CHAPTER 13

Normal Labor and Delivery

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KEY ABBREVIATIONS	
American College of Obstetricians and Gynecologists	ACOG
Cephalopelvic Disproportion	CPD
Left Occiput Anterior	LOA
Occiput Anterior	OA
Occiput Posterior	OP
Occiput Transverse	OT
Prostaglandins	PGs
Randomized Controlled Trial	RCT
Right Occiput Anterior	ROA

LABOR: DEFINITION AND PHYSIOLOGY

Labor is defined as the process by which the fetus is expelled from the uterus. **More specifically, labor requires regular, effective contractions that lead to dilation and effacement of the cervix.** This chapter describes the physiology and normal characteristics of term labor and delivery.

The physiology of labor initiation has not been completely elucidated, but the putative mechanisms have been well reviewed by Liao and colleagues.[1] Labor initiation is species-specific, and the mechanisms in human labor are unique. The four phases of labor from quiescence to involution are outlined in Figure 13-1.[2] The first phase is quiescence and represents that time in utero before labor begins when uterine activity is suppressed by the action of progesterone, prostacyclin, relaxin, nitric oxide, parathyroid hormone–related peptide, and possibly other hormones. During the activation phase, estrogen begins to facilitate expression of myometrial receptors for prostaglandins (PGs) and oxytocin, which results in ion channel activation and increased gap junctions. This increase in the gap junctions between myometrial cells facilitates effective contractions.[3] In essence, the activation phase readies the uterus for the subsequent stimulation phase, when uterotonics, particularly PGs and oxytocin, stimulate regular contractions. In the human, this process at term may be protracted, occurring over days to weeks. The final phase, uterine involution, occurs after delivery and is mediated primarily by oxytocin. The first three phases of labor require endocrine, paracrine, and autocrine interaction between the fetus, membranes, placenta, and mother.

The fetus has a central role in the initiation of term labor in nonhuman mammals; in humans, the fetal role is not completely understood (Figure 13-2).[2-5] In sheep, term labor is initiated through activation of the fetal hypothalamic-pituitary-adrenal axis, with a resultant increase in fetal adrenocorticotrophic hormone and cortisol.[4,5] Fetal cortisol increases production of estradiol and decreases production of progesterone by a shift in placental metabolism of cortisol dependent on placental 17α-hydroxylase. The change in the progesterone/estradiol ratio stimulates placental production of oxytocin and PG, particularly $PGF_{2\alpha}$.[4] If this increase in fetal adrenocorticotrophic hormone and cortisol is blocked, parturition is delayed.[5] In contrast, humans lack placental 17α-hydroxylase and there is no increase in fetal cortisol near term. Rather, in humans, uterine activation may be potentiated in part by increased fetal adrenal production of dehydroepiandrostenedione, which is converted in the placenta to estradiol and estriol. Placental estriol stimulates an increase in maternal (likely decidual) $PGF_{2\alpha}$, PG receptors, oxytocin receptors, and gap junctions. In humans, there is no documented decrease in progesterone near term and a fall in progesterone is not necessary for labor initiation. However, some research suggests the possibility of a "functional progesterone withdrawal" in humans: Labor is accompanied by a decrease in the concentration of progesterone receptors, as well as a change in the ratio of progesterone receptor isoforms A and B in both the myometrium[6,7] and membranes.[8] More research is needed to elucidate the precise mechanism through which the human parturition cascade is activated. Fetal maturation may play an important role, as well as maternal

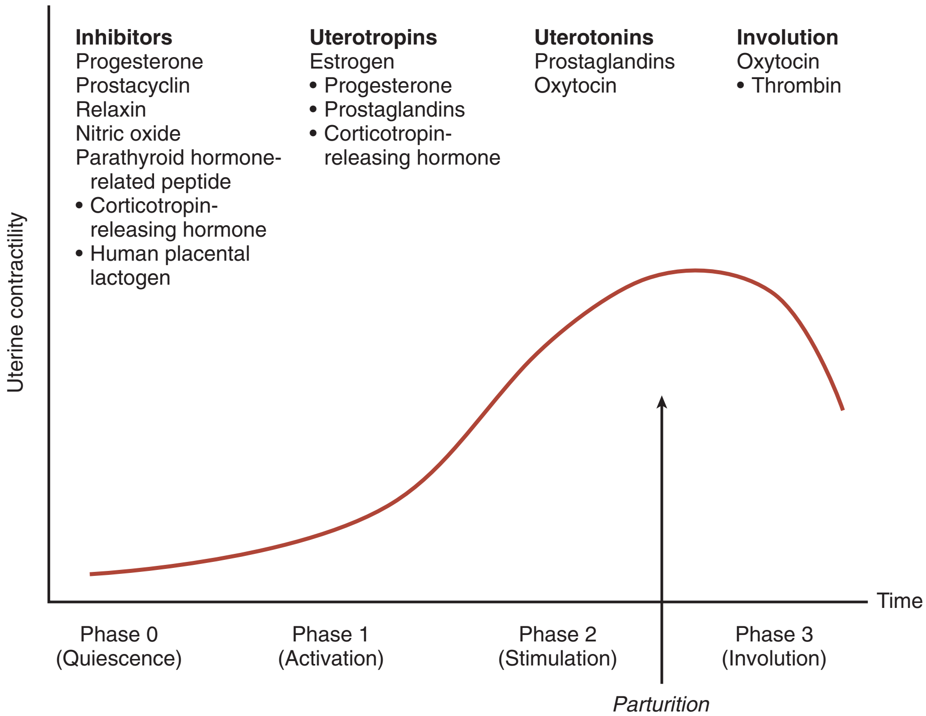


FIGURE 13-1. Regulation of uterine activity during pregnancy and labor. (Modified from Challis JRG, Gibb W: Control of parturition. Prenat Neonat Med 1:283, 1996.)

cues that affect circadian cycling. There are distinct diurnal patterns of contractions and delivery in most species, and in humans, the majority of contractions occur at night.[2,9]

Oxytocin is used commonly for labor induction and augmentation; a full understanding of the mechanism of oxytocin action is helpful. **Oxytocin is a peptide hormone synthesized in the hypothalamus and released from the posterior pituitary in a pulsatile fashion. At term, oxytocin is a potent uterotonic agent that is capable of stimulating uterine contractions at intravenous infusion rates of 1 to 2 mIU/min.**[10] **Oxytocin is inactivated largely in the liver and kidney, and during pregnancy, it is degraded primarily by placental oxytocinase. Its biologic half-life is approximately 3 to 4 minutes, but appears to be shorter when higher doses are infused.** Concentrations of oxytocin in the maternal circulation do not change significantly during pregnancy or before the onset of labor, but they do rise late in the second stage of labor.[10,11] Studies of fetal pituitary oxytocin production and the umbilical arteriovenous differences in plasma oxytocin strongly suggest that the fetus secretes oxytocin that reaches the maternal side of the placenta.[10,12] The calculated rate of active oxytocin secretion from the fetus increases from a baseline of 1 mIU/min before labor to around 3 mIU/min after spontaneous labor.

Significant differences in myometrial oxytocin receptor distribution have been reported, with large numbers of fundal receptors and fewer receptors in the lower uterine segment and cervix.[13] Myometrial oxytocin receptors increase on average by 100- to 200-fold during pregnancy, reaching a maximum during early labor.[10,11,14,15] This rise in receptor concentration is paralleled by an increase in uterine sensitivity to circulating oxytocin. Specific high-affinity oxytocin receptors have also been isolated from human amnion and decidua parietalis but not decidua vera.[10,13] **It has been suggested that oxytocin plays a dual role in parturition.** First, through its receptor, oxytocin directly stimulates uterine contractions. Second, oxytocin may act indirectly by stimulating the amnion and decidua to produce PG.[13,16,17] Indeed, even when uterine contractions are adequate, induction of labor at term is successful only when oxytocin infusion is associated with an increase in PGF production.[13]

Oxytocin binding to its receptor activates phospholipase C. In turn, phospholipase C increases intracellular calcium both by stimulating the release of intracellular calcium and by promoting the influx of extracellular calcium. Oxytocin stimulation of phospholipase C can be blocked by increased levels of cyclic adenosine monophosphate. Increased calcium levels stimulate the calmodulin-mediated activation of myosin light-chain kinase. Oxytocin may also stimulate uterine contractions via a calcium-independent pathway by inhibiting myosin phosphatase, which in turn increases myosin phosphorylation. **These pathways ($PGF_{2\alpha}$ and intracellular calcium) have been the target of multiple tocolytic agents: indomethacin, calcium channel blockers, beta mimetics (through stimulation of cyclic adenosine monophosphate), and magnesium.**

MECHANICS OF LABOR

Labor and delivery are not passive processes in which uterine contractions push a rigid object through a fixed aperture. The ability of the fetus to successfully negotiate the pelvis during labor and delivery depends on the complex interactions of three variables: uterine activity,

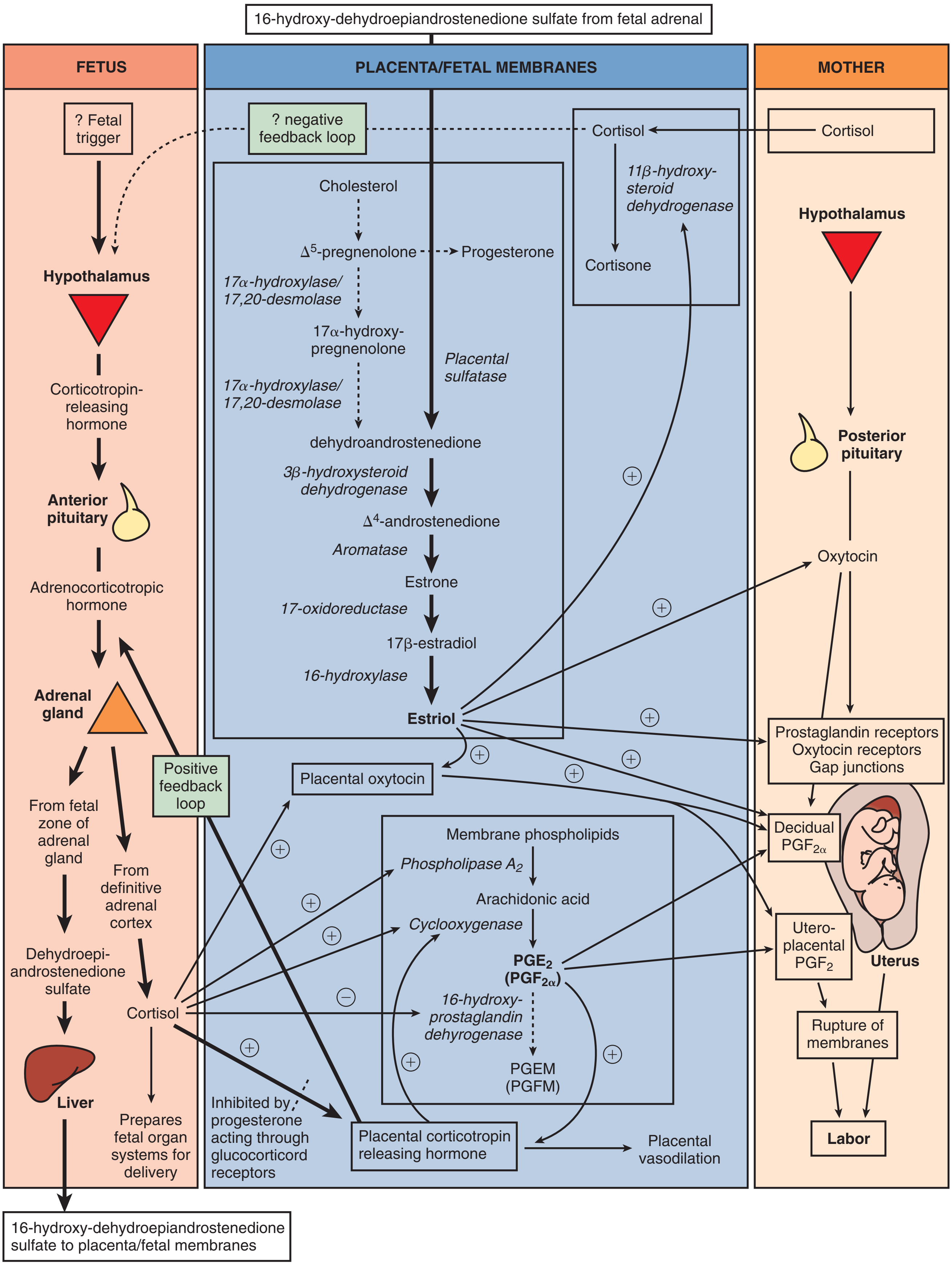


FIGURE 13-2. Proposed "parturition cascade" for labor induction at term. The spontaneous induction of labor at term in the human is regulated by a series of paracrine/autocrine hormones acting in an integrated parturition cascade responsible for promoting uterine contractions. *PGE*$_2$, Prostaglandin E$_2$; *PGEM,* 13, 14-dihydro-15-keto-PGE$_2$; *PGF*$_{2\alpha}$, prostaglandin F$_{2\alpha}$; *PGFM,* 13, 14-dihydro-15keto-PGF$_{2\alpha}$. (Modified from Norwitz ER, Robinson JN, Repke JT: The initiation of parturition: a comparative analysis across the species. Curr Prob Obstet Gynecol Fertil 22:41, 1999.)

the fetus, and the maternal pelvis (*Powers*, *Passenger*, *Passage*).

Uterine Activity (Powers)

The powers refer to the forces generated by the uterine musculature. Uterine activity is characterized by the frequency, amplitude (intensity), and duration of contractions. Assessment of uterine activity may include simple observation, manual palpation, external objective assessment techniques (such as external tocodynamometry), and direct measurement via an internal uterine pressure catheter (IUPC). External tocodynamometry measures the change in shape of the abdominal wall as a function of uterine contractions and, as such, is qualitative rather than quantitative. Although it permits graphic display of uterine activity and allows for accurate correlation of fetal heart rate patterns with uterine activity, external tocodynamometry does not allow measurement of contraction intensity or basal intrauterine tone. The most precise method for determination of uterine activity is the direct measurement of intrauterine pressure with an IUPC. However, this procedure should not be performed unless indicated given the small but finite associated risks of uterine perforation, placental disruption, and intrauterine infection.

Despite technologic improvements, the definition of "adequate" uterine activity during labor remains unclear. Classically, three to five contractions per 10 minutes has been used to define adequate labor; this pattern has been observed in approximately 95% of women in spontaneous labor. In labor, patients usually contract every 2 to 5 minutes, with contractions becoming as frequent as every 2 to 3 minutes in late active labor, as well as during the second stage. Abnormal uterine activity can also be observed either spontaneously or resulting from iatrogenic interventions. ***Tachysystole* is defined as more than five contractions in 10 minutes, averaged over 30 minutes. If tachysytole occurs, documentation should note the presence or absence of fetal heart rate (FHR) decelerations. The term *hyperstimulation* should no longer be used.**[18]

Various units have been devised to objectively measure uterine activity, the most common of which is the *Montevideo unit* (MVU), a measure of average frequency and amplitude above basal tone (the average strength of contractions in millimeters of mercury multiplied by the number of contractions per 10 minutes). Although 150 to 350 MVU has been described for adequate labor, 200 to 250 MVU is commonly accepted to define adequate labor in the active phase of labor.[19,20] There are no data that identify adequate forces during latent labor. Although it is generally believed that optimal uterine contractions are associated with an increased likelihood of vaginal delivery, there are limited data to support this assumption. If uterine contractions are "adequate" to effect vaginal delivery, one of two things will happen: either the cervix will efface and dilate, and the fetal head will descend, or there will be worsening caput succedaneum (scalp edema) and molding of the fetal head (overlapping of the skull bones) without cervical effacement and dilation. The latter situation suggests the presence of cephalopelvic disproportion (CPD), which can be either absolute (in which a given fetus is simply too large to negotiate a given pelvis) or relative (in which delivery of a given fetus through a given pelvis would be possible under optimal conditions, but is precluded by malposition or abnormal attitude of the fetal head), or pelvic outlet obstruction such as with uterine fibroids.

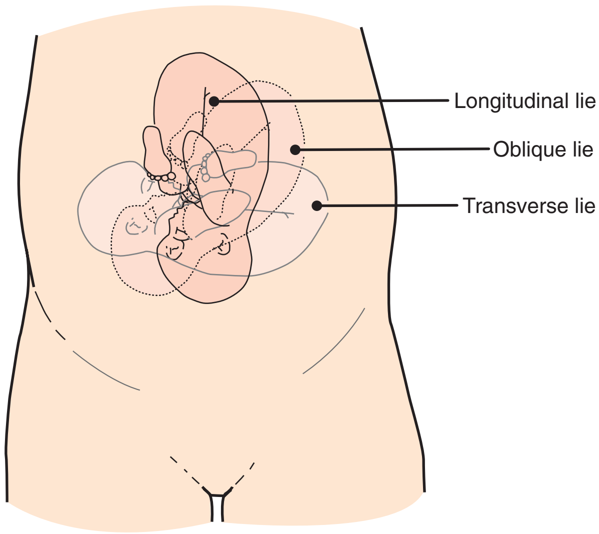


FIGURE 13-3. Examples of different fetal lie.

The Fetus (Passenger)

The passenger, of course, is the fetus. Several fetal variables influence the course of labor and delivery.

1. Fetal *size* can be estimated clinically by abdominal palpation or with ultrasound, but both are subject to a large degree of error. **Fetal macrosomia (defined by the American College of Obstetricians and Gynecologists [ACOG] as actual birth weight greater than 4500 g[21])** is associated with an increased likelihood of failed trial of labor and may be associated with labor abnormalities.[22]
2. ***Lie* refers to the longitudinal axis of the fetus relative to the longitudinal axis of the uterus**. Fetal lie can be longitudinal, transverse, or oblique (Figure 13-3). In a singleton pregnancy, only fetuses in a longitudinal lie can be safely delivered vaginally.
3. ***Presentation* refers to the fetal part that directly overlies the pelvic inlet.** In a fetus presenting in the longitudinal lie, the presentation can be cephalic (vertex) or breech. Compound presentation refers to the presence of more than one fetal part overlying the pelvic inlet, such as a fetal hand and the vertex. Funic presentation refers to presentation of the umbilical cord and is rare at term. In a cephalic fetus, the presentation is classified according to the leading bony landmark of the skull, which can be either the occiput (vertex), the chin (mentum), or the brow (Figure 13-4). *Malpresentation*, referring to any presentation other than vertex, is seen in approximately 5% of all term labors.
4. ***Attitude* refers to the position of the head with regard to the fetal spine (the degree of flexion and/or extension of the fetal head).** Flexion of the head is important to facilitate *engagement* of the head in the maternal pelvis. When the fetal chin is optimally

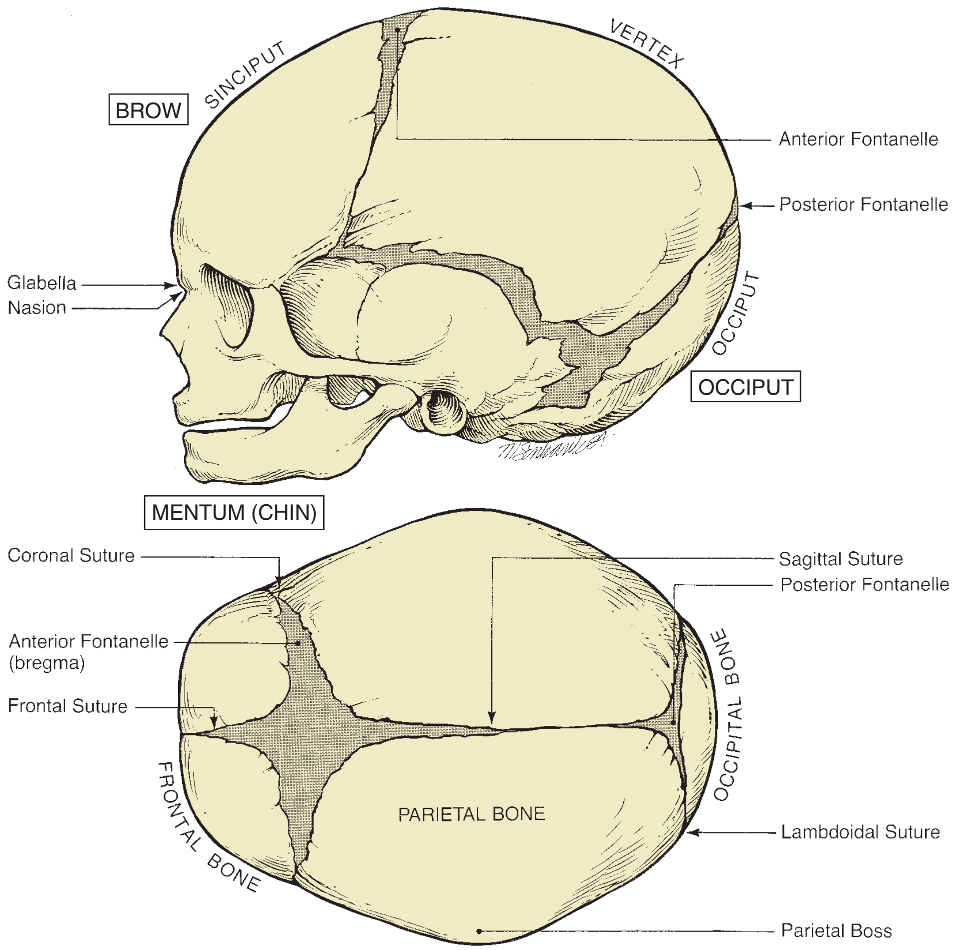


FIGURE 13-4. Landmarks of fetal skull for determination of fetal position.

flexed onto the chest, the suboccipitobregmatic diameter (9.5 cm) presents at the pelvic inlet (Figure 13-5). This is the smallest possible presenting diameter in the cephalic presentation. As the head deflexes (extends), the diameter presenting to the pelvic inlet progressively increases even before the malpresentations of brow and face are encountered (see Figure 13-5), and may contribute to failure to progress in labor. The architecture of the pelvic floor along with increased uterine activity may correct deflexion in the early stages of labor.

5. ***Position* of the fetus refers to the relationship of the fetal presenting part to the maternal pelvis, and it can be assessed most accurately on vaginal examination.** For cephalic presentations, the fetal occiput is the reference. If the occiput is directly anterior, the position is occiput anterior (OA). If the occiput is turned toward the mother's right side, the position is right occiput anterior (ROA). In the breech presentation, the sacrum is the reference (right sacrum anterior). The various positions of a cephalic presentation are illustrated in Figure 13-6. In a vertex presentation, position can be determined by palpation of the fetal sutures. The sagittal suture is the easiest to palpate. Palpation of the distinctive lamdoid sutures should identify the position of the fetal occiput. The frontal suture can also be used to determine the position of the front of the vertex. Most commonly, the fetal head enters the pelvis in a transverse position and, then as a normal part of labor, rotates to an OA position. Most fetuses deliver in the OA, LOA, or ROA position. In the past, less than 10% of presentations were occiput posterior (OP) at delivery.[23] However, epidural analgesia is associated with an increased risk of OP presentation (observed in 12.9% of women with epidural analgesia).[24]

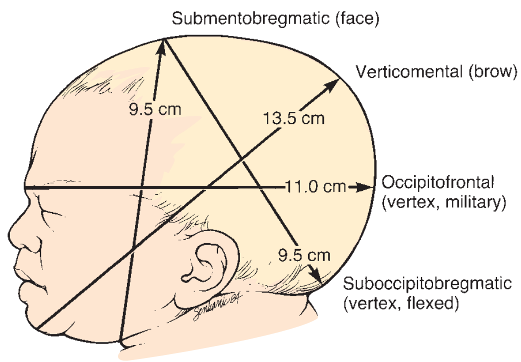


FIGURE 13-5. Presenting diameters of the average term fetal skull.

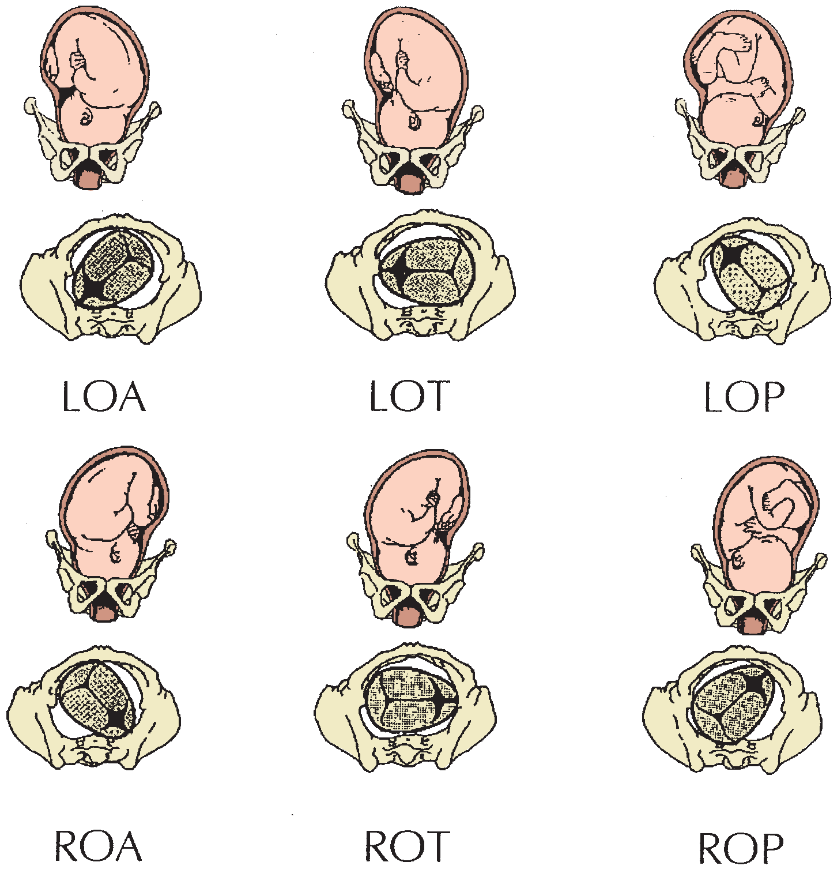


FIGURE 13-6. Fetal presentations and positions in labor. *LOA,* Left occiput anterior; *LOP,* left occiput posterior; *LOT,* left occiput transverse; *ROA,* right occiput anterior; *ROT,* right occiput transverse; *ROP,* right occiput posterior. (Modified from Norwitz ER, Robinson J, Repke JT: The initiation and management of labor. *In* Seifer DB, Samuels P, Kniss DA [eds]: The Physiologic Basis of Gynecology and Obstetrics. Philadelphia, Lippincott Williams & Wilkins, 2001.)

Asynclitism occurs when the sagittal suture is not directly central relative to the maternal pelvis. If the fetal head is turned such that more parietal bone is present posteriorly, the sagittal suture is more anterior and this is referred to as posterior asynclitism. Anterior asynclitism occurs when there is more parietal bone presenting anteriorly. The occiput transverse (OT) and OP positions are less common at delivery and more difficult to deliver. *Malposition* refers to any position in labor that is not ROA, OA, or LOA.

6. ***Station* is a measure of descent of the bony presenting part of the fetus through the birth canal** (Figure 13-7). The current standard classification (–5 to +5) is based on a quantitative measure in centimeters of the distance of the leading bony edge from the ischial spines. The midpoint (0 station) is defined as the plane of the maternal ischial spines. The ischial spines can be palpated on vaginal examination at approximately 8 o'clock and 4 o'clock. For the right-handed person, they are most easily felt on the maternal right.

An abnormality in any of these fetal variables may affect both the course of labor and the likelihood of vaginal delivery. For example, OP presentation is well known to be associated with longer labor.[25]

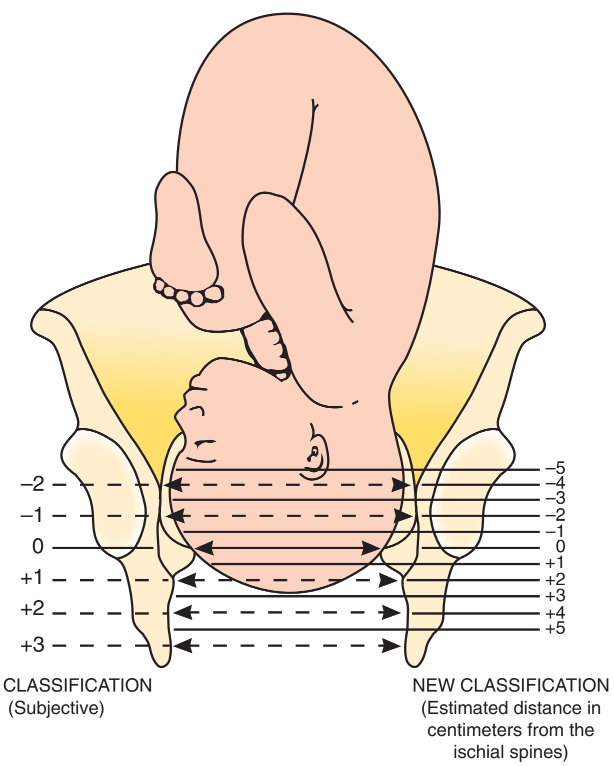


FIGURE 13-7. The relationship of the leading edge of the presenting part of the fetus to the plane of the maternal ischial spines determines the station. Station +1/+3 (old classification) or +2/+5 (new classification) is illustrated.

The Maternal Pelvis (Passage)

The passage consists of the bony pelvis (composed of the sacrum, ilium, ischium, and pubis) and the resistance

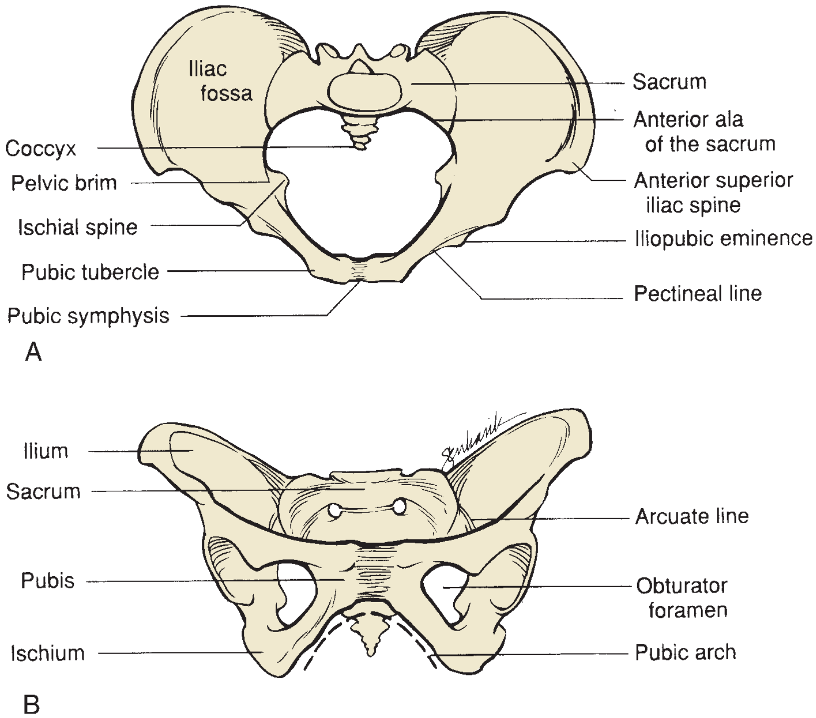


FIGURE 13-8. Superior **(A)** and anterior **(B)** view of the female pelvis. (From Repke JT: Intrapartum Obstetrics. New York, Churchill Livingstone, 1996, p 68.)

provided by the soft tissues. The bony pelvis is divided into the false (greater) and true (lesser) pelvis by the pelvic brim, which is demarcated by the sacral promontory, the anterior ala of the sacrum, the arcuate line of the ilium, the pectineal line of the pubis, and the pubic crest culminating in the symphysis (Figure 13-8). Measurements of the various parameters of the bony female pelvis have been made with great precision, directly in cadavers and using radiographic imaging in living women. Such measurements have divided the true pelvis into a series of planes that must be negotiated by the fetus during passage through the birth canal, which can be broadly classified into the pelvic inlet, midpelvis, and pelvic outlet. X-ray pelvimetry and computed tomography (CT) have been used to define average and critical limit values for the various parameters of the bony pelvis (Table 13-1).[26,27] Critical limit values are measurements that are associated with a significant probability of CPD.[26] **However, CT and x-ray pelvimetry are rarely used, having been replaced by a clinical trial of the pelvis (labor).** The remaining indications for x-ray or CT pelvimetry are evaluation for vaginal breech delivery or evaluation of a woman who has suffered a significant pelvic fracture.[28]

Clinical pelvimetry is currently the only method of assessing the shape and dimensions of the bony pelvis in labor. A useful protocol for clinical pelvimetry is detailed in Figure 13-9 and involves the assessment of the pelvic inlet, midpelvis, and pelvic outlet. The inlet of the true pelvis is largest in its transverse diameter (usually greater than 12.0 cm). The *diagonal conjugate* (the distance from the sacral promontory to the inferior margin of the symphysis pubis as assessed on vaginal examination) is a clinical representation of the anteroposterior diameter of the pelvic inlet. The *true conjugate* (or *obstetric conjugate*) of the pelvic inlet is the distance from the sacral promontory to the superior aspect of the symphysis pubis. This measurement cannot be made clinically but can be estimated by subtracting 1.5 to 2.0 cm from the diagonal conjugate. This is the smallest diameter of the inlet, and it usually measures approximately 10 to 11 cm. The limiting factor in the midpelvis is the interspinous diameter (the measurement between the ischial spines), which is usually the smallest diameter of the pelvis but should be greater than 10 cm. The pelvic outlet is rarely of clinical significance. The anteroposterior diameter from the coccyx to the symphysis pubis is approximately 13 cm in most cases, and the transverse diameter between the ischial tuberosities is approximately 8 cm.

TABLE 13-1 AVERAGE AND CRITICAL LIMIT VALUES FOR PELVIC MEASUREMENTS BY X-RAY PELVIMETRY

DIAMETER	AVERAGE VALUE	CRITICAL LIMIT*
Pelvic Inlet		
Anteroposterior (cm)	12.5	10.0
Transverse (cm)	13.0	12.0
Sum (cm)	25.5	22.0
Area (cm^2)	145.0	123.0
Pelvic Midcavity		
Anteroposterior (cm)	11.5	10.0
Transverse (cm)	10.5	9.5
Sum (cm)	22.0	19.5
Area (cm^2)	125.0	106.0

Modified from O'Brien WF, Cefalo RC: Labor and delivery. *In* Gabbe SG, Niebyl JR, Simpson JL (eds): Obstetrics: Normal and Problem Pregnancies, ed 3. New York, Churchill Livingstone, 1996, p 377.
*The critical limit values cited imply a high likelihood of cephalopelvic disproportion.

The shape of the female bony pelvis can be classified into four broad categories: gynecoid, anthropoid, android, and platypelloid (Figure 13-10). This classification, based

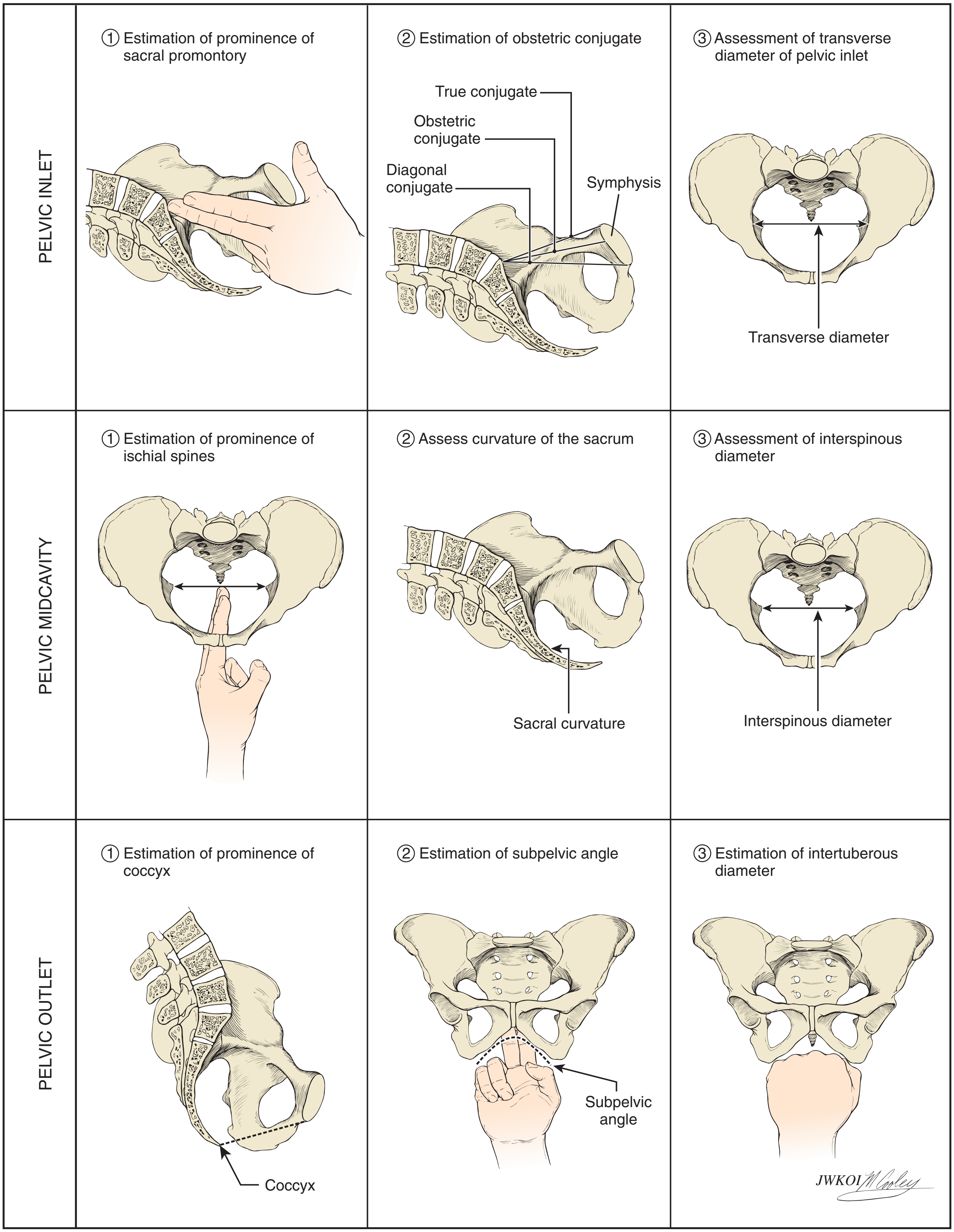


FIGURE 13-9. A protocol for clinical pelvimetry.

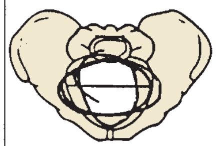
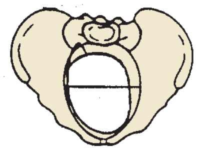
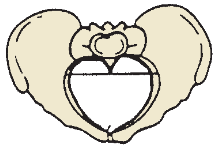
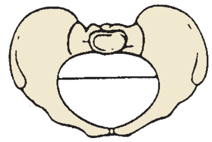
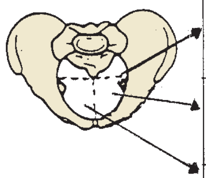
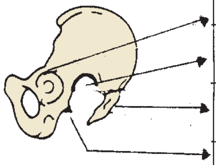
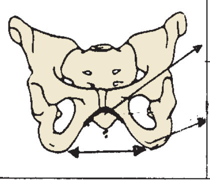
		 Gynecoid	 Anthropoid	 Android	 Platypelloid
Pelvic inlet 	Widest transverse diameter of inlet	12 cm	<12 cm	12 cm	12 cm
	Anteroposterior diameter of inlet	11 cm	>12 cm	11 cm	10 cm
	Forepelvis	Wide	Divergent	Narrow	Straight
Pelvic midcavity 	Side walls	Straight	Narrow	Convergent	Wide
	Sacrosciatic notch	Medium	Backward	Narrow	Forward
	Inclination of sacrum	Medium	Wide	Forward (lower third)	Narrow
	Ischial spines	Not prominent	Not prominent	Not prominent	Not prominent
Pelvic outlet 	Subpubic arch	Wide	Medium	Narrow	Wide
	Transverse diameter of outlet	10 cm	10 cm	<10 cm	10 cm

FIGURE 13-10. Characteristics of the four types of female bony pelvis. (Modified from Callahan TL, Caughey AB, Heffner LJ [eds]: Blueprints in Obstetrics and Gynecology. Malden, MA, Blackwell Science, 1998, p 45.)

on the radiographic studies of Caldwell and Moloy, separates those with more favorable characteristics (gynecoid, anthropoid) from those that are less favorable for vaginal delivery (android, platypelloid).[29] In reality, however, many women fall into intermediate classes, and the distinctions become arbitrary. The gynecoid pelvis is the classic female shape. The anthropoid pelvis with its exaggerated oval shape of the inlet, largest anterioposterior diameter, and limited anterior capacity is more often associated with delivery in the OP position. The android pelvis is male in pattern and theoretically has an increased risk of CPD, and the platypelloid pelvis with its broad, flat pelvis theoretically predisposes to a transverse arrest. Although the assessment of fetal size along with pelvic shape and capacity is still of clinical utility, it is a very inexact science. An adequate trial of labor is the only definitive method to determine whether a given fetus will be able to safely negotiate a given pelvis.

Pelvic soft tissues may provide resistance in both the first and second stages of labor. In the first stage, resistance is offered primarily by the cervix, whereas in the second stage, it is offered by the muscles of the pelvic floor. In the second stage of labor, the resistance of the pelvic musculature is believed to play an important role in the rotation and movement of the presenting part through the pelvis.

CARDINAL MOVEMENTS IN LABOR

The mechanisms of labor, also known as the cardinal movements, refer to the changes in position of fetal head during its passage through the birth canal. Because of the asymmetry of the shape of both the fetal head and the maternal bony pelvis, such rotations are required for the fetus to successfully negotiate the birth canal. **Although labor and birth comprise a continuous process, seven discrete cardinal movements of the fetus are described: engagement, descent, flexion, internal rotation, extension, external rotation or restitution, and expulsion** (Figure 13-11).

Engagement

Engagement refers to passage of the widest diameter of the presenting part to a level below the plane of the pelvic inlet (Figure 13-12). In the cephalic presentation with a well-flexed head, the largest transverse diameter of the fetal head is the biparietal diameter (9.5 cm). In the breech, the widest diameter is the bitrochanteric diameter. Clinically, engagement can be confirmed by palpation of the presenting part both abdominally and vaginally. With a cephalic presentation, engagement is achieved when the presenting part is at 0 station on vaginal examination. Engagement is considered an important clinical prognostic sign because it demonstrates that, at least at the level of the pelvic inlet,

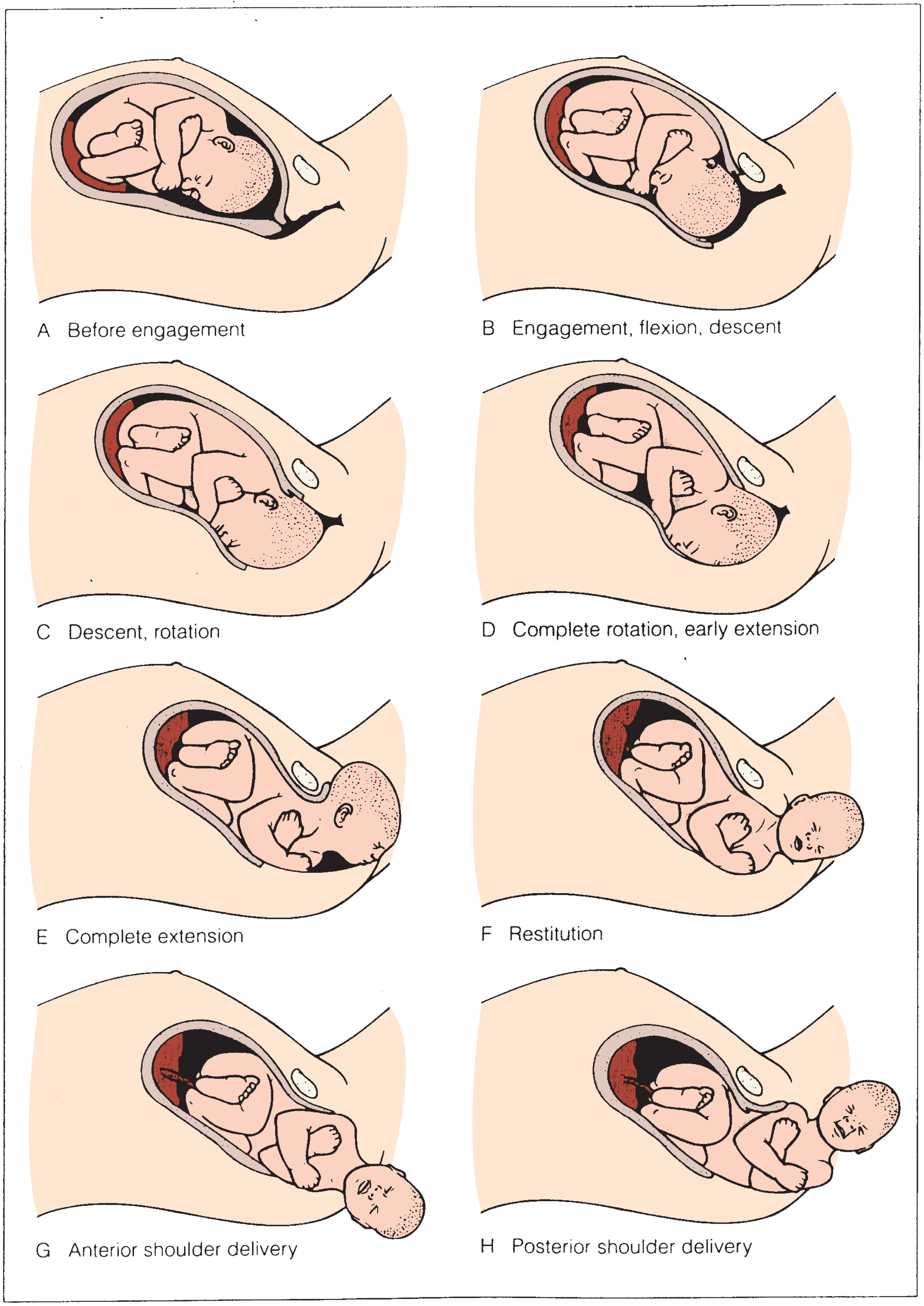


FIGURE 13-11. Cardinal movements of labor.

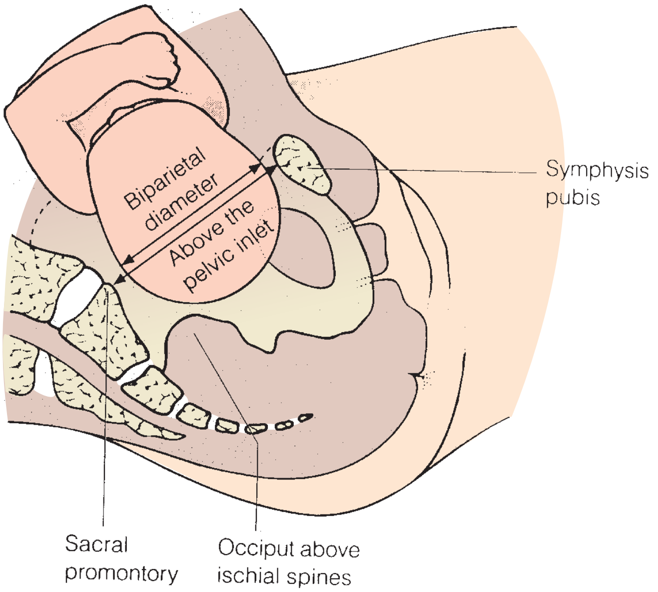


FIGURE 13-12. Engagement of the fetal head.

the maternal bony pelvis is sufficiently large to allow descent of the fetal head. In nulliparas, engagement of the fetal head usually occurs by 36 weeks' gestation. In multiparas, however, engagement can occur later in gestation or even during the course of labor.

Descent

Descent refers to the downward passage of the presenting part through the pelvis. Descent of the fetus is not continuous; the greatest rates of descent occur during the deceleration phase of the first stage of labor and during the second stage of labor.

Flexion

Flexion of the fetal head occurs passively as the head descends owing to the shape of the bony pelvis and the resistance offered by the soft tissues of the pelvic floor. Although flexion of the fetal head onto the chest is present to some degree in most fetuses before labor, complete flexion usually occurs only during the course of labor. The result of complete flexion is to present the smallest diameter of the fetal head (the suboccipitobregmatic diameter) for optimal passage through the pelvis.

Internal Rotation

Internal rotation refers to rotation of the presenting part from its original position as it enters the pelvic inlet (usually OT) to the anteroposterior position as it passes through the pelvis. As with flexion, internal rotation is a passive movement resulting from the shape of the pelvis and the pelvic floor musculature. The pelvic floor musculature, including the coccygeus and ileococcygeus muscles, forms a V-shaped hammock that diverges anteriorly. As the head descends, the occiput of the fetus rotates toward the symphysis pubis (or, less commonly, toward the hollow of the sacrum), thereby allowing the widest portion of the fetus to negotiate the pelvis at its widest dimension. Owing to the angle of inclination between the maternal lumbar spine and pelvic inlet, the fetal head engages in an asynclitic fashion (i.e., with one parietal eminence lower than the other). With uterine contractions, the leading parietal eminence descends and is first to engage the pelvic floor. As the uterus relaxes, the pelvic floor musculature causes the fetal head to rotate until it is no longer asynclitic.

Extension

Extension occurs once the fetus has descended to the level of the introitus. This descent brings the base of the occiput into contact with the inferior margin at the symphysis pubis. At this point, the birth canal curves upward. The fetal head is delivered by extension and rotates around the symphysis pubis. The forces responsible for this motion are the downward force exerted on the fetus by the uterine contractions along with the upward forces exerted by the muscles of the pelvic floor.

External Rotation

External rotation, also known as restitution, refers to the return of the fetal head to the correct anatomic position in relation to the fetal torso. This can occur to either side depending on the orientation of the fetus. This is again a passive movement resulting from a release of the forces exerted on the fetal head by the maternal bony pelvis and its musculature and mediated by the basal tone of the fetal musculature.

Expulsion

Expulsion refers to delivery of the rest of the fetus. After delivery of the head and external rotation, further descent brings the anterior shoulder to the level of the symphysis pubis. The anterior shoulder is delivered in much the same manner as the head, with rotation of the shoulder under the symphysis pubis. After the shoulder, the rest of the body is usually delivered without difficulty.

NORMAL PROGRESS OF LABOR

Progress of labor is measured with multiple variables. With the onset of regular contractions, the fetus descends in the pelvis as the cervix both effaces and dilates. The clinician must assess not only cervical effacement and dilation but fetal station and position with each vaginal examination to judge labor progress. This assessment depends on skilled digital palpation of the maternal cervix and the presenting part. In labor, the cervix shortens (becomes more effaced). Cervical effacement refers to the length of the remaining cervix and can be reported in length or as a percentage. If percentage is used, 0% effacement refers to at least a 2 cm long or a very thick cervix, and 100% effacement refers to no length remaining or a very thin cervix. Most clinicians use percentage to follow cervical effacement during labor. Generally, 80% or greater effacement is required for the diagnosis of active labor. Dilation, perhaps the easiest assessment to master, ranges from closed (no dilation) to complete (10 cm dilated). For most people, a cervical dilation that accommodates a single index finger is equal to 1 cm and 2 index fingers dilation is equal to 3 cm. If no cervix can be palpated around the presenting part, the cervix is 10 cm or completely dilated. The assessment of station (see earlier) is important for documentation

TABLE 13-2 SUMMARY OF MEANS AND 95TH PERCENTILES FOR DURATION OF FIRST- AND SECOND-STAGE LABOR

PARAMETER	MEAN	95th PERCENTILE
Nulliparas		
Latent labor	7.3-8.6 hr	17-21 hr
First stage	7.7-13.3 hr	16.6-19.4 hr
First stage, epidural	10.2 hr	19 hr
Second stage	53-57 min	122-147 min
Second stage, epidural	79 min	185 min
Multiparas		
Latent labor	4.1-5.3 hr	12-14 hr
First stage	5.7-7.5 hr	12.5-13.7 hr
First stage, epidural	7.4 hr	14.9 hr
Second stage, F2	17-19 min	57-61 min
Second stage, epidural	45 min	131 min

Data from references 30, 31, 32, 35, 38.

TABLE 13-3 MEDIAN DURATION OF TIME ELAPSED IN HOURS* FOR EACH CENTIMETER OF DILATION DURING LABOR

CERVICAL DILATION (cm)	BEFORE PERIOD	AFTER PERIOD	*p* VALUE
3-4	2.03	2.30	.36
4-5	1.29	2.17	<.01
5-6	0.66	0.67	.84
6-7	0.62	0.54	.32
7-8	0.44	0.51	.25
8-9	0.41	0.52	.05
9-10	0.44	0.50	.27

From Vahratian A, Zhang J, Hasling J, et al: The effect of early epidural versus early intravenous analgesia use on labor progression: a natural experiment. Am J Obstet Gynecol 191:259, 2004.

*An interval-censored regression model with a log normal distribution was fitted to adjust for maternal age, prepregnancy BMI, and gravidity.

of progress, but it is also critical when determining if an operative vaginal delivery is feasible. Fetal head position should be regularly determined once the woman is in active labor and ideally before significant caput has developed, obscuring the sutures. Like station, knowledge of the fetal position is critical before performing an operative vaginal delivery.

Labor has two categorizations: phases and stages. Phases are divided into latent and active. The *latent phase* of labor is defined as the period between the onset of labor and the point when labor becomes active. The onset of labor is difficult to identify objectively. Usually, it is defined by the initiation of regular painful contractions. Women are frequently at home at this time; therefore, the identification of labor onset depends on patient memory, and hence the length of latent labor is difficult to truly quantify. The beginning of active labor is a retrospective diagnosis because the definition of the active phase of labor is when the slope of cervical dilation accelerates. **In general, active labor requires ≥80% effacement and ≥4 cm dilation of the cervix, but the dilation at which active labor begins is particularly variable.**

In addition, there are three stages of labor. The first stage is from labor onset until full dilation. The second stage is from full dilation until delivery of the baby, and the third stage is from the delivery of the baby until the delivery of the placenta.

The work of Dr. Emanuel Friedman in the 1950s and 1960s was seminal to the current knowledge of labor progress. He analyzed labor progress in 500 nulliparous and multiparous women, and reported normative data that are still useful today.[30,31] Of note, Friedman's second-stage lengths are somewhat artificial because most nulliparous women in that era had a forceps delivery once the duration of the second stage reached 2 hours. More recent data evaluating women in spontaneous labor without augmentation or operative delivery from multiple countries are amazingly similar in the means, suggesting that these normative data are reliable and useful (Table 13-2).[32-35] Of interest, epidural use appears to add about 2 hours to the first stage and about 20 minutes to the second stage in both multiparous and nulliparous women.[35] Friedman's data popularized the use of the labor graph, first depicting only cervical dilation and then modified to include descent and dilation.[37] **Rates of 1.5 cm and 1.2 cm dilation per hour in the active phase for multiparous and nulliparous women, respectively, represent the 5th percentile for rates of dilation[31] and have led to the general concept that in active labor, dilation of at least 1 cm per hour should occur** (Table 13-3). More recent analysis of data from the National Collaborative Perinatal Project, the same data evaluated by Friedman, suggested that progress in active labor in women who ultimately have a vaginal delivery is in fact faster but that these women enter active labor later than initially described.[36] Specifically, most nulliparous women were not in active labor until approximately 5-6 cm and the slope of labor progress did not really increase until after 6 cm. This is an important finding and suggests that clinicians may be diagnosing active phase arrest too early, which could result in unnecessary cesarean deliveries[36,37] (see Chapter 14). The time when an individual patient enters the active phase becomes obvious only retrospectively, as noted earlier, and is more difficult to recognize in nulliparous women.[36]

A more practical approach to following labor progress was introduced by Schulman and Ledger, when they published a modified labor graph that evaluated labor progress focused on latent and active phase only, and this is the graph most commonly used today (Figure 13-13).[38] When evaluating labor progress, it is extremely important to understand that progress in latent phase is slower and less predictable both in multiparas and nulliparas. Factors affecting the duration of labor include parity, maternal body mass index, fetal position, maternal age, and fetal size. Longer labors are associated with increased maternal body mass index,[39] fetal position other than OA,[40] and older maternal age.[41,42] **Factors significantly associated with a prolonged second stage included induced labor, chorioamnionitis, older maternal age, non–African American ethnicity, and parity ≥5.**[41,43] Limits of lengths of first and second stages incorporating the effect of epidural use are helpful in identifying those women who may benefit from interventions (see Table 13-2).[32,34,35]

Mean lengths of the third stage of labor are not affected by parity. In a case series of nearly 13,000 singleton vaginal deliveries greater than 20 weeks' gestation, the median

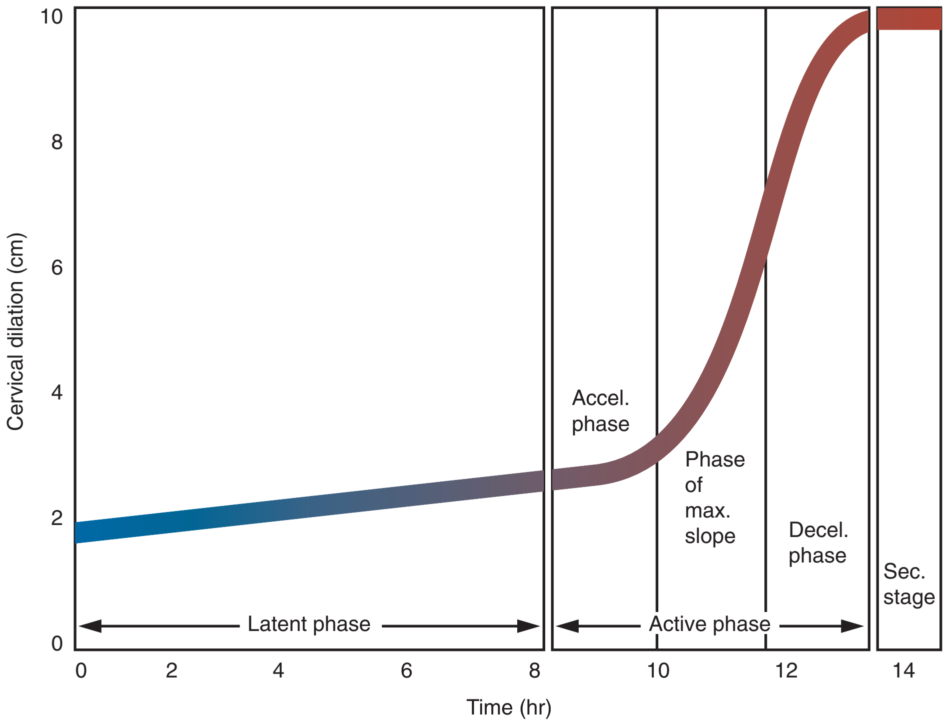


FIGURE 13-13. Modern labor graph. Characteristics of the average cervical dilation curve for nulliparous labor. (Modified from Friedman EA: Labor: Clinical Evaluation and Management, ed 2. Norwalk, CT, Appleton-Century-Crofts, 1978.)

third stage duration was 6 minutes and exceeded 30 minutes in only 3% of women.[44] A threshold of 30 minutes was associated with a significantly increased risk of a greater than 500 mL blood loss, a drop in postdelivery hematocrit by greater than or equal to 10%, or a need for dilation and curettage.[44] This suggests that manual removal and/or extraction of the placenta is indicated after 30 minutes.

Interventions Affecting Normal Labor Outcomes

Various interventions have been suggested to promote normal labor progress, including maternal ambulation during active labor (Figure 13-14). However, a well-designed randomized trial of over 1000 women in active labor comparing ambulation with usual care found no differences in the duration of the first stage, need for oxytocin, use of analgesia, or route of delivery.[45] In contrast, upright rather than recumbent positioning during labor was associated with significantly shorter first stage of labor and less epidural use.[46] In addition, the presence of a labor doula compared with no support was associated with a significant reduction in use of analgesia, oxytocin, and operative or cesarean delivery and an increase in satisfaction by the woman.[47] These data were compelling enough for doula support in labor to receive an A rating, meaning that it should be recommended for use during labor.[48] **In a randomized trial of nulliparas in active labor, IV administration at 125 mL/min of D_5NS was associated with a significant reduction in labor length and in second stage length compared to NS.**[49]

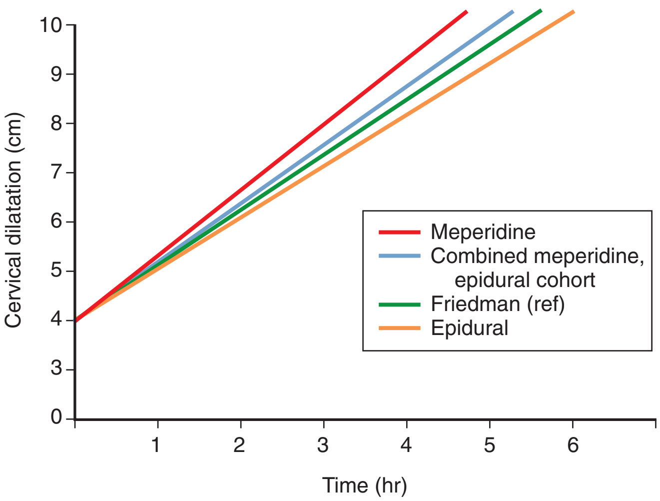


FIGURE 13-14. Comparison of the rates of cervical dilation during the active phase of labor originally reported by Friedman and now reported for the women who received patient-controlled intravenous meperidine, patient-controlled epidural analgesia, and the combined cohort. (From Alexander JM, Sharma SK, McIntire DD, Leveno KJ: Epidural analgesia lengthens the Friedman active phase of labor. Obstet Gynecol 100:46, 2002.)

Active Management of Labor

Dystocia is lack of progress of labor for any reason and is the second most common indication for cesarean delivery, following previous cesarean delivery. In the late 1980s, in an effort to reduce the rapidly rising cesarean delivery rate, active management of labor was popularized in the United States based on findings in Ireland, where the routine use of active management was associated with very low rates of cesarean delivery.[50] Protocols for active management included admission only when labor was established (painful contractions and spontaneous rupture of membranes, 100% effacement, or passage of blood-stained mucus); artificial rupture of membranes on diagnosis of labor; aggressive oxytocin augmentation for labor progress of less than 1 cm/hr with high-dose oxytocin (6 mIU/min initial dose, increased by 6 mIU/min every 15 minutes to a maximum of 40 mIU/min); and patient education.[50] Observational data suggested that this management protocol was associated with rates of cesarean delivery of 5.5% and delivery within 12 hours in 98% of women.[50] Only 41% of the nulliparas actually required oxytocin augmentation. Multiple nonrandomized studies were subsequently published attempting to duplicate these results in the United States and Canada.[51-54] Two of these reported a significant reduction in cesarean delivery when compared with historical controls.[51,53] However, in two of three randomized controlled trials (RCTs), there was no significant decrease in the rate of cesarean delivery with active compared with routine management of labor.[55,56] In the third RCT, the overall cesarean delivery rate was not significantly different; however, when confounding variables were controlled, cesarean delivery was significantly lower in the actively managed group.[54] In all randomized trials, labor duration was significantly decreased by a range of 1.7 to 2.7 hours, and neonatal morbidity was not different between groups. A recent Cochrane review concluded that early oxytocin augmentation in women with spontaneous labor was associated with a significant decrease in cesarean delivery. In addition, early amniotomy with oxytocin augmentation was associated with a significantly shortened labor.[57] Of note, amniotomy alone did not affect labor length or cesarean. This reduction in labor duration has significant cost and bed management implications, especially for busy labor and delivery units. Perhaps the most important factor in active management is delaying admission until active labor has been established.

Second Stage of Labor

Abnormal progress in fetal descent is the dystocia of the second stage. For practical purposes, second-stage durations of greater than 1 hour for multiparous women without an epidural, 2 hours for multiparous women with an epidural and nulliparous women without an epidural, and 3 hours for nulliparous women with an epidural identify women who are outliers, representing only 5% of women in these categories (see Table 13-2).[35] In nulliparous women vaginal delivery decreased, and chorioamnionitis, severe tears, and uterine atony increased significantly with second stages longer than 3 hours. However, neonatal outcome was not altered.[58] Although there is no indication that these limits should be used arbitrarily to justify ending the second stage, they identify a subset of women who require further evaluation.[58]

Other models include prospectively determined second-stage partograms in which the median second-stage lengths are similar to those outlined in Table 13-2.[59] Women with a prolonged second stage by these criteria should be evaluated for potential interventions. As with active labor, poor progress may be related to inadequate contractions; initiating oxytocin in the second stage may be effective if contraction frequency is diminished. If malposition is diagnosed, rotation to OA (either manually or by forceps) may be indicated in the second stage. If neither uterine forces nor fetal position are abnormal, the default diagnosis is cephalopelvic disproportion. No excess neonatal morbidity has been reported in association with a prolonged second stage in the absence of nonreassuring fetal heart rate tracings. Therefore, if steady progress is observed, there is no need for arbitrary time cut-offs.[60-64] In contrast, maternal morbidity, including perineal trauma, postpartum hemorrhage, and chorioamnionitis, is significantly higher in women with a second stage lasting longer than 2 or 3 hours.[58,64] However, it is important to note that performing an instrument-assisted vaginal delivery is unlikely to reduce perineal trauma and morbidity. If the fetal heart rate tracing is reassuring, continuing the second stage beyond 3 hours is reasonable. After 4 hours, the likelihood of vaginal delivery declines and maternal morbidity increases. The incidence of a vaginal delivery, including operative delