Review of Literature
Instrumental Vaginal Delivery in the new millennium- Is it a dying art? Still debatable for obstetricians. An unfortunate trend in modern obstetrics is the extensive and, at times, indiscriminate use of caesarean delivery. Consequently, questions have emerged about the economic implications of caesarean section and alternative modes of delivery.

The WHO recommends the rate of caesarean sections at between 10-15% of all births to achieve optimal maternal & perinatal safety. Overall UK rate increased from just 4% to 20-24% during 1971-2001. The rate in the USA was at 23.5%. Among developing countries, Brazil has one of the highest rates of caesarean sections in the world. In the public health network, the rate reaches 35%, while in private hospitals the rate approaches 80%. The rise in prevalence of caesarean deliveries in developed countries has been attributed to multiple factors, including changes in physician/patient expectations and attitudes about risk, changes in clinical practise (e.g. Fewer trials of labour after previous caesarean delivery, vaginal breech births, fewer instrumental deliveries, more induction of labour and caesarean deliveries by maternal request). The lack of appropriate training in operative vaginal deliveries contribute to a great extent in the selection of CS as the mode of delivery.

Reducing maternal mortality by three quarters by the year 2015 became an important Millenium Developmental Goal in the Millenium Declarations. The CS rate can act as a proxy indicator of maternal mortality (i.e. rising CS rate indicate improved maternal care) has been
questioned\textsuperscript{14}, as good obstetric outcome may be with low rates of CS. Although CS has a mortality rate <1%, in many developing countries maternal mortality is 10-20 times greater with CS than with normal births\textsuperscript{15}. To reduce increasing CS rates, operative vaginal deliveries has been suggested. The RCOG considers the vacuum extraction the instrument of choice\textsuperscript{16}.

Assisted vaginal deliveries (ventouse and forceps) is an integral part of obstetric care worldwide which offers an option to accomplish safe delivery for the mother and the obstetrician. Improved training in operative vaginal delivery has been recommended and it has been suggested that safe use of these techniques may help to reduce the caesarean delivery rate.

The \textbf{Chamberlen family} invented the clinical art of obstetric forceps 400 years ago. In 18\textsuperscript{th} century, it was first announced by Edmund Chapman, the obstetrician of Essex and London, who publicly made known the forceps used by the Chamberlens. The crowning event was the discovery in 1818 of a number of the Chamberlens in a well concealed chest in Woodham Mortimer Hall, Essex, which posses a cephalic curve. \textbf{Andre Levret}\textsuperscript{17}, in 1747 introduced the pelvic curve.

\textbf{G. Barton} presented his forceps in 1925 for application to heads arrested in the transverse diameter of the inlet, especially those with a posterior-parietal presentation in the pelvis with short AP diameter. (chief contraindication for Keilland’s forceps). The \textbf{Piper forceps} was designed by Edmund B. Piper of Philadelphia, in 1924 for use in the aftercoming head of breech deliveries. The \textbf{Bill handle} had a automatic axis traction.
Later, the Norwegian Obstetrician, Christian Kielland (1871-1941), designed straight forceps without a pelvic curve and a sliding lock for the correction of asyncylytism. They are the forceps of choice in cases of deep transverse arrest in the patient with a gynaecoid or anthropoid pelvis. The forceps described by L. Laufe in 1956 ingeniously incorporates features of the Keilland and the Barton forceps. Now-a-days, short curved outlet Wrigley's forceps are in use.18

The history of vacuum extractor is much shorter but its use is increasing, so that a majority of assisted vaginal deliveries are now performed using this instrument as apposed to the obstetric forceps. The vacuum principle was probably first applied in medicine with a cupping - glass to treat depressed skull fractures in infants and adults. The first attempted obstetrical application was in 1705 by James Yonge. Neil Arnott (1788-1874) outlined the principles of pneumatic extractor. Some 20 years later, James Young Simpson of Edinburg (1811-1870) developed a practical suction tractor.

