeh in 1995, 3rd and 4thperineal injuries were all significantly common in the forceps group[60].AchannaSin 1994 inferred that, incidence of birth canal trauma varied significantly with forceps being higher[61].

In present study, episiotomy extension was seen in 21.1 % cases of outlet forceps and 4.4% were seen in vacuum and these results were similar to Shameel Fin 2016 in which extension was seen in 9.1% cases foe whom forceps was applied and no cases in vacuum[31]. Singh Abha concluded with episiotomy and extension of 40 % in outlet forceps and 13.3% in vacuum group[24].

When properly applied, forceps add to the volume passing through introitus, whereas vacuum cup adds no extra volume. This explains the tendency for more lacerations, extension of episiotomy, perineal injuries.

Table 24: Comparison of Outlet Forceps and Vacuum according to blood transfusion in various studies.

Study	Outlet Forceps (%)	Vacuum (%)
Singh Abha2007[24]	4	0
Prameela R.C 2014[30]	10	3
Shameel F 2016[31]	0.67	0
ChaudhariP 2015-16[27]	8.57	1.4
Present study 2016-17	11.1	6.7

In a study by Prameela R.C, blood transfusion was required in 10% cases of forceps and 3 % in vacuum group which was almost similar to our study which required 11.1% in forceps and 6.7% in vacuum[30]. This showed that blood transfusion requirement in vacuum group is comparatively less as seen in other studies too; reason might be less of traumatic PPH or less anemic patients in vacuum group. Outlet forceps required blood transfusion in higher proportions. The reason being it had more cases of atonic PPH and majority patients coming to our tertiary care centre are unbooked and anemic on admission. After delivery in outlet Forceps group 6(17.2%) had anemia after delivery and in Vacuum group 3(12%) had anemia after delivery. This was among 35 and 25 patients in outlet forceps and vacuum respectively which did not anemia on admission that is Hb>

10 gm% and after delivery it was Hb<10 gm%, classifying them as anemic according to WHO guidelines. There was no significant difference in anemia between two groups after delivery.

Table 25:Comparison of Outlet Forceps and Vacuum according to PPH in various studies.

Study	Outlet Forceps (%)	Vacuum (%)
Shihadeh[60]1995	12	4.05
Singh Abha[24] 2007	3.3	0
Prameela R.C[30] 2014	0	9.0
Shameel F[31] 2015	4.7	0
Chaudhari P[27]2015-16	7.1	1.4
Present study 2016-17	13.3	11.1

In a study by Shihadeh in 1995, PPH was more significant in forceps group i.e. 12% compared to 4 % in vacuum group[60]. This was almost similar to study done in 2016 by Chaudhari P where 7.1% cases of forceps requires blood transfusion and 1.4% of vacuum[27].

In present study, there was not much significant difference between PPH in two groups but forceps group was 13.3 % which was slightly higher than vacuum group.

The reason for more patients with PPH in forceps group was they had traumatic PPH and majority of the patient attending our tertiary care centre were anemic on admission and

had an unbooked status for antenatal visits. Traumatic PPH was higher in Outlet forceps group than in Vacuum group concluding more maternal morbidity in outlet forceps group.

Table 26:Comparison of Outlet Forceps and Vacuum according to low Apgar score 1 atminute in various studies.

Study	Forceps (%)	Vacuum (%)
Johanson RB[6]1993	1	3
Shihadeh[60] 1995	36.66	34.53
Johnson[21] 2004	1	3
Singh Abha[24] 2007	21.6	30
Ramchandara C[32] 2015	8	2
Chaudhari P[27] 216	35.4	20.9
Present study 2016-17	8.9	13.3

In clinical trials of Johanson RB in 1993 and Johnson et al about 1 % in forceps and 3 % in vacuum deliveries had low Apgar score at 1 minute[6, 21].

In the present study, 8.9% had low Apgar score in forceps group and 13.3 % in vacuum group which was almost similar to study done by Singh Abha in 2007, where 21.6% had low Apgar in forceps group and 30% in vacuum group[24].

Table 27:Comparison of Outlet Forceps and Vacuum according to low Apgar score at 5minutes.

