

# **INSTRUMENTAL VAGINAL DELIVERY : REVISITED**

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# Instrumental vaginal delivery

- Initially reserved for the delivery of dead infants,
- From the late sixteenth century, instrumental intervention in the process of labor became more widely accepted and practiced.
- **Today, assisted vaginal delivery is an integral part of obstetric care worldwide.**

# Incidence of instrumental intervention

- Of the 593,400 births -**UK** between 2005 and 2006- 65,867 (11.1%) were assisted with forceps/vacuum .
- **USA, 3.6 %** of all deliveries
- The **incidence varies widely** (between and within countries) **1.5% ---26%**.
- Such differences -alternative management strategies- individual labor wards

- The overall rate of operative vaginal delivery has been **diminishing**, but the **proportion** of operative vaginal deliveries conducted by **vacuum assisted births has been increasing** and is more than **four times** the rate of **forceps** assisted births.
- **Forceps** deliveries account for **1%** of vaginal births and **vacuum** deliveries account for about **4 %** of vaginal births.

- In recent years, the **success rate** for **operative vaginal deliveries** has been quite high (**99 %**). appropriate choice of candidates for this intervention.
- However, the **wide range of operative vaginal delivery rates (1 to 23%)** suggests that **evidence based guidelines** for operative vaginal delivery are **either inadequate or randomly applied**

# INDICATIONS

- (**ACOG**) practice bulletin outlined the following indications for operative vaginal delivery (forceps or vacuum), recognizing that **no indication is absolute**; cesarean delivery is also an option in these clinical settings:
- **Prolonged second stage of labor** — In nulliparous women, this is defined as lack of continuing progress for 3 hours with regional anesthesia or 2 hours without anesthesia. In multiparous women, it refers to lack of continuing progress for 2 hours with regional anesthesia or 1 hour without anesthesia.

# INDICATIONS

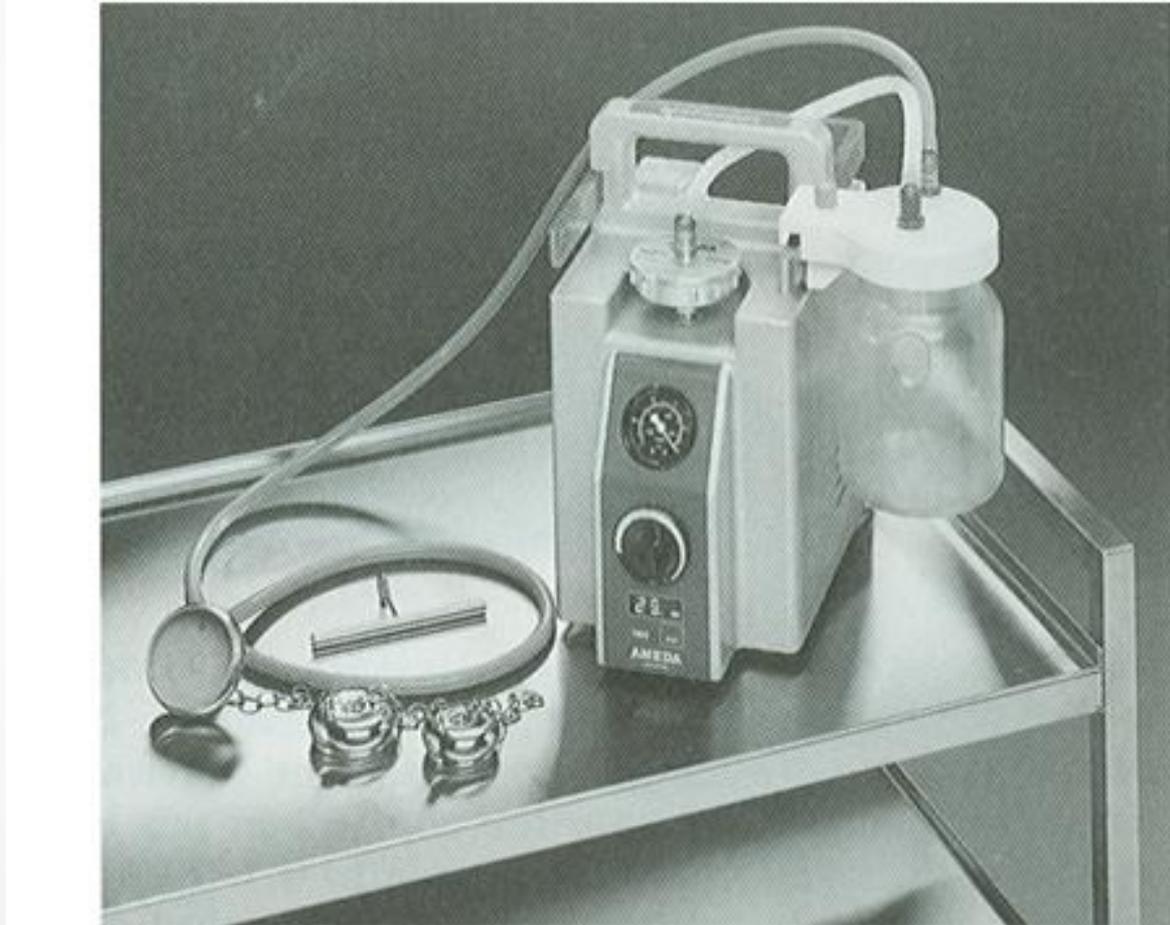
- **Nonreassuring fetal status** — Suspicion of immediate or potential fetal compromise ( nonreassuring fetal heart rate pattern, abruption) is an indication for use of forceps or vacuum when expeditious vaginal delivery can be readily accomplished; **otherwise, cesarean** delivery may be the safer and more effective option.
- **Maternal cardiac or neurological disease** — Forceps or vacuum can be used to shorten the second stage of labor if the Valsalva maneuver is contraindicated because of maternal cardiovascular or neurologic disease, or if pushing is ineffective because of maternal neurological or muscular disease.

