

Vacuum Assisted Vaginal Delivery
Articles

1. Historical / Educational

- **Kelly J. Compression of the fetal brain. Am J Obstet Gynecol 1963; 85:687-94.**
The causes, mechanisms, and dangers of cerebral compression have been reviewed. The association of pressure on fetal head and the reflex bradycardia it induces at a threshold of 11 pounds have been discussed. Measures to regulate the amount of cerebral compression exerted by forceps have been suggested.
- **Lovset J. Modern Techniques of Vaginal Operative Delivery in Cephalic Presentation. Acta Obst. Et. Gynec. Scandinav. 1965, 44:102-106.**
The main methods and means for delivering the head vaginally in cephalic presentation are given a short survey: the forceps, the vacuum extractor, forceps pharmacodynamique and the method developed in Toulouse since 1959 with Syntocinon and Pentothal are reviewed.
- **Bird GC. The Importance of Flexion in Vacuum Extractor Delivery. Br. J Obstet Gynecol 1976; 83:194-200.**
Two modifications of Malmstrom's cup were used in a study of the position of the cup in 500 vacuum extractor deliveries. The incidence of completely flexing applications varied from 0 to 92 percent according to the level of the head and the position of the occiput when the cup was applied and, in occipito-posterior positions, the type of cup that was used. With mid-cavity occipito-posterior positions it was 30 percent with one modification (suction tube attached eccentrically to the dome of the cup – the 'modified' cup) and 92 percent with the other (tube attached to the lateral wall of the cup – the 'occipito-posterior cup' or 'OP cup'). The high incidence of face-to-pubis or occipito-lateral delivery when cups with a dome-attached suction tube were used in mid-cavity occipito-posterior positions was found to be largely the result of deflexing applications. It was concluded that cups of this type are unsuitable for use in these cases. A study of two large series of vacuum extractor operations suggested that failed vacuum extractor rates can be reduced by using cups that are more manoeuvrable and which accept stronger oblique traction than Malmstrom's cup.
- **Moolgaoker AS, Ahamed SOS, Payne AR. A Comparison of Different Methods of Instrumental Delivery Based on Electronic Measurements of Compression and Traction. Obstet & Gynecol, 1979; 54(3): 299-309.**
Electronic measurements of compression, using hydrostatic technique, were made during 44 normal deliveries and compared with the values obtained during 32 deliveries using Kielland's forceps, 21 using Neville Barnes' forceps, 48 using Moolgaoker's adjustable forceps, and 26 using Malmstrom's vacuum extractor. Electronic recordings of traction, using strain gauges, were made simultaneously during all the instrumental deliveries except those with Kielland's forceps. By exercising suitable controls over most of the multiple factors operating at the time of any delivery the authors were able to compare objectively the efficiency of the different methods of instrumental delivery. Smaller forces of compression and traction were exerted and better Apgar scores were recorded in infants delivered with the adjustable forceps than in infants delivered with the other instruments. The superiority of the adjustable forceps was most noticeable during midcavity deliveries of the malrotated head.
- **Bird GC. The Use of the Vacuum Extractor. Clinics in Obstet Gynecol 1982; 9:3:641-661.**

The ease with which the suction cup can be applied (not always correctly) without hurting the mother leads to a great deal of misuse of the VE and is its greatest disadvantage, because misuse often results in failure, sometimes seriously injures or kills the baby, discredits the VE when it is blamed for these bad results and encourages further misuse when results are not bad. On the other hand, those who have learned to use the instrument correctly and who use it with discipline and care obtain very good results.