Study	Outlet Forceps (%)	Vacuum (%)
Johanson RB[6] 1993	4	6
Shihadeh[60] 1995	3.58	3.34
Johnson[21] 2004	0	1
Singh Abha[24] 2007	20	13.3
Ramchandra C[32] 2015	12	8
Chaudhari P[27] 2016	21.6	11.3
Present study 2016-17	8.9	13.3

In a study by Shihadeh, low Apgar<7 at 5 mins was seen 3.58% of forceps and 3.34% of vacuum. APGAR scores were similar between both the groups[60]. There was no statisticalsignificance.

Johnson concluded that, low Apgar<7 at 5 mins was not seen in forceps group and in 1% ofvacuum[21].

In present study low Apgar at 5 mins that is 13.3% was in vacuum group and in forceps group it was 8.9% and was not statistically significant and these results were similar to Johanson R.B in 1993[6].

Vacuum group had high proportion of Low Apgar than in Outlet group showing neonatal morbidity more with vacuum but reason might be majority patients had fetal distress on admission.

Table 28:Comparison of Outlet Forceps and Vacuum according to jaundice, cephalohametoma, neurological injuries and facial and scalp injuries (instrumental marks).

Study	Forceps (%)				Vacuum (%)			
	Jaundice	Cephalo-Hematoma	Neurolog-ical Injuries	Facial injuries	Jaundice	Cephal-haematoma	Neurolo-gical Injuries	Facial Injuries
Johanson RB[6] 1993	--	3	--	--	--	9	--	--
Shihadeh[60] 1995	4.66	1.67	2.66	21.33	12.14	4.76	0.24	15.24
Singh Abha[24] 2007	0	1.66	0	38.3	16.6	16.6	0	10
Shameel F[30] 2015	6.41	0	--	0.33	33.3	33.3	--	0
Chaudhari P[27] 2016	3	3	1.5	41.5	12.9	17.8	0	11.3
Present study 2016-17	1.1	0	0	5.6	8.9	1.1	0	0

Prolonged second stage labour and longer vacuum application allows time for accumulation of more interstitial scalp fluid, which in turn leaves the tissues more vulnerable for abrasions, lacerations and cephalohaematoma formation.

Study done by Johanson, had cephalohaematoma 3% in forceps and 9% in vacuum which is comparable with the present study in which no neonate in forceps had cephalohaematoma while 1.1 % had in vacuum group[6]. In a study by Shihadeh, cephalohematoma was seen in 1.67% of forceps group & 4.76% of vacuum group[60].When properly applied, forceps adds to the volume passing through the introitus, whereas the vacuum cup adds no extra volume. This may partly explain the tendency for more lacerations, face marks in the forceps group. There were no cases with any neurological injuries as seen in study by Singh Abha in 2007[24] which were similar to our present study.

Conclusion

CONCLUSION

In present study, maternal and neonatal outcome was assessed amongst vacuum and forceps deliveries. There was evidence of less maternal trauma with vacuum extraction than with forceps delivery. Fetal morbidity was higher in vacuum group compared to forceps delivery. Hence concluding that the choice of operative vaginal delivery need to be individualized and tailored based on maternal and perinatal indications as one instrument cannot be stated as superior to the other instrument.

In today's modern obstetric era the use of operative vaginal deliveries is on a decline due to various reasons such as maternal and neonatal morbidities even though few and far in between leading to litigations. Inadequately trained younger residents lacking the incentive as well as experience to use instruments opt for safer option of cesarean sections. Thereby, reiterating the fact that institutional programmed training modules for younger residents in the art of operative vaginal delivery will eventually bring down the incidence of cesarean sections. Anthropologically the reduction in vaginal deliveries will have major impact on the future generation's capacity to deliver vaginally as evolutionarily vaginal deliveries may become obsolete.

With the expertise and appropriate decision on the indication and meticulous handling of the instrument whether outlet forceps or vacuum, especially in a tertiary care centre, the feto-maternal outcome is equally good with both the instruments.

Summary

SUMMARY

Instrumental vaginal delivery has been an important part of obstetric practice. This study was done to compare feto-maternal outcome with both vacuum and outlet forceps delivery.

We included 180 patients(90 in each group) for which outlet forceps and vacuum was applied after following up the inclusion and exclusion criteria and indication for application.

Objectives of study:

1. To compare the maternal morbidity with vacuum and outlet forceps delivery.
2. To compare the neonatal morbidity with vacuum and outlet forceps delivery.

The main indications of instrumental vaginal deliveries were fetal distress, prolonged second stage of labour, failure of secondary forces, and prophylactic use in cases to cut short second stage like severe preeclampsia, heart disease . The most common indication in this study was failure of secondary forces or poor maternal bearing down efforts in both the groups.