- In the past, shortening the second stage was an acceptable option, independent of any specific maternal or fetal indications, because early studies suggested the risk of fetal morbidity was higher when the second stage of labor exceeded two hours.
- More **recent evidence does not support this practice**

# PREREQUISITES

- The **operator should be an individual experienced** in operative vaginal delivery and should determine the following prerequisites prior to application of instruments.
- The **cervix is fully dilated.**
- The **membranes are ruptured.**
- The **head is engaged.**
- Fetal presentation, position, lie, and any asynclitism are **known.** The fetus must be in a **vertex** presentation (unless the purpose is to use forceps to assist in delivery of an after-coming head).

- The **fetal size** has been estimated ; adequate mid and outlet **pelvic dimensions**, and no obstructions or contractures exist
- **Maternal anesthesia is satisfactory.**
- **Maternal bladder is empty.**
- The **patient consents to the procedure**. The risks of the procedure should be explained to the woman and documentation of the indication and maternal and fetal assessments should be made in the medical record .
- The **record should also document the informed consent discussion** (with specific risks, benefits, and alternatives delineated), and that her questions were answered.
- The **option** of performing an **immediate cesarean** delivery should be available if complications arise.

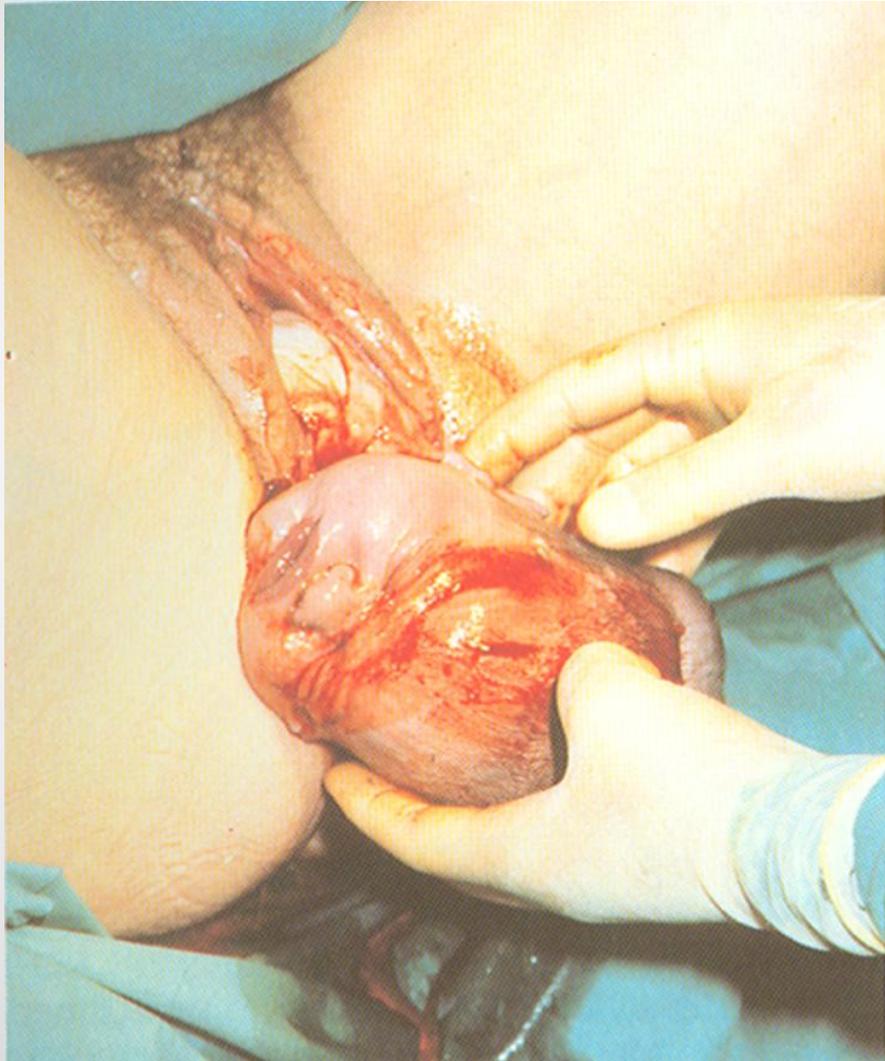


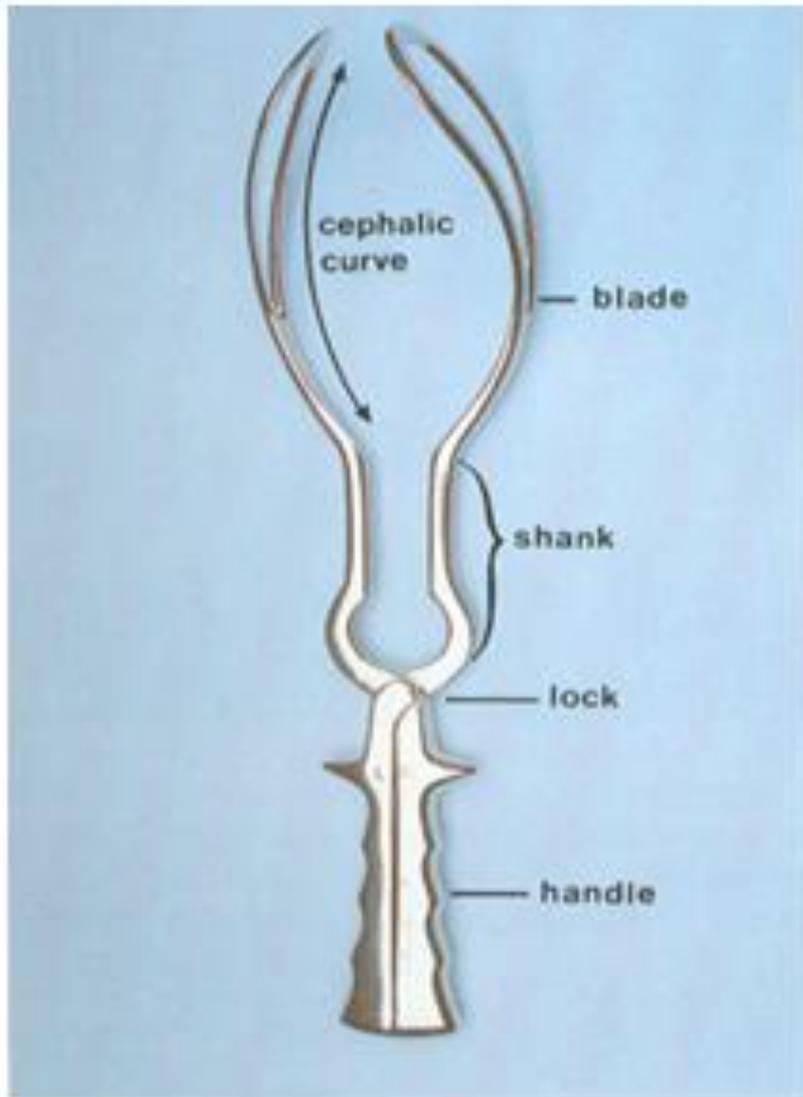


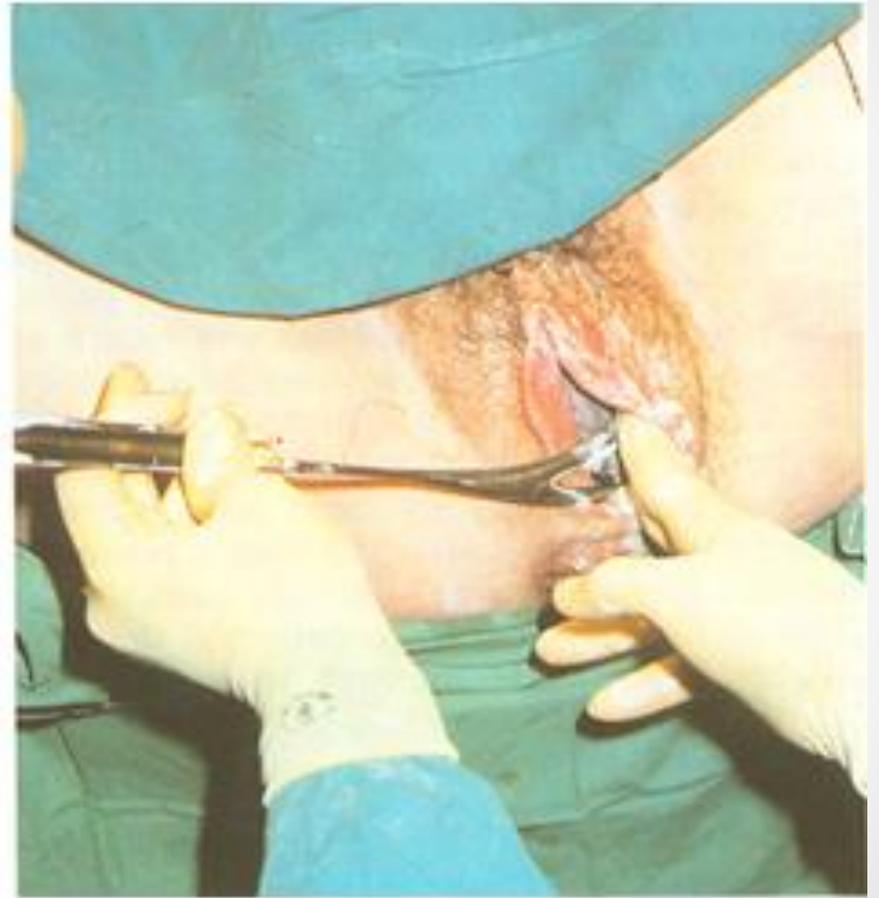
















**141** The relationship between the pelvic cavity and the pelvic curve of the forceps.





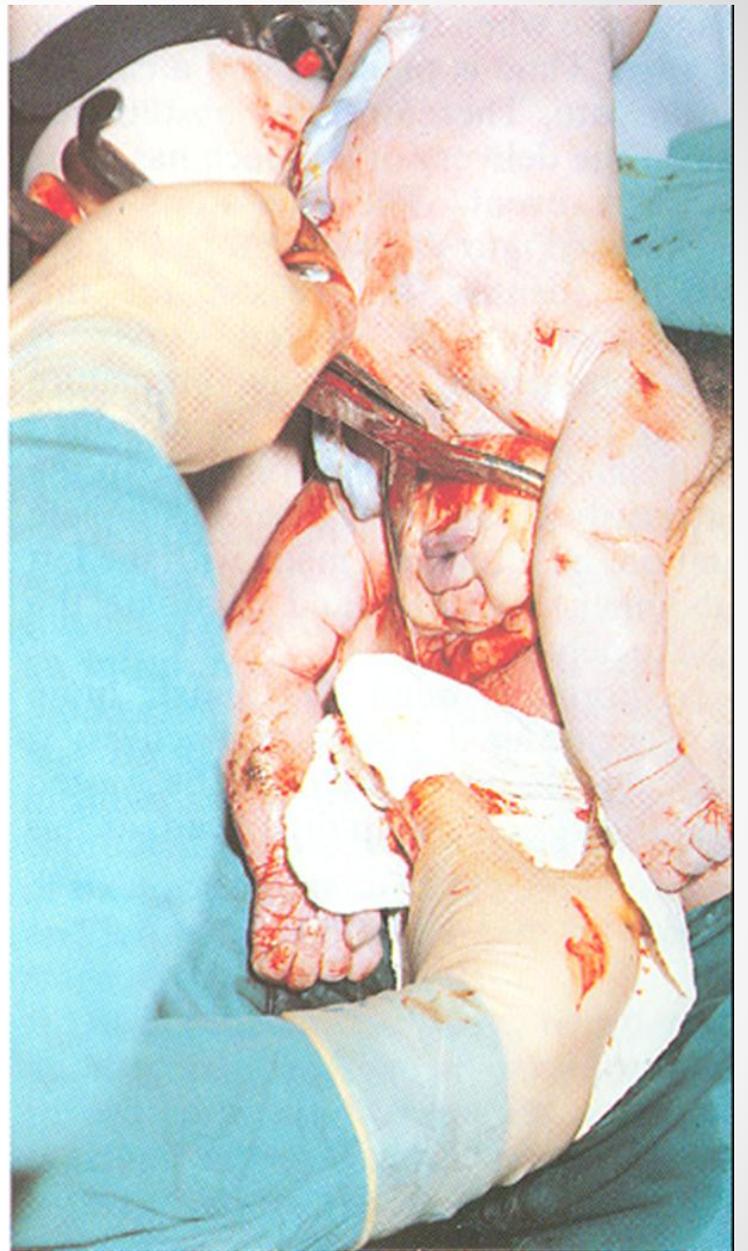
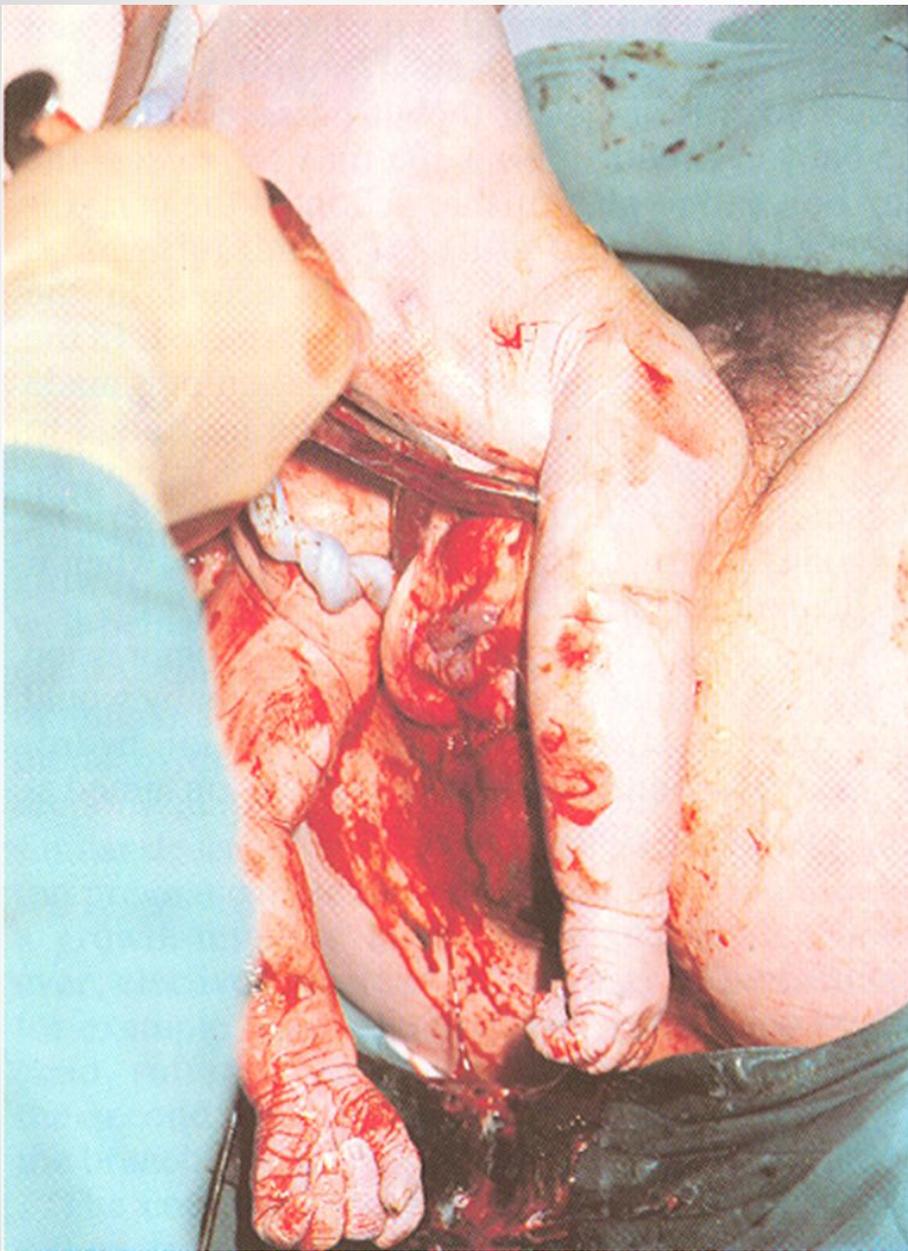












# Contraindications

- Most **contraindications** to instrumental delivery are related to the potential for **unacceptable fetal risks**.
- **Fetal prematurity** is a relative contraindication. Some other contraindications include known **fetal demineralizing diseases** (eg, osteogenesis imperfecta), **fetal bleeding diatheses** (eg, hemophilia, alloimmune thrombocytopenia), **unengaged head**, **unknown fetal position**, **malpresentation** (eg, brow, face), and **suspected fetal-pelvic disproportion**.
- A **nonreassuring fetal heart rate pattern** is not a contraindication to operative vaginal delivery

- **vacuum should not be used to assist delivery prior to 34 weeks of gestation because of the risk of fetal intraventricular hemorrhage.**
- **Prior scalp sampling or multiple attempts at fetal scalp electrode placement are also relative contraindications to vacuum extraction since these procedures may increase the risk of cephalohematoma or external bleeding from the scalp wound.**
- **Vacuum is also not recommended to perform a rotation.**