Tage Malmstrom of Sweden (1911-1995) was the father of modern extractor. His unique contribution was a metal cup with an in-curved rounded margin. The next significant contribution was made by the English obstetrician Geoffrey Bird (1922-2001), who separated the traction and suction ports and emphasized the importance of accurate cup placement over the flexion point. In the 1970's, in an attempt to reduce scalp trauma attributed to the metal cups, vacuum cups were manufactured with soft material. By the end of the 20th century, due to much higher failure rate with soft cups, vacuum cups were
INSTRUMENTS FOR OPERATIVE VAGINAL DELIVERY

VACUUM CUP

Suction Machine

Delivery Tray

Wrigley’s Forceps

Forceps Blade with Pelvic and Cephalic curve

Forceps Handle with English Lock
manufactured with harder plastic and these continued in widespread use\textsuperscript{19}.

**Indications for Operative Vaginal Delivery (no indication is absolute and each case should be considered individually)\textsuperscript{16}.

<table>
<thead>
<tr>
<th>Type</th>
<th>Indication</th>
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<tbody>
<tr>
<td><strong>Fetal</strong></td>
<td>Presumed fetal compromise</td>
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<tr>
<td><strong>Maternal</strong></td>
<td>Medical indications to avoid Valsalva (e.g., cardiac disease NYHA Class III or IV hypertensive crises, cerebral vascular disease, myasthenia gravis, spinal cord injury)</td>
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<tr>
<td><strong>Inadequate progress</strong></td>
<td>Nulliparous women: lack of continuing progress for three hours (total of active and passive second stage labour) with regional anaesthesia, or two hours without regional anaesthesia. Multiparous women: lack of continuing progress for two hours (total of active and passive second stage labour) with regional anaesthesia, or one hour without regional anaesthesia. Maternal fatigue/exhaustion</td>
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CONTRAINDICATIONS TO OPERATIVE VAGINAL DELIVERY\textsuperscript{16}

At present, the RCOG recommends avoiding the use of vacuum below 34 weeks because of the susceptibility of the preterm infant to cephalhaematoma, intracranial hemorrhage, and neonatal jaundice (Evidence level IV)

Instrumental deliveries before full dilatation of the cervix are contraindicated. There are few exceptions which include a prolapsed cord at 9 cm in a multiparous woman or a second twin.

Fetal bleeding disorders (e.g. alloimmune thrombocytopenia) or a predispositions to fracture (e.g. osteogenesis imperfecta) are relative contra indications.

The vacuum extraction is contraindicated with a face presentation.

Vintzileos AM\textsuperscript{20} et al showed that in cases in which the VE was used to deliver fetuses with non-assuring fetal heart rate patterns, blood gas parameters did not differ from those in cases with normal spontaneous deliveries. The authors concluded that VE is not contraindicated in cases of non-assuring fetal heart rate patterns.

Bird GC (1976)\textsuperscript{21}, established the importance of flexion in vacuum extractor delivery. He concluded that consistently good applications demand accurate diagnosis of the position of the occiput & the direction of the sagittal suture, knowledge of the ideal application site, and a manoeuvreable cup. If the distance between cup's anterior edge & the posterior angle of the bregma is less than 3 cm, or if the sagittal suture is not pointing to the centre of the cup, the cup should be removed & reapplied. Moving it back by as little as 1 cm may prevent failure & other
complications.

**Chenoy R**\(^2\)\(^2\) found a 22% incidence of significant fetal scalp trauma with the soft cup, as opposed to a 37% incidence with the metal cup. Also, soft cap was more likely to fail than the metal cup when excessive caput was present.

**Jonge E.T.M. DE (1991)**\(^2\)\(^3\) conducted a retrospective study over a 5-year period to identify causes of failure & their impact on neonatal outcome. There was a statistically significant difference between the two groups in terms of pre-application assessment of fetal size, maternal pelvis and palpable fetal head above the pelvic brim (\(p<0.00001\)). There was also a significant difference in neonatal morbidity (\(p<0.01\)). All 5 neonatal deaths occurred in the failure group and were associated with multiple instrumentation.

The babies born by forceps & ventouse have been followed up on long term basis by many authors.

**Seidman DS et al (1991)**\(^2\)\(^4\) determined the long term outcome of instrumental deliveries in 52,282 infants born in Jerusalem between 1964 and 1972. For each individual, events at birth were related to results of intelligence test and medical examination done at 17 years of age. 1747 individuals were delivered by vacuum, 937 by forceps, 47,500 by spontaneous delivery, and 2098 by caesarean section. Mean intelligence scores at 17 were significantly higher (\(p<0.0001\)) in the vacuum and forceps delivery groups than in the spontaneous -delivery group; however, after adjustment for confounding factors by stepwise multiple regression, these differences were no longer seen. Although, the
forceps-delivery group had functional impairment of feet, vision, and retina compared with the spontaneous-delivery group, and the vacuum-extraction group had impairment of the legs, differences were small. Findings suggest that infants delivered by vacuum or forceps are not at risk of physical and cognitive impairment at 17 years of age.