Mostly forceps and vacuum were applied for age group of 26- 30 years and primigravida, which showed a statistical significance.

The cases which came to our tertiary care centre majority of them were unbooked that is 74.4% in vacuum versus 58.9 % in forceps which was statistically significant.

Extension of episiotomy was more with forceps that is 21.1% and with vacuum being 4.4%.This difference was statistically significant.

Postpartum hemorrhage was also more common in forceps group that is 13.3%compared to vacuum 11.1% but the difference was not statistically significant.

The need for blood transfusion was seen more in cases of forceps that is 11.1% cases whereas in vacuum i.e. 6.7% cases but was not statistically significant.

The Apgar at 1 minute and 5 minutes was almost same in both vacuum and forceps delivery. There was no statistical difference between both the groups.

When parameter for neonatal morbidity was compared it was found that facial marks (instrumental marks) was statistically significant in forceps group constituting 5.6% whereas there were no cases in vacuum group.

There was a significant difference in cephalohaematoma which was 1.1% in vacuum and no cases in forceps.

The neonatal hyperbilirubinemia was compared and was found to be 8.9% in vacuum assisted vaginal delivery compared to 1.1% in forceps delivery concluding there statistical significant.

NICU admission due to various reasons including cephalohaematoma and neonatal hyperbilirubinemia was more in vacuum that is 27.8% than forceps which was 24.4% but there was no significant difference between the two groups when NICU admission was taken into account.

However, according to this study neonatal morbidity is more with vacuum and maternal morbidity slightly higher with outlet forceps delivery.

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Annexures

PROFORMA

NAME: CASE NO:

AGE:

I.P.NO.:

D.O.A.:

D.O.D.:

ADDRESS:

TOTAL STAY IN HOSPITAL:

OCCUPATION:

BOOKED/UNBOOKED

H/o Amenorrhaea:

COMPLAINTS OF:

LabourPains:

Duration:

Leaking P/V:

Bleeding P/V:

Antenatal Check-up: Regular/Irregular

Against Tetanus: Immunised/Not

OBSTETRIC HISTORY:

Married Life

Consanguinity

Gravida: Para: Abortions: Living

I II III IV

Preterm/ Term Gestational age

Hospital/Home

Sex

ANC

Tetanus Toxoid

Operative Forceps/ vacuum

Caesarean Section

- Emergency indication
- Elective indication

Last Delivery:

Last Abortion:

MENSTRUAL HISTORY:

A.O.M.:

P.M.C.: Regular/Irregular

Minimal/Moderate/Excessive Flow

L.M.P.:

E.D.D.:

U.S.G.E.D.D:

Period of gestation in weeks:

PAST HISTORY:

Preeclampsia/Eclampsia/Tuberculosis/UTI/ Rheumatic Fever/Diabetes/ Hypertension:

FAMILY HISTORY:

Diabetes/Tuberculosis/Hypertension/Twin Pregnancy/Congenital Anomalies:

PERSONAL HISTORY:

O/E: Build:

Nourishment:

Height:

Weight:

B.P:

Pulse:

Pallor:

Pedal Edema:

CVS/RS:

P/A: Height of the uterus:

Any previous scar:

Presentation:

Position: FHS:

P/V: (at the time of instrumental delivery):

Cervix: Effacement: Dilatation:

Vertex: Station: Position: Membranes:

Caput: None: Moulding:

Moderate:

Severe:

Liquor: - Clear

- Meconium - Thin

- Thick

INVESTIGATIONS:

Hb% - before and after delivery

Urine-Alb

Blood Group and Rh type:

Blood Sugar

VDRL/HIV/HBsAg:

CTG – at time of admission

MODE OF DELIVERY:

VACUUM/ FORCEPS

Indication:

Episiotomy:

Duration of 1st stage:

Duration of 2nd stage:

Time of vacuum formation: Application & locking

Duration of traction:

No. of slippage/reapplication:

Child:

Sex and birth weight of baby

Placenta:

Weight:

NEONATAL OUTCOME:

Apgar at 1 min:

Apgar at 5 mins:

Any other injury: Duration of 3rd stage:

Forceps marks: scalp or facial injuries

Neurological injuries

Cephalhaematoma:

MATERNAL OUTCOME:

Blood loss:

PPH – traumatic/atonic

Perineal tear: third degree perineal tear and complete perineal tear

CONDITION ON DISCHARGE:

MOTHER: need for blood transfusion and post deliveryHbgm %, number of days of hospital stay whether > 5 or < 5 days

CHILD: need for NICU admission

Serum Bilirubin: at birth and 3rd Day:

INFORMED CONSENT

Date:

Obstetrician:

I / We the attenders of the patient were told the condition of the patient i.e

_____

_____

_____and the need for instrumental either vacuum or forceps intervention. I/we the attenders of the patient agree to participate in the study. The nature and purpose of the study and its potential risks / benefits and expected duration of the study, and other relevant details of the study have been explained to me in detail in my own understandable language. I /we understand that my participation is voluntary and that I/we are free to withdraw at any time, without giving any reason, without my medical care or legal right being affected. I/ we give permission for these individuals to have access to patient records. And we hereby give consent to the treating doctors for the same and we do not claim any responsibility on to the treating doctors, staff or hospital for any maternal and fetal complications and patient condition.

Signature of patient / attenders :

Time :

<u>ತಿಳುವಳಿಕೆಯ ಒಪ್ಪಿಗೆ ಪತ್ರಅಧ್ಯಯನ ಶೀರ್ಷಿಕೆ:</u>–

“ಂ ಅಔಒಕಂಖಂಖಿಖಗಿಇ ಖಖಿಗಆಜ ಔಈ ಔಃಖಖಿಇಖಿಖಿಖಅ ಔಗಖಿಅಔಒಇ ಃಇಖಿಘಇಇಓ ಗಿಂಅಗಗಒ ಇಘಿಖಿಖಂಅಖಿಖಔಓ ಂಓಆ ಔಗಖಿಐಇಖಿ ಈಔಖಿಅಇಕಖ ಆಇಐಖಗಿಇಖಿಜ”

ಶ್ರೀ/ಶ್ರೀಮತಿ ಆದ ನಾನು ಈ ಮೇಲಿನ ಸಂಶೋಧನ ವಿಷಯದ ಬಗ್ಗೆ ನನಗೆ ಅರ್ಥವಾಗುವರೀತಿಯಲ್ಲಿ ನನ್ನದೇ ಭಾಷೆಯಲ್ಲಿ ತಿಳಿಸಿರುತ್ತಾರೆ. ಈ ಸಂಶೋಧನಾ ವಿಷಯದಲ್ಲಿ ನಾನು ಒಬ್ಬ ವಿಷಯಿಯಾಗಿ ಭಾಗವಹಿಸಲು ನನ್ನ ಸಂಪೂರ್ಣವಾಗಿಒಪ್ಪಿಗೆಇರುತ್ತದೆ. ಈ ಸಂಶೋಧನಾಉದ್ದೇಶವನ್ನು ಪೂರ್ಣವಾಗಿಅರಿತಿರುತ್ತೇನೆ. ಮತ್ತು ಈ ಸಂಶೋದನೆಗೆಯಾವುದೇ ಪ್ರಯೋಗಾಲಯದ ಪರೀಕ್ಷೆಗಳು, ಔಷಧಿಗಳನ್ನು ಒಳಗೊಂಡಿರುವುದಿಲ್ಲ. ಈ ಸಂಶೋಧನೆಗೆ ನನ್ನಿಂದಯಾವುದೇಆರ್ಥಿಕತೆಯಅವಶ್ಯಕತೆಇರುವುದಿಲ್ಲ. ನಾನು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ನನ್ನ ಸಹಕಾರವನ್ನು ಹಿಂಪಡೆದು ಈ ಸಂಶೋಧನೆಯಿಂದ ಹೊರಹೋಗುವ ಹಕ್ಕನ್ನು ಹೊಂದಿರುತ್ತೇನೆ. ಇದರಿಂದ ನನ್ನಚಿಕಿತ್ಸೆಗೆಯಾವುದೇರೀತಿಯತೊಂದರೆಯಾಗುವುದಿಲ್ಲ. ಮುಖ್ಯವಾಗಿ ನನ್ನಿಂದ ಪಡೆದ ಈ ಮಾಹಿತಿಯು ಸಂಶೋಧನೆಗೆ ಮಾತ್ರ ಸೀಮಿತವಾಗಿರುತ್ತದೆ. ಮತ್ತು ಈ ಮಾಹಿತಿಯುಎಲ್ಲೂ ಸೋರಿಕೆಯಾಗದಂತೆಎಚ್ಚರಿಕೆ ವಹಿಸುವುದಾಗಿ ತಿಳಿವಳಿಕೆ ನೀಡಿರುತ್ತಾರೆಂದು ನಾನು ದೃಢಪಡಿಸಿಕೊಂಡು ಒಪ್ಪಿಗೆ ನೀಡಿರುತ್ತೇನೆ.

ರೋಗಿಯ ಸಹಿ/ ಸಾಕ್ಷಿ ಸಹಿ. ಸಂಶೋದಕನ ಸಹಿ

ಬೆರಳಚ್ಚು.

PATIENT INFORMATION SHEET

Study title: A comparative study of obstetric outcome between vaccum extraction and Outlet forceps deliveries.

Study location: R L Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College. Tamaka, Kolar

Details-

Patients presenting in labour at term gestation with singleton pregnancy and vertex presentation in the inpatient department will be taken up for instrumental vaginal delivery according to the ACOG guidelines.

Patients will be compared in the two groups according to maternal morbidity and fetal morbidity.

Maternal morbidity in terms of need for episiotomy, episiotomy extension, perineal tears, post partum hemorrhage, need for hospital stay will be compared. Neonatal morbidity in terms of apgar score, instrumental marks, scalp and facial marks, cephalohaematoma, jaundice will be analyzed and compared. Patients in this study will have to undergo routine blood investigations such as a complete blood count, viral serology. To assess the fetal well being a cardiotocography will be done.

Please read the following information and discuss with your family members. You can ask any question regarding the study. If you agree to participate in the study we will collect information (as per proforma) from you or a person responsible for you or both. Relevant history will be taken. This information collected will be used only for dissertation and publication.

All information collected from you will be kept confidential and will not be disclosed to any outsider. Your identity will not be revealed. This study has been reviewed by the Institutional Ethics Committee and you are free to contact the member of the Institutional Ethics Committee. There is no compulsion to agree to this study. The care you will get will not change if you don't wish to participate. You are required to sign/ provide thumb impression only if you voluntarily agree to participate in this study.

For further information contact
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Department of Obstetrics and Gynecology
Sri Devaraj Urs Medical College , Kolar

KEY TO MASTER CHART

Instrumental vaginal delivery (IVD)

IVD	Key
Forceps	0
Vacuum	1

Maternal age

Age in years	Key
<20	0
21-25	1
26-30	2
>31	3

Parity

Parity	Key
Primigravida	0
Gravida 2	1
Gravida 3	2
>Gravida 3	3

Gestational age

Gestational age in weeks	Key
37 0/7 - 40	0
40 1/7 – 42	1
>42 1/7	2

Antenatal visit

Antenatal visit	Key
Booked	0
Unbooked	1

Indications for application of instruments

Indications	Key
Prolonged second stage	0
Severe pre eclampsia	1
GDM	2
Fetal distress	3
Prolonged second stage + fetal distress	4
Severe pre eclampsia + fetal distress	5
Poor maternal bearing down efforts	6
Poor maternal bearing efforts+fetal distress	7
Maternal heart disease	8

Maternal outcome characterstics

Maternal characterstics	Key
Episiotomy – 1) required 2)Not required	 0 1
Episiotomy extension – 1)no extension 2)3rd degree perineal tear 3)Complete perineal tear	 0 1 2
Blood transfusion- 1) required 2)Not required	 0 1
Hb level on admission before delivery i.e. anemia status – 1) Hb > 10 gm% anemia absent 2) Hb < 10 gm% anemia present	 0 1
Hb status between groups who were not anemic before delivery Hb > 10 gm% and Hb < 10 gm% after delivery- 1) Hb > 10 gm% before delivery 2)Hb< 10 gm% after delivery	 0 1
Post partum hemorrhage (PPH) – 1) no PPH	 0

2) Atonic PPH 3)Traumatic PPH	1 2
Need for hospital stay > 5 days – 1) discharge at 5th day 2) hospital stay > 5 days due to maternal factors 3) hospital stay > 5 days due to perinatal factors	 0 1 2
Failed instrumentation cases which were taken for cesarean section 1)successful application 2)failed forceps 3)failed vacuum	 0 1 2