# Minimum and maximum estimated fetal weight

- **No consensus regarding the minimum and maximum estimated fetal weights** that should preclude operative vaginal delivery.
- **Upper threshold** — Instrumental delivery of the macrosomic infant may be associated with an increased risk of injury. As an example, a study of 2924 macrosomic infants (birth weight >4000 g) found the risk of persistent significant injury was higher after forceps than after spontaneous delivery (relative risk [RR] 2.6) or cesarean birth (RR 4.2), although the overall rate of persistent injury was low (0.3 percent)

- **A trial of labor and careful use of forceps or vacuum extraction are acceptable for most fetuses suspected to be macrosomic .**
- Under these circumstances, the obstetrician should be aware of the **risk of shoulder dystocia**, especially when the second stage of labor is prolonged

# Lower threshold

- **Vacuum should not be used to assist delivery prior to 34 weeks of gestation (mean birth weight 2500 g ) because of increased risks of fetal intraventricular hemorrhage in premature infants.** Premie sized forceps have been used on fetuses as small as 1000 g
- Two forceps are available which are smaller in dimension than standard forceps and are intended for use in the low birth weight or very low birth weight populations. "Baby" Elliot and "baby" Simpson forceps

# TRIAL OF INSTRUMENTAL DELIVERY

- Although one can never be certain of a successful outcome, **an operative vaginal delivery** should only be considered when the **likelihood of success is high**
- As an example, in one study, the rates of subdural or cerebral hemorrhage, facial nerve injury, convulsions, central nervous system depression, and mechanical ventilation **were higher** in infants delivered by cesarean birth after a failed instrumental delivery than in those delivered by cesarean with **no prior attempt at operative vaginal delivery**.
- However, other studies have not shown adverse effects from failed operative vaginal delivery as long as cesarean delivery followed promptly.
- **No randomized trials** have been performed comparing a trial of instrumental vaginal delivery (vacuum extraction or forceps) to immediate cesarean delivery for women with failure to progress in the second stage of labor.

- **Multiple variables** have been associated with **an increased risk of failed** operative delivery; two common causes are **occiput posterior position** and **macrosomia** .
- Other factors include **one fifth of the head palpable abdominally, the presenting part only as far as the ischial spines, excessive molding of the fetal head, protracted labor, and maternal obesity.**

# CLASSIFICATION OF FORCEPS DELIVERIES

- **Outlet forceps** — The application of forceps when the scalp is visible at the introitus without separating the labia, the fetal skull has reached the pelvic floor, the sagittal suture is in anteroposterior diameter or a right or left occiput anterior or posterior position, the fetal head is at or on the perineum, rotation does not exceed 45 degrees.
- **Low forceps** — The application of forceps when the leading point of the fetal skull is 2 cm or more beyond the ischial spines (at least + 2 station;), but not on the pelvic floor.
- **Midforceps** — The application of forceps when the head is engaged, but the leading point of the skull is higher than +2 cm station.

- **Under very unusual circumstances**, such as the sudden onset of severe fetal or maternal compromise, application of **forceps above +2 cm station** may be attempted while simultaneously initiating preparations for a cesarean delivery in the event the forceps maneuver is unsuccessful.
- **Under no circumstances**, however, should forceps be applied **to an unengaged presenting part or when the cervix is not completely dilated**

# CHOICE OF INSTRUMENT

- Determined **by level of training** with the various **forceps and vacuum** equipment.
- Factors that might influence choice are the availability of the instrument, the degree of maternal anesthesia, and knowledge of the risks and benefits associated with each instrument

- In general, **vacuum** delivery is probably safer than **forceps** for the **mother**, while **forceps** are probably safer than **vacuum** for the **fetus**.
- **Vacuum** easier to apply, place less force on the fetal head, require less maternal anesthesia, result in less maternal soft tissue trauma
- the advantages of **forceps** are that they are **unlikely to detach from the head**, can be **used on premature fetuses** or for a **rotation**, result in **less cephalohematoma and retinal hemorrhage**, and **do not aggravate bleeding from scalp lacerations**.

- A meta-analysis of randomized trials found that **forceps were less likely to fail to achieve vaginal birth than vacuum** (RR 0.65, 95% CI 0.45-0.94; 7 trials, 2419 participants), **but with more maternal trauma** .
- Use of vacuum extraction is a relatively easy procedure

# Vacuum

- A meta-analysis compared soft (silicone, plastic, rubber) vacuum extractor cups to rigid (metal, plastic) ones.
- **Soft cups were more likely to fail** in achieving vaginal delivery (OR 1.63, 95% CI 1.17-2.28).
- However, there were **fewer scalp injuries and cephalohematomas with the soft cup** and no differences between groups in regard to maternal injury.
- Metal or rigid cups were more suitable for occiput posterior, transverse, and difficult occiput anterior deliveries, whereas the soft cup was appropriate for uncomplicated deliveries

# Forceps -hundreds of types

- The instrument selected should have cephalic and pelvic curves appropriate to the size and shape of the fetal head, maternal pelvis, and planned procedure
- **Simpson** type forceps tend to fit a long molded head, **Elliott** or **Tucker-McLane** type forceps are better suited to a round unmolded head, **and Kielland** forceps are useful for rotations because of their minimal pelvic curve and sliding lock

# Traction

- **Traction with forceps** (or vacuum) should be **steady** (not rocking) and **in the line of the birth canal**. Traction should be exerted **with each contraction** and in conjunction **with maternal expulsive efforts**; the forceps can be relaxed between contractions to reduce fetal cranial compression.
- In most cases, **progress is noted with the first or second pull and delivery occurs by the third or fourth pull** .
- The procedure **should be abandoned if descent does not occur** with appropriate application and traction.