Heycock E. et al (1999)\textsuperscript{25}, undertook a five year follow up of a cohort of women and children delivered by forceps or vacuum extractor in a randomised controlled study at District general hospital in the West Midlands. Urinary incontinence of varying severity was reported by 47\% & bowel habit urgency by 44\% of the respondents. No significant differences between instruments were found in terms of either bowel or urinary dysfunction. Overall 13\% of children were noted to have visual problems. However, there was no significant difference between the two groups: ventouse 12.8\% compared with forceps 12.5\%; odds ratio 0.9, 95\% CI 0.38-2.5. Among the children with visual problems, majority had a positive family history for visual problems.

Long term sequelae for ocular trauma are extremely rare, and ophthalmologic screening should be reserved for specific cases\textsuperscript{26}.

Cormody\textsuperscript{27} did one randomized comparison of vacuum versus forceps delivery that evaluated children at 9 months of age found no statistically significant differences between the two groups regarding head circumference, weight, head-circumference-to-weight ratio, hearing, or vision. The study did note that jaundice seen more in infants delivered by vacuum than by forceps.
Ngan NY\textsuperscript{28} did a 10-year matched follow-up evaluation of 295 children delivered by vacuum extractor and 302 control patients who had been delivered spontaneously at the same hospital and revealed no differences between the two groups in terms of scholastic performance, speech, ability of self-care, or neurologic abnormality.

Nilsen ST\textsuperscript{29}, in an 18-year follow-up study of males delivered by mid-cavity Keilland's forceps rotation did not show any late adverse effects when subjects were compared with those of VE group. Thus, there appears to be a role for mid-cavity rotational deliveries in current practice.

Tan KH (1992)\textsuperscript{30}, analyse the Kielland's forceps for rotation of the fetal head and mid-cavity delivery. Primiparity, induction of labour, and epidural analgesia were associated with a significantly higher incidence of rotational delivery by Kielland's forceps. The success rate of delivery was 93.4\% (128 of 137). There was no maternal and perinatal mortality. About one-third of the mothers experienced postpartum morbidity, commenest being retention of urine, PPH and vaginal lacerations. Traumatic injuries were present in about one-quarter of the babies and were minor.

Johanson R B et al (1993)\textsuperscript{31}, in their randomised prospective study compared the new vacuum extractor policy with forceps delivery found significantly fewer women with anal spinchter damage or upper vaginal extensions in the vacuum extractor group (11\% vs 17\%). Although there were more babies in the vacuum extractor group with
cephalhaematoma (9% vs 3%), there were fewer babies in VE group with other facial injuries.

Teng AU (1997)\textsuperscript{32}, identified variables that increase the chance of neonatal scalp injury during vacuum extraction in their prospective observational study. Logistic regression analysis showed duration of vacuum application to be the best predictor of scalp injury, followed by duration of 2\textsuperscript{nd} stage of labour and paramedian cup placement. The proportion of injuries was greater for applications exceeding 10 minutes. (p<0.01)

Bofill J A et al (1997)\textsuperscript{33}, prospectively analyzed factors involved in the development of cephalhaematoma from vacuum extraction. He concluded that station at point of application (p=0.008), increasing asynclitism (p=0.001) and increasing application to delivery time (p=0.002) correlated significantly with cephalhaematoma.

Srisomboon J et al (1998)\textsuperscript{34}, in a prospective randomised clinical trial compared the effectiveness and complications of Malstrom metal cup and the silicon rubber cup. Vacuum extraction delivery with the silicon rubber cup is associated with reduced scalp injuries but, has a greater tendency to fail when the fetus presents in occipito-posterior position, has excessive caput or severe degree of moulding.

Chan C.C.T. (1999)\textsuperscript{35}, analyzed retrospectively the pattern of usage of both the forceps and vacuum extractor as well as the neonatal outcome in 1995 at the Kandang Kerbau Hospital, Singapore. Vacuum deliveries were significantly associated with higher parity and shorter labours. VE was associated with a 4 fold increase in both the risk of Erb's
palsy and sub-aponeurotic haemorrhage, and a 3-fold increased risk in sustaining a cephalhaematoma compared with the forceps group. The conclusions drawn from the study had reservation in pronouncing the vacuum extractor as ‘the instrument of first choice’ and suggest an inherent risk in using the vacuum extractor.

**Okunwobi YS (2000)**36, carried out a prospective analysis to describe decision-to-delivery intervals for assisted vaginal vertex delivery. The mean (SD) decision-to-delivery interval was 34.4 minutes. For cases with fetal distress, forceps were significantly quicker at 23.3 minutes than the ventouse 29.2 minutes. Perineal repair was required following 96% forceps deliveries compared with 87% ventouse (p=0.015). Perineal trauma was not influenced by the interval between decision and delivery.

**Miksovsky et al (2001)**37, summarized the current state of knowledge of obstetric vacuum extraction. They considered vacuum extraction as State of the Art in the new millennium, thus replacing forceps as the preferred method of instrumental delivery.

**Shi Wu Wen et al (2001)**38, conducted a population-based historical cohort study in the Canadian province of Quebec to assess the maternal and fetal outcomes associated with vacuum extraction and forceps deliveries. Their analysis does not suggest that vacuum extaction is superior to forceps or vice versa. Each instrument appears to have its own advantages and disadvantages. The choice of instruments to facilitate vaginal delivery should be based on assessment of the individual women’s health profile and other important medical and nonmedical factors.
Mesleh Ratib A (2002), carried out a retrospective case note review of all instrumental deliveries at the Armed Forces Hospital, Riyadh. He concluded that forceps is more likely to be used in the primigravida and prolonged 2nd stage of labour and less likely to fail. Ventouse is more likely to be used by registrars. Extension of an episiotomy and low Apgar score at one minute is more likely to occur with ventouse deliveries.

Revah A (2004), in their study concluded that failed instrumental delivery performed as a trial of forceps and/or vacuum in a setting where a caesarean section can follow promptly is not associated with increased morbidity of either mother or baby.

SOGC, clinical practice guidelines suggests that failure of the chosen method vacuum and/or forceps in a reasonable time should be considered an indication for abandonment of the method.

Demissie K et al (2004), in their population based retrospective study compared neonatal morbidity and mortality from operative vaginal delivery and analyzed two cohorts of live singleton births in the United States and New Jersey. In the U.S. cohort, VE was associated with fewer birth injuries and neonatal seizures and with a lesser need for assisted ventilation. Among New Jersey births, VE was likelier than forceps delivery to be complicated by postpartum bleeding and shoulder dystocia. The two methods were associated with similar risks of intracranial haemorrhage, retinal haemorrhage and feeding problems. When vacuum and forceps were used sequentially, there was a greater chance that
mechanical ventilation would be needed, and the risk of third- and fourth-degree perineal tears was increased.

Yarrow C et al (2004)42, did a retrospective audit of Canadian family physicians to assess outcomes after vacuum assisted deliveries. Family physicians were usually successful with vacuum-assisted deliveries. Complications were infrequent and rapidly resolved. Nulliparity was associated with failure in some cases.

Bahl R (2004)43, in a prospective cohort study noted outcomes of subsequent pregnancies three years after previous operative delivery. 32% of the women wish to avoid future pregnancy. Women were more likely to aim for vaginal delivery (87%, adjusted odds ratio 15.55; 95% CI 5.25-46.40) and more likely to have vaginal delivery (78%, 9.50; 3.48-25.97) if they had had a previous instrumental delivery rather than a caesarean section.

Bailey P.E. (2005)44, focused attention on declining rates of instrumental deliveries over the past two decades in the midst of pandemic of caesarean section. Vacuum extraction can be taught to midlevel practitioners (midwives, nurse and general physicians) thereby, increasing access to emergency obstetric care, especially at the periphery.