Perinatal outcome characterstics

Perinatal charactertics	Key
Apgar score – 1)normal 1'-7/10 5'-9/10 and more 2)Low apgar 1'-5/10 5'-7/10 and less	 0 1
Need for NICU admission – 1) no need for NICU admission 2)fetal distress present on admission as shown by CTG 3)fetal distress was indication for application of	 0 1 2

instrument 4) distress immediately after application and delivery	3
Jaundice – 1)jaundice present 2)jaundice absent	 0 1
Cephalohaematoma – 1)cephalohamatoma present 2)cepahalohaematoma absent	 0 1
Scalp and facial injuries – 1)present 2)absent	 0 1
Neurological injuries 1)present 2)absent	 0 1

serialno	IVD	Age	Parity	GestationalAge	ANC	Indications	Episotomy	EpisotomyExtension	BloodTransfusion	Hb level on admission	Hb level after delivery	need for hospital stay > 5 days	failed instrumentation which were taken for ceserean section	PPH	APGARScore	Jaundice	NICUAdmissionFetal Distresson Admission	Cephalhematoma	ScalpandFacialInjuries	NeurologicalInjuries
1	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1
2	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1
3	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1
4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
7	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
10	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1
11	0	3	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	1	1
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124	1	1	0	0	1	4	0	0	1	1		0	0	0	0	1	0	1	1	1
125	1	1	0	0	1	4	0	0	1	1		0	0	0	0	1	0	1	1	1
126	1	1	0	0	1	4	0	0	1	1		0	0	0	0	1	0	1	1	1
127	1	1	0	0	1	5	0	0	1	1		0	0	0	0	1	0	1	1	1
128	1	1	0	1	1	5	0	0	1	1		0	0	0	0	1	0	1	1	1
129	1	1	0	1	1	5	0	0	1	1		0	0	0	0	1	0	1	1	1
130	1	1	0	1	1	5	0	0	1	1		0	0	0	0	1	0	1	1	1
131	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
132	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
133	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
134	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
135	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
136	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
137	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
138	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
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140	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
141	1	1	0	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
142	1	1	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
143	1	1	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
144	1	1	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
145	1	1	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
146	1	1	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
147	1	0	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
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150	1	0	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
151	1	0	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
152	1	0	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
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154	1	0	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
155	1	0	1	1	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
156	1	0	1	2	1	6	0	0	1	1		0	0	0	0	1	0	1	1	1
157	1	0	1	2	1	7	0	0	1	1		0	0	0	0	1	0	1	1	1

158	1	0	1	2	1	7	0	0	1	1		0	0	0	0	1	0	1	1	1
159	1	3	2	2	1	7	1	0	1	1		0	0	0	0	1	1	1	1	1
160	1	3	2	2	1	7	1	0	1	1		0	0	0	0	1	1	1	1	1
161	1	0	0	0	1	0	0	0	1	1		0	0	0	0	1	1	1	1	1
162	1	0	0	0	1	0	0	0	1	1		0	0	0	0	1	1	1	1	1
163	1	0	0	0	1	0	0	0	1	1		0	0	0	0	1	1	1	1	1
164	1	0	0	0	1	0	0	0	1	1		0	0	0	0	1	1	1	1	1
165	1	0	0	0	1	1	0	0	1	1		0	0	0	0	1	1	1	1	1
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168	1	1	0	0	1	3	0	0	1	1		0	0	0	0	1	1	1	1	1
169	1	1	0	0	1	3	0	0	1	1		0	0	0	1	1	1	1	1	1
170	1	1	0	0	1	3	0	0	1	1		0	0	0	1	1	1	1	1	1
171	1	2	1	1	1	1	0	0	1	1		0	0	1	1	1	1	1	1	1
172	1	2	1	1	1	6	0	0	1	1		0	0	1	1	1	1	1	1	1
173	1	2	1	1	1	6	0	0	1	1		0	0	1	1	1	1	1	1	1
174	1	2	1	1	1	6	1	0	1	1		0	0	1	1	1	1	1	1	1
175	1	2	1	1	1	6	1	0	1	1		1	0	1	1	1	1	1	1	1
176	1	2	1	1	1	6	1	0	1	1		1	0	1	1	1	1	1	1	1
177	1	2	2	1	1	6	1	0	1	1		1	0	1	1	1	1	1	1	1
178	1	2	2	1	1	6	1	0	1	1		1	0	1	1	1	1	1	1	1
179	1	2	2	2	1	6	1	0	1	1		2	0	1	1	1	2	1	1	1
180	1	2	2	2	1	7	1	0	1	1		2	2	1	1	1	3	1	1	1