# SEQUENTIAL ATTEMPTS

- **ACOG** has suggested that **multiple attempts** at operative vaginal delivery **using different instruments** (vacuum, different types of forceps) **be avoided** due to the greater potential for maternal and/or fetal injury.
- Population based evidence has **shown increased risks from sequential application of vacuum and forceps** while a few small studies have not demonstrated increased risk, but these may be limited by their study sizes.
- In one large study, the incidence of subdural or cerebral hemorrhage in infants delivered by vacuum and forceps, vacuum alone, or forceps alone was approximately 21, 10, and 8, per 10,000 births, respectively

# WHEN TO ABANDON THE PROCEDURE

- **Operative vaginal delivery should be abandoned if it is difficult to apply the instrument, descent does not easily proceed with traction, or the baby has not been delivered within a reasonable time (eg, 15 to 20 minutes)**
- Some experts have recommended **abandoning the procedure after three pulls.**
- A cohort study found that 82 percent of completed operative deliveries occurred with one to three pulls, and that **pulling more than three times was associated with infant trauma in 45 percent of such deliveries**

# No need to be a hero in the operating room

- The operator should not be fixated on affecting a vaginal delivery.
- It is essential that the operator be willing to abandon a planned or attempted operative delivery and have the ability to **perform a cesarean birth** if evaluation or reevaluation of the clinical status shows that an instrumental delivery is contraindicated (eg, **the fetal head is not engaged, the position is uncertain, the procedure is not succeeding**).
- It is important to remember to examine the mother for possible tissue trauma after a failed attempt at operative delivery, as well as after successful attempts.

# OUTCOME AFTER FAILED PROCEDURES

- Overall, **a failed operative delivery** was associated with significantly higher rates of umbilical pH <7.0 (4.7 versus 1.7 percent), **Apgar score  $\leq 3$**  at 5 minutes (1.7 versus 0.6 percent), **seizures in the first 24 hours** of life (0.9 versus 0.1 percent), **and hypoxic ischemic encephalopathy (HIE)** (1.1 versus 0.1 percent).

# RISKS

- **Maternal and fetal complication rates** depend on a number of factors, which are not entirely independent.
- These include parity, forceps/cup position, head position at application, and station.
- The **rate of subdural or cerebral hemorrhage** associated with vacuum extraction was equivalent to that associated with forceps use or cesarean delivery during labor, but higher than after spontaneous delivery or a cesarean delivery performed prior to labor. This suggests that **the intrapartum indication for intervention was the major risk factor for this complication**, rather than mode of delivery

# RISKS

- A meta-analysis of 10 trials **comparing vacuum with forceps delivery found VACUUM deliveries** were associated with **less maternal soft tissue trauma** (OR 0.41, 95% CI 0.33-0.50), required **less general and regional anesthesia**, and resulted in **fewer cesarean deliveries**
- However, use of a **vacuum** was **less likely to result in successful vaginal delivery than forceps**. The lower cesarean delivery rate after attempted vacuum extraction was likely due to follow-up trial of forceps, whereas failed forceps typically resulted in a cesarean delivery
- **Patient selection** may have also been a factor; the **vacuum approach may have been used in patients more likely to deliver with minimal assistance**.

- **Neonates delivered by vacuum extraction had more neonatal cephalohematoma (OR 2.38) and retinal hemorrhages (OR 1.99) than those delivered by forceps**
- **Vacuum-assisted deliveries were associated with significantly lower rates of birth injury, seizures, and assisted ventilation than forceps assisted deliveries, after adjustment for confounders; neonatal death rates were equivalent.**

# Maternal complications

## Short-term

- **Short-term maternal risks from instrumental delivery include pain at delivery, perineal pain at 24 hours, lower genital tract lacerations and hematomas, urinary retention and incontinence, anemia, anal incontinence, and rehospitalization**
- **A randomized trial : at least one adverse maternal outcome---**
- **(periurethral/labial laceration, vaginal laceration, 3rd or 4th degree laceration, vulvar or vaginal hematomas, or cervical lacerations)**
- **--- occurred in 48 % of forceps, 36 % of silastic vacuum extractor**

- **Severe maternal trauma** is primarily associated with **rotational and midforceps operations** ; **direct bladder injury, ureteral lacerations/transections, and uterine rupture** have been reported in such cases
- **A retrospective review of 50,210 vaginal deliveries and a cohort study of 87,267 vaginal deliveries**
- the rates of **third and fourth degree lacerations** were: **spontaneous delivery (2 %), vacuum extraction (10 to 11 %), and forceps delivery (17 to 20 %)**

- Additional **maternal morbidities** occur when **episiotomy is performed** at the time of the operative vaginal delivery. These morbidities include an **increased risk of postpartum hemorrhage and perineal infection, and a greater need for moderate or strong analgesia** .
- Most studies show **performing an episiotomy** (midline or mediolateral ) appears **to increase**, rather than decrease, **the risk of perineal trauma** when employed in association with operative vaginal deliveries.

- A study that calculated odds ratios (OR) for **severe perineal laceration in nulliparous** women undergoing various types of delivery reported :
- **Vacuum** extraction **without episiotomy** (OR 9.4)
- **Forceps** delivery **without episiotomy** (23.2)
- **Vacuum** extraction **with episiotomy** (34.7)
- **Forceps** delivery **with episiotomy** (41.8)
- Similar results have been reported in multiparous women

- **Fetal position also has an impact on the risk of maternal trauma during delivery . The rate of **rectal injury is higher** for instrumental delivery from the **occiput posterior (OP)** compared with the **occiput anterior (OA)** position (for forceps delivery: 72 versus 54 percent; for vacuum delivery: 33 versus 27 percent)**

# Long-term

- **Long-term maternal sequelae** from operative delivery are **urinary and anal function**, such as **urinary incontinence, fecal incontinence, pelvic organ prolapse, and, occasionally, fistula formation.**
- A trial that randomly assigned 75 women to forceps or vacuum delivery and surveyed them five years postpartum reported **47 percent had some degree of urinary incontinence and 20 percent had loss of bowel control "sometimes" or "frequently"** .
- The long-term rates of morbidity were similar regardless of the instrument used to assist delivery.