- **American College of Obstetricians and Gynecologists. (1994). Operative vaginal delivery. ACOG Technical Bulletin No. 196, Washington, DC: Aauthor.**
The scope of operative vaginal delivery as described in this bulletin includes the use of forceps and vacuum extraction as well as the management of shoulder dystocia and internal podalic version. While knowledge of the material presented is necessary to perform operative vaginal deliveries, it alone is not sufficient to achieve optimal maternal and perinatal outcome. Technical skill should be taught during residency training and maintained through use in clinical practice.
- **Bofill JA, et al. Graduate Education- Forceps and Vacuum Delivery: A Survey of North American Residency Programs; Obstetrics and Gynecology, Vol. 88, No 4; Oct. 1996.**
Instruction in both types of operative vaginal delivery is found in most programs. The forceps are used more commonly, but vacuum is the preferred instrument in about one-third of training programs. Instruction in midpelvic delivery is offered in 64% of programs, but we noted a declining trend.
- **Bofill JA, et al. Operative Vaginal Delivery: A Survey of Fellows of ACOG; Obstetrics and Gynecology, Vol. 88, No. 6; Dec. 1996.**
The majority of respondents have an operative vaginal delivery rate of no more than 15%. Most respondents have abandoned mid-pelvic operative vaginal delivery. Practice patterns reflect differences in residency training; the more recently trained Fellows more often were taught and use vacuum for delivery.
- **Guidance for Perinatal Care, fourth edition. Am. College of Obstet. Gynecol. 1997.**
Guidelines for Perinatal Care, on Operative Vaginal delivery, and Cesarean Delivery, are general and intended to be adapted to many different situations, taking into account the needs and resources particular to the locality, the institution, or type of practice. Variations and innovations that improve the quality of patient care are to be encouraged rather than restricted. The purpose of these guidelines will be well served if they provide a firm basis on which local norms may be built.
- **Murray ML, Vacuum Extraction. Learning Resources International, Inc.: 1997; 56-82.**
Description of types of Vacuum Extractors, purposes, nurses and doctor's roles, hazards and a review of a case.
- **Vacca A. Handbook of Vacuum Extraction in Obstetric Practice. British Library Cataloguing in Publication Data. London, Edward Arnold 1997; 55-62.**
Technique using posterior cups.
- **Operative Obstetrics; Vacuum Delivery-Chapter 9 173-189.**
Text Book Chapter describing types of vacuum extractors, reasons for use, instructions for use, and complications that can occur.
- **Plauche WC. Vacuum Extraction-Chapter 16 281-297.**
Text Book Chapter containing historical information, instrument types, contraindications and cautions, VE forces, techniques, indications and morbidity/mortality for Vacuum Extraction.
- **Need for CAUTION When Using Vacuum Assisted Delivery Devices. FDA Public Health Advisory: FDA, May 1998.**

Warning to advise you that vacuum assisted delivery devices may cause serious or fatal complications, and to provide guidance to minimize the risk.

- **FDA Warns About Vacuum Assisted Delivery Devices. AWHONN Lifelines. Aug. 1998.**
Article discussing the FDA Warning and recommendations for Vacuum-assisted delivery.
- **ACOG Committee Opinion; Delivery by Vacuum Extraction. The American College of Obstetricians and Gynecologists, Sept. 1998; pg. 1.**
Although the Committee on Obstetric Practice supports the FDA's role in informing physicians and the public of potential risks of therapeutic devices, the Committee also has concerns regarding the implications of the recent FDA advisory on vacuum-assisted delivery devices.
- **ACOG Stresses Continued Use of Vacuum Devices. OB. GYN. News. Oct. 1998.**
ACOG urges obstetricians to continue using vacuum-assisted delivery devices as needed as a follow-up to the FDA warning about complications and fatalities contributed to VE.
- **Labeling Guidance Suggested Format and Content for Labeling of Fetal Vacuum Extractors. Obstetrics and Gynecology Devices Panel. October 1998.**
Description of VE device, indications and usage, contraindications, warnings and precautions, adverse events, patient counseling information, conformance to standards, clinician use.
- **Marinac-Dabic D. Epidemiology Branch Office of Surveillance and Biometrics. October 1998.**
Report on FDA Advisory, and review of literature, labeling, discussion with manufacturers, users, facilities and professional organizations.
- **Vacuum Extractor Labeling Template Will Serve As Industry Guidance. October 1998.**
FDA's upcoming labeling template for fetal vacuum extractors should advise manufacturers to list details of certain indications that are associated with "prolonged second stage of labor," FDA's Obstetrics and Gynecology Devices Panel recommended at an Oct. 20 meeting in Rockville, MD.
- **Perez A. Cutting Your Risks With Vacuum-Assisted Deliveries. OBG Management, March 1999; 22-35.**
Panel of perinatologists detail 15 steps for avoiding the medicolegal pitfalls associated with this mode of operative vaginal delivery.
- **ACOG Practice Bulletin. Clinical Management Guidelines for Obstetricians-Gynecologists. Number 17, June 2000.**
The incidence of operative vaginal delivery in the US is estimated to be 10-15% and although these procedures are safe in appropriate circumstances, controversy about them persists. Recent reports have highlighted the potential for maternal and neonatal complications associated with operative vaginal delivery, although the risks associated with alternative procedures also must be considered. This document addresses the specific controversial issues and presents the available information on which to base decisions concerning their use. The technical aspects of the use of forceps and vacuum extractors are beyond the scope of this publication.