Moanlou HD (2005)45, recommended that neonatal health care providers should frequently evaluate neonate for early diagnosis of SGH and the institution of early treatment should be implemented with the hope of minimizing neonatal morbidity viz. anaemia, hypotension, persistant metabolic acidosis, and hyperbilirubinemia.
Caughey et al (2006) conducted a retrospective cohort study to compare perinatal outcomes in forceps and vacuum assisted deliveries. The authors tested the hypothesis that the force vectors operating in forceps deliveries will result in fewer cases of shoulder dystocia but more severe perineal lacerations. Shoulder dystocia was more frequent in women having vacuum-assisted delivery than forceps (3.5% Vs 1.5%, p<0.001). Low 5-minute Apgar scores, cephalhaematoma, admission to a neonatal intensive care, and neonatal jaundice also were more frequent in the ventouse group. On the other hand, women having forceps delivery had more third- or fourth-degree lacerations (36.9% Vs 26.8%, p<0.001).

Groom KM (2006) conducted a prospective randomised controlled trial of the Kiwi Omnicup vs conventional ventouse cup at Queen Charlotte's and Chelsea Hospital, London. Kiwi Omnicup is a rigid cup with a central connection to the suction catheter, less cumbersome and for a single use only. As such, it may be appropriate to consider its use for uncomplicated low cavity 'lift out' deliveries, but it is less successful than conventional ventouse in routine clinical practice. Relying on it only may lead to a rise in caesarean section rates at full dilatation.

Samuel Lurie et al (2006) performed a retrospective analysis at the Edith Wolfson Medical Center, a university tertiary health care facility during a 1 year period to assess the decision-to-delivery interval for vacuum verses forceps vaginal deliveries. The decision-to-delivery interval was 8.6±5.4 min and 13.8±6.2 min for forceps and vacuum deliveries, respectively (p=0.0001). It appears that it is quicker to accomplish
forceps delivery than vacuum extraction.

If the head is delayed in the pelvic cavity and there is a mento-anterior position, the forceps may be used to assist delivery.49

Opoku BK (2006)50, reviewed vacuum deliveries at Komfo Anokye Teaching Hospital, Kumasi over a 1 year period. The incidence was found to be 3.1% and failure rate of 6.4%. The main indication for the procedure was prolonged 2nd stage of labour which occurred in 37.2% of parturients. The mean birth weight was 3.1kg. The use of vacuum extraction as a means of assisted delivery was found to be safe with reference to both maternal and fetal outcomes.

Nasseri F (2007)51, in their case report noticed that neonatal subgaleal hemorrhage is a rare but potentially lethal complication of instrumental delivery, particularly vacuum extraction. Education and training on the proper use of vacuum is vital to reduce the incidence of this condition.

As per Plauche WC52, the incidence of subgaleal haemorrhage is estimated to occur in 4 of 10,000 spontaneous vaginal deliveries and in 59 of 10,000 vacuum-assisted deliveries. Boo NY53 and Gonaert P54 reported the incidence of subgaleal haematomas following vacuum deliveries to range from 26 to 45 per 1000 vacuum deliveries.

Maric M et al (2008)55, concluded that it is contradictory to try vacuum delivery if the head is not visible in the introitus of vagina. The vacuum force must be increased in one step to proper power level of 80N (0.8 bar, 600 mm hg), traction should take maximum one minute. Failure of vacuum extraction is indication for caesarean section, not for forceps
delivery, unless the failure occurs in the introitus. Avoiding complicated vacuum extraction, prolonged traction and timely cup detachment can prevent infant head, brain and soft tissue injuries.

**Baloch S (2008)**, observed that maternal morbidity was more frequent with abdominal delivery while neonatal morbidity and mortality was more frequent with instrumental delivery.

**Baskett TF (2008)**, conducted a prospective observational study of 1000 vacuum assisted deliveries using the Omnicup device and noted a statistically significant relationship between unfavourable cup applications (deflexing and paramedian) and scalp trauma in infants born to nulliparous women (<0.01).

Overall, the incidence of serious complications with vacuum extraction is approximately 5%.

Use of a partogram, upright or lateral positions and avoiding epidural analgesia will reduce the need for operative vaginal delivery. In primiparous women with epidural anesthesia, starting oxytocin in the second stage of labour can reduce the need for non rotational forceps delivery.

A survey of 121 developing countries reported that 37% of specialists know assisted delivery but, they are neither teach nor use it. 15% of the respondents admitted no knowledge of the procedure.

The Royal College of Obstetricians and Gynecologists (RCOG), concluded that: obstetricians should be competent, and confident, in the use of both vacuum and forceps, but, in view of reduction of maternal
injuries the vacuum should be considered to be the instrument of first choice.