# Neonatal complications

## Short-term

- **The short-term complications to the fetus** from operative vaginal delivery are usually caused by head compression and traction on the fetal intracranial structures, face, and scalp. The **most serious complication is intracranial hemorrhage.**

**Incidence of intracranial hemorrhage by mode of delivery**

Delivery type	Incidence
Vacuum extraction	1 in 860
Forceps	1 in 664
Forceps and vacuum	1 in 280
Cesarean delivery after failed forceps/vacuum	1 in 333
Cesarean delivery with labor	1 in 907
Cesarean delivery without labor	1 in 2750
Spontaneous vaginal birth	1 in 1900

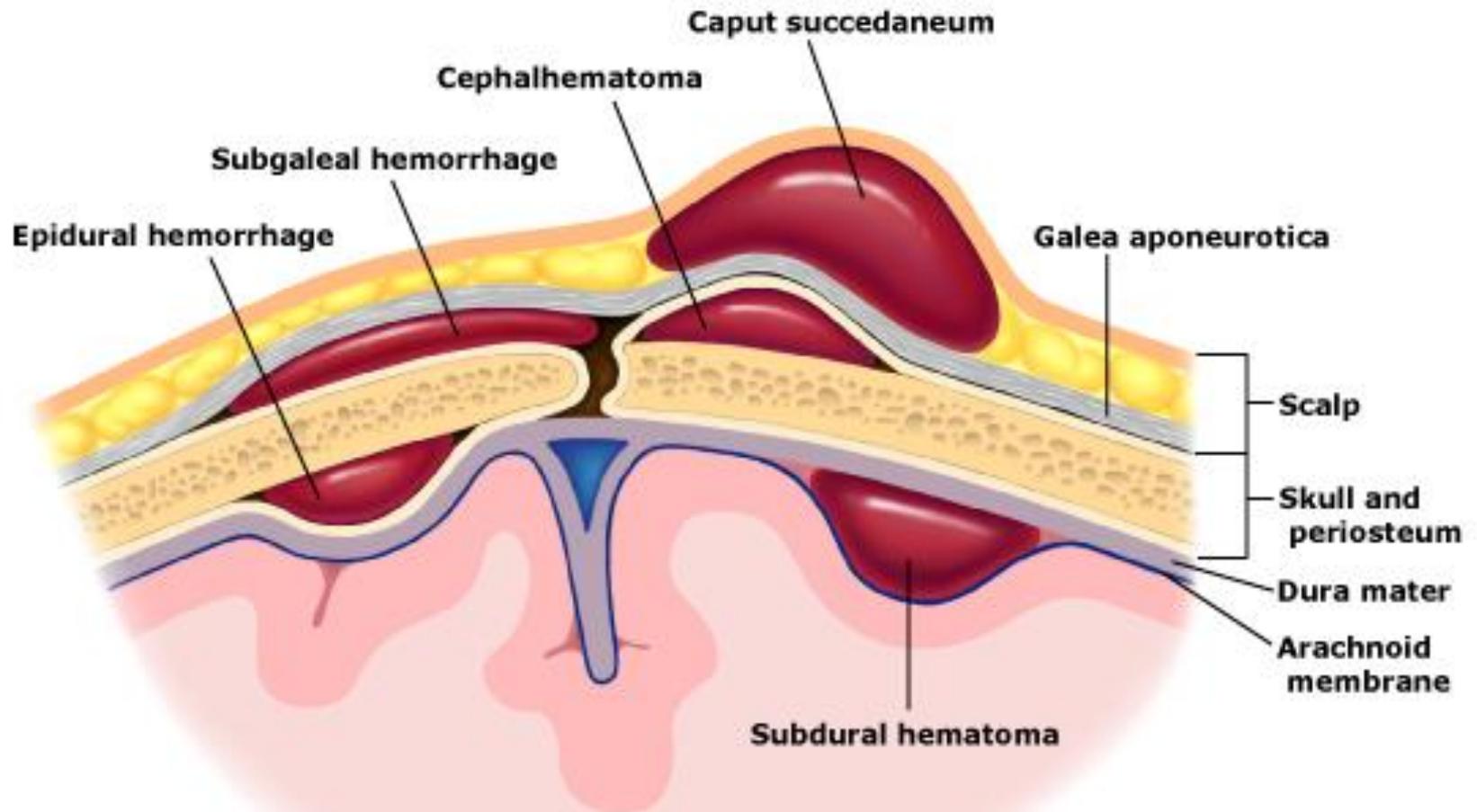
*Adapted from: data in Towner D, Castro MA, Eby-Wilkens E, Gilbert WM. N Engl J Med 1999; 341:1709.*

- **Other complications** : bruises, abrasions and lacerations, facial nerve palsy, cephalohematoma, retinal hemorrhage, subgaleal hemorrhage, and skull fracture .
- Virtually all of these complications can also occur in the course of a spontaneous vaginal delivery, but the incidence is lower than with instrumental delivery.
- incidence of each complication varies widely and depends on a number of factors, such as the **equipment used** (metal, plastic, vacuum, forceps), fetal station, and **the experience of the operator.**

# Vacuum-assisted deliveries

- **The incidence of serious neonatal complications with vacuum extraction is approximately 5 %.**
- Torsion and traction of the vacuum cup can cause fetal scalp abrasions and lacerations, separation of the scalp from underlying structures leading to cephalohematoma, subgaleal hematoma(26 to 45 per 1000 vacuum deliveries ), intracranial hemorrhage, hyperbilirubinemia, and retinal hemorrhage

## Neonatal extracranial and intracranial birth injuries



- In general, **the incidence of retinal hemorrhage is higher for vacuum-**assisted than for spontaneous vaginal or cesarean deliveries (75, 33, and 7 percent, respectively) .
- These hemorrhages typically resolve without sequelae within four weeks of birth.
- **Cephalohematoma**, in particular, is **more common after vacuum-assisted extraction than forceps** delivery (approximately 15 versus 2 percent)