2. Vacuum Extraction Vs. Forceps

- **Berkus MD, et. al. Cohort study of Silastic obstetric vacuum cup deliveries: II. Unsuccessful vacuum extraction; Obstetrics and Gynecology, Nov. 1986; 68(5): 662-6.**

Abstract of study on Silastic vacuum, outlet forceps and midforceps and c-sections. The frequency of scalp trauma, including cephalohematoma, did not differ between vacuum extractor-forceps and forceps delivery, or between vacuum extractor-cesarean and vacuum extractor delivery.

- **Epperly T, Breitinger E. Vacuum Extraction; AFP, Sept. 1988; 38(3):205-210.**
Vacuum extraction rivals forceps delivery in efficacy, is less traumatic to the mother and is as safe or safer than forceps delivery for the infant. Soft plastic cup extractors minimize the technical, maternal and fetal problems of vacuum extraction and have made this method of delivery ideal for the family physician who practices obstetrics.
- **Williams M., et. al. A Randomized Comparison of Assisted Vaginal Delivery by Obstetric Forceps and Polyethylene Vacuum Cup. Obstetrics and Gynecology, Nov. 1991; 78(5): 789-794.**
Study comparing vaginal delivery by forceps and vacuum cups. Neonatal outcomes did not differ significantly. Maternal outcomes also did not differ significantly.
- **Johanson RB, Rice C, Doyle M. A randomized prospective study comparing the new vacuum extractor policy with forceps delivery. Br J Obstet Gynecol 1993; 100:524-30.**
Assisted vaginal delivery using the new vacuum extractor policy is associated with significantly less maternal trauma than with forceps. Further studies are required to assess neonatal morbidity adequately.
- **Bofill J, et. al. A randomized prospective trial of the obstetric forceps versus the M-cup vacuum extractor. Am. J. Obstet Gynecol, Nov. 1996.**
The M-cup vacuum extractor cup appears to be as efficient (and faster) than the obstetric forceps but is associated with significantly more fetal cephalhematomas, whereas maternal injuries are more common with the forceps.
- **Letter to Professor Vacca. Wright State University School of Medicine, OB/GYN. April 1997.**
Explanation of the abandonment of vacuum delivery in 21 women of a study involving 322 women.
- **Escamilla J.O, Escamilla G.H. The Vacuum extraction to forces in posterior presentation comparison. Am J Obstet Gynecol, Jun 1997; 176(6).**
- Response to Bofill J, et. al. A randomized prospective trial of the obstetric forceps versus the M-cup vacuum extractor. Am. J. Obstet Gynecol, Nov. 1996. article with questions regarding the effectiveness of vacuum extraction.
- **Bofill JA, Martin JN, Morrison JC. The Mississippi Operative Vaginal Delivery Trial: lessons learned. Contemporary OB/GYN, October 1998: 60-79.**
While certain positions are best managed by use of either the forceps or the vacuum extractor, the authors of the largest randomized trial of these approaches found that both techniques usually worked well for operative vaginal delivery. Following is a detailed summary of their survey results as well as a guideline for handling special cases.
- **Chad CCT. Is the Vacuum Extractor Really the Instrument of First Choice? Aust. NZ J Obstet Gynecol. 1999, 39; 3:305-309.**
This study was a retrospective analysis of the pattern of usage of both the forceps and vacuum extractor as well as the neonatal outcome on all the instrumental deliveries conducted in 1995 at the Kandang Kerbau Hospital, Singapore. There was a trend towards using the vacuum extractor in less difficult cases. Almost all the instrumental deliveries were conducted by specialists. Birth trauma was significantly more likely to occur with the vacuum extractor.
- **Robson S, Pridmore B. Have Kielland Forceps Reached Their 'Use By' Date? Aust. NZ J Obstet Gynecol. 1999, 39; 3:301-304.**

Kielland forceps have long been used in Australian hospitals for rotation and delivery from occipitolateral and occipitoposterior positions. We have studied the pattern and use of these forceps in our hospital and conducted a statewide survey of the obstetric trainees about their experience with Kielland forceps. We conclude that current obstetric training programs are unlikely to provide registrars with sufficient skill in their safe use.

3. Vacuum Cup Design & Testing

- **Bird GC. The Importance of Flexion In Vacuum Extractor Delivery. Br. J. Obstet Gynecol. 1976, 83:194-200.**
Two modifications of Malmstrom's cup were used in a study of the position of the cup in 500 vacuum extractor deliveries. The study of two large series of vacuum extractor operations suggested that failed vacuum extractor rates can be reduced by using cups that are more manoeuvrable and which accept stronger oblique traction than Malmstrom's cup.
- **Duchon MA, DeMund MA, Brown RH. Laboratory Comparison of modern vacuum extractors. Obstetrics and Gynecology, 1988 Feb.; 71(2):155-158.**
The Malmstrom, Soft cup, and Mity-Vac vacuum extractors were compared in the laboratory using a tensile strength tester and a fetal cephalic model.
- **Muise KL, Duchon MA, Brown RH. Effect on angular traction on the performance of modern vacuum extractors. Am J of Obstet Gynecol, October 1992; 167, No. 4, 1125-1129.**
Application of oblique traction resulted in a linear decline in maximal tractive force. An understanding of in vitro performance may allow tailoring of cup selection to the clinical situation.
- **Muise K, Duchon MA, Brown RH. The Effect of Artificial Caput on Performance of Vacuum Extractors. Obstetrics and Gynecology, Vol 81, No. 2; Feb. 1993.**
There is a demonstrable deterioration in the performance of bell-shaped cups with the formation of chignon. These data suggest that when using a bell-shaped extractor, efforts should be directed toward minimizing chignon formation by applying vacuum only with traction.
- **Ross M. Vacuum Delivery: Advantages of soft cup extraction. Contemporary OB/GYN, Vol. 39, No. 6; June, 1994.**
A new design helps the device to resist detachment during chignon formation and is kinder to the fetal scalp than the metal cup or forceps.
- **Cosmi EV, Labor and Delivery: The Proceedings of the 2nd World Congress on Labor and Delivery. May 1997.**
This paper focuses on two issues that are likely to influence the manner in which vacuum extraction is practiced; the association between instrumental delivery and injury to the pelvic floor with its possible consequences; and the evidence on which the recommendations for the use of soft or rigid cups is based.
- **Paluska S. Vacuum-Assisted Vaginal Delivery. American Family Physician, May, 1997.**
The vacuum procedure is relatively easy to learn and offers a safer, less traumatic alternative to the use of forceps or cesarean section for indicated deliveries. Advances in extractor cup design have resulted in fewer cases of neonatal and maternal trauma and improved efficacy. As with any procedure, strict attention to technique and sound clinical judgment are essential for success.
- **Bofill JA, et. al. A Randomized Trial of Two Vacuum Extraction Techniques. Obstetrics and Gynecology, Vol. 89, No. 5; May, 1997.**

- Study meant to determine whether two techniques of vacuum extraction delivery – continuous vacuum and intermittent vacuum – have different effects on maternal-fetal outcomes. No difference in maternal or fetal outcome could be demonstrated if the level of vacuum was decreased between contractions or if an effort was made to prevent fetal loss of station.
- **Bofill JA, et. al. A Randomized prospective trial of the obstetric forceps versus the M-cup vacuum extractor. Am J Obstet Gynecol, June, 1997. Abstract.**
Purpose was to determine the efficacy of the obstetric forceps versus the M-cup, a new vacuum extractor cup, and maternal-neonatal complication rates.
 - **Chez RA, Bofill JA, Morrison JC. Performing vacuum-assisted vaginal delivery. Contemporary OB/GYN, Nov. 1998.**
Follow-up interview to the article “The Mississippi Operative Vaginal Delivery Trial: lessons learned” and reflects the investigators’ combined knowledge, experience, and judgment with vacuum-assisted vaginal delivery.
 - **Vacca A, Operative Techniques: The trouble with vacuum extraction. Obstetrics and Gynecology 1999; 9, 41-45.**
This review examines the important issues and presents a number of strategies aimed at reducing the rate of complications associated with vacuum extraction.
 - **Cotzias, Christina & Paterson-Brown, Sara. Ventouse: use, cup placement and success. Journal of Obstetrics and Gynaecology (1998) Vol. 18, No. 4.**
Sixty ventouse deliveries were analysed prospectively with specific attention apid to cup placement and its influence on successful or failed delivery. There was an 18.3% failure rate and 21.7% of all ventouse deliveries attempted had the cup inaccurately positioned. Cup placement was significantly more likely to be inaccurate when there was malposition of the fetal head. Significantly more tractions were needed when the cup was incorrectly positioned, but although there was a trend toward more failed attempts with the ventouse when the cup was inaccurately placed, this was not significant.
 - **Labour Ward Audit 1999. 10/02/99**
Figures of women/babies delivered at QCCH in 1999.

4. Complications

- **Goveart P. Cranial Hemorrhage in the term newborn infant. London: MacKeith Press, 1993: 23-30.**
Descriptions of hemorrhage types and causes, including; cephalhaematoma, and skull injuries.
- **Ames M, Wong D, Fassett M, Shaw K, deLemos R, Chambliss L. Major neonatal head trauma associated with vacuum extraction. Am J Obstet Gynecol 1995; 172:288. Abstract.**
Review of all vacuum deliveries at one hospital during three month period. Information was collected in the delivery room and prior to discharge concerning details of labor and delivery and maternal and neonatal outcome.
- **Cavlovich F. Subgaleal Hemorrhage in the Neonate. JOGNN, June, 1995.**
Subgaleal hemorrhage in the neonate, a possible complication of vacuum extraction, is a medical emergency. Neonates delivered with the assistance of vacuum extraction and displaying any signs of neurologic disturbance, blood loss, or anemia should be evaluated promptly for the possibility of hemorrhage. A case report is provided in this article to describe recognition and management of a neonate in hypovolemic shock after vaginal birth assisted by vacuum extraction.

- **Smith S, et. al. Subgaleal Hematoma: The Need for Increased Awareness of Risk. The J of Family Practice, Dec. 1995.**
Report of six cases of subgaleal hematoma and a literature review.
- **Chadwick LM, Pemberton PJ, Kurniczuk JJ. Neonatal subgaleal haematoma: Associated risk factors, complications and outcome. J. Paediatr. Child Health 1996, 32, 228-232.**
Subgaleal hematoma is an uncommon type of birth trauma, and is associated with delivery or attempted delivery by vacuum extraction. The most commonly associated clinical problems are hypovolaemia and coagulopathy. The long-term outcome for neonate with this condition is good.
- **Vacca A. Annotation: Birth by vacuum extraction: Neonatal outcome. J. Paediatr. Child Health 1996; 32, 204-206.**
Subgaleal haemorrhage is a serious and sometimes life-threatening condition associated with vacuum extraction. With increasing use of the vacuum extractor as the preferred instrument for assisted vaginal delivery, neonatal pediatricians should be prepared to encounter a greater number of infants with SGH and other effects associated with vacuum extraction. In order to reduce morbidity and to prevent mortality in infants with SGH, neonatal caregivers should be able to recognize the occurrence of this type of bleeding and to institute appropriate forms of management. This annotation describes the effects of vacuum extraction on the newborn infant and suggests some measures for the management of these conditions.
- **Teng F, Sayre J. Vacuum Extraction: Does Duration Predict Scalp Injury? Obstetrics and Gynecology, Feb. 1997.**
Cosmetic scalp trauma occurred in 21% of our newborns delivered by vacuum extraction and was more common after longer vacuum applications, longer second stages, and paramedian cup placement.
- **Perrin R, et. al. Management and Outcomes of Posterior Fossa Subdural Hematomas in Neonates. Neurosurgery, Jun. 1997.**
PFSDHs are rare but important lesions to diagnose early in the neonatal period. Surgery can be life-saving when performed in a timely manner for signs and symptoms of brain stem dysfunction. A search for an underlying cause predisposing to a PFSDH may, on occasion, reveal a coagulation disturbance or a neoplasm that will require additional therapeutic considerations.
- **Sounding Board. The Risks of Lowering the Cesarean-Delivery Rate. NE J of Medicine, Jan. 1999.**
The advantages of a safe vaginal delivery over a cesarean delivery are clear: a vaginal delivery is associated with lower maternal and neonatal morbidity, and it costs less. We contend that these advantages apply only to safe vaginal deliveries and that reducing the rate of cesarean delivery may lead to higher costs and more complications for mothers and their babies. The reason is that two of the strategies proposed to reduce the cesarean delivery rate, increasing the number of vaginal deliveries among women who have had cesarean deliveries and increasing the number of operative vaginal deliveries, are associated with uterine ruptures and neonatal trauma, respectively.
- **Brumfield C, Gilstrap LC, O'Grady JP, Ross MG, Schifrin BS. Cutting Your Legal Risks With Vacuum Assisted Deliveries. OBG Management. March, 1999, 23-35.**
Panel of perinatologists detail 15 steps for avoiding the medicolegal pitfalls associated with this mode of operative vaginal delivery.
- **Dixon, et. al. Failed Forceps: the Time To Cesarean Section - How Long Is Too Long? Am. J. Obstet Gynecol, 1999, 80, 1:378.**

Study concurs with ACOG guidelines that LSCS should be immediately available in such cases but suggests that with continuous monitoring an interval beyond one minute delay is consistent with safe practice.

- **Robinson JN, et. al. Episiotomy, operative vaginal delivery, and significant perineal trauma in nulliparous women. Am. J. Obstet Gynecol. Nov. 1999, 181; 5:1180-1184.**
Study suggests that in forceps delivery neither the type of forceps nor episiotomy influences the risk of significant perineal trauma. When vacuum extraction delivery is performed, the use of episiotomy is associated with a higher risk of significant perineal trauma.
- **O’Grady JP, Gimovsky ML, McIlhargie CJ. Vacuum Extraction in Modern Obstetric Practice. The Parthenon Publishing Group, 199?.**
Section detailing the complications associated with vacuum extraction. Specifically, intracranial hemorrhage.
- **Towner D, Castro MA, Eby-Wilkens E, Gilbert WM. Effect of Mode of Delivery in Nulliparous Women on Neonatal Intracranial Injury. NE J of Medicine. Dec. 1999, 341: 23: 1709-1714.**
The rate of intracranial hemorrhage is higher among infants delivered by vacuum extraction, forceps or cesarean section during labor than among infants delivered spontaneously, but the rate among infants delivered by cesarean section before labor is not higher, suggestion that the common risk factor for hemorrhage is abnormal labor.
- **Ames-Castro M, Fasseti M, Aslulyman OH, Wong D, Chambliss L, Ouzounian JG. Identification of Major Neonatal Morbidity Associated with the Vacuum Extractor: Development of an Institutional Protocol to Improve Safety and Efficacy. Submitted Obstet Gynecol. Jan. 1999.**
The vacuum extractor is a safe and effective instrument for operative vaginal delivery, but misuse can result in significant neonatal injury.
- **Towner D, Ames-Castro M, Eby-Wilkins E, Gilbert WM. Increase in Intracranial Hemorrhage and Other Major Morbidities Associated with All Types of Operative Deliveries as Compared to Spontaneous Vaginal Delivery in Nulliparous Women. Submitted AM J Obstet Gynecol, 1999.**
All forms of operative delivery are associated with increased intracranial hemorrhages and major morbidity. Further study needs to be done to elucidate the true risk factors for these neonatal morbidities.
- **Ross MG, Fresquez M. Impact of FDA Advisory on Reported Vacuum-Assisted Delivery Morbidity: The Tip of The Iceburg! Am J Obstet Gynecol. Jan 2000, 506.**
The FDA advisory was associated with a 22-fold increase in the rate of reported adverse events. It is apparent that vacuum delivery is associated with greater neonatal morbidity, mortality, than was previously recognized. Thus, the adage that the vacuum is “designed to come off before infant damage occurs” appear unsubstantiated.

5. Miscellaneous