## Frequency of birth trauma related to mode of delivery cases per 10,000 births

Trauma	Spontaneous birth	Vacuum assisted	Forceps assisted	Cesarean no labor	Cesarean with labor
Subdural or cerebral hemorrhage	2.9	8.0	9.8	4.1	7.4
Intraventricular hemorrhage	1.1	1.5	2.6	0.8	2.5
Subarachnoid hemorrhage	1.3	2.2	3.3	0.0	1.2
Facial nerve injury	3.3	4.6	45.4	4.9	3.1
Brachial plexus injury	7.7	17.6	25.0	4.1	1.8
Convulsions	6.4	11.7	9.8	8.6	21.3
CNS depression	3.1	9.2	5.2	6.7	9.6
Feeding difficulty	68.5	72.1	74.6	106.3	117.2
Mechanical ventilation	25.8	39.1	45.4	71.3	103.2

Data from: Towner D, Castro MA, Eby-Wilkens E, et al. Effect of mode of delivery in nulliparous women on neonatal intracranial injury. *N Engl J Med* 1999; 341:1709.

- **Shoulder dystocia also appears to be more common with vacuum-assisted than forceps deliveries . This is likely the reason that vacuum-assisted deliveries are at higher risk of brachial plexus injury than forceps-assisted deliveries or cesarean delivery**

# Forceps-assisted deliveries

- Short-term **complications** resulting from **forceps** deliveries include **skin markings and lacerations, external ocular trauma, intracranial hemorrhage, subgaleal hematomas, hyperbilirubinemia, retinal hemorrhage, lipoid necrosis, nerve injury, skull fractures, and death** .
- **Facial palsies** and **depressed skull fractures**, in particular, are more common with use of forceps than vacuum devices; both complications can also occur after a non-instrumental delivery.

# Long-term

- Acute fetal injuries with potential long-term sequelae include intracranial hemorrhage (subdural, subarachnoid, intraventricular and/or intraparenchymal hemorrhage) and neuromuscular injury; however, these sequelae are rare.
- **Developmental outcome appears to be equivalent for both forceps and vacuum assisted births.**

- **One of the few follow-up evaluations comparing outcome at school age after operative or spontaneous delivery among 3413 5 year-olds found no differences in cognitive testing**
- **A cohort study of almost 25,000 births did not find any association between forceps delivery and adult epilepsy**

**• Thank you for  
your time**



- **A** Ask for help; address the patient (inform her about what you are going to do and get informed consent); assess anesthesia needs.
- **B** Bladder empty
- **C** Cervix fully dilated
- **D** Determine fetal position and think shoulder dystocia
- **E** Extractor and resuscitation equipment ready
- **F** Apply cup on the flexion point
- **G** Gentle traction in the proper axis
- **H** Halt traction when the contraction is over; halt the procedure if it is not progressing normally.
- Modified from: Deutchman, M. Vacuum extraction: A necessary skill. Am Fam Physician 2000; 62:1270.

- There are no prospective randomized trials examining the impact of prophylactic low forceps delivery in low birth weight infants. Observational studies have reported conflicting findings
- The evidence does not clearly identify a superior mode of delivery in cephalic presenting low birth weight infants and very little data address the very low birth weight infant.
- Larger trials do not demonstrate any increase in neurologic injury with the use of low forceps in low birth weight infants, and a role for low forceps in clinically indicated situations would appear reasonable in this population

- One large cohort study found that mediolateral episiotomy during operative vaginal delivery protected against anal sphincter injury . Of note, the only randomized trial comparing routine versus restrictive episiotomy did not show a difference in outcomes, including anal sphincter tear or postpartum hemorrhage
- Rates of third and fourth degree lacerations have decreased over several decades in the US .
- Observational data suggest that more than 50 percent of this reduction can be accounted for by decreased use of forceps and episiotomy

- The Food and Drug Administration (**FDA**) issued an advisory (May 21, 1998) regarding the possibility of two major life-threatening complications following use of vacuum assisted devices:
- (1) **subgaleal hematoma** (ie, collection of blood between the aponeurosis covering the scalp and the periosteum; blood can extend across suture lines and beneath the scalp and into the neck) and
- (2) **intracranial hemorrhage** (subdural, subarachnoid, intraventricular, and/or intraparenchymal hemorrhage).
- The FDA also recommended these devices be used only **when a specific obstetric indication** is present and **when five criteria could be met**

- Food and Drug Administration advisory for caution when using vacuum assisted delivery devices
- 1. Be sure that persons who use vacuum devices for assisted delivery are versed in their use, and that they are aware of the indications, contraindications and precautions as supported in the accepted literature and current device labeling. See the list of sample references and resources that accompany this advisory.
- 2. Before using a vacuum assisted delivery device, read and understand the device's instructions. Pay particular attention to the manufacturer's instructions regarding cup placement, vacuum strength to be used, cumulative duration of applications and number of recommended extraction attempts. The recommended use for all these products is to apply steady traction in the line of the birth canal. Rocking movements or applying torque to the device may be dangerous. Since the instructions may be different for each device type or style, it is important to use the instructions provided by the manufacturer of the particular product being used.
- 3. Alert those who will be responsible for the infant's care that a vacuum assisted delivery device has been used, so that they can monitor the infant for signs of complications.
- 4. Educate the neonatal care staff about the complications of vacuum assisted delivery devices that have been reported to the FDA and in the literature (see references). They should watch for the signs of these complications in any infant in whom a vacuum assisted delivery device was used.
- 5. Report reactions associated with the use of vacuum assisted delivery devices to the FDA.
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- United States Food and Drug Administration, May 21, 1998.  
<http://www.fda.gov/cdrh/fetal598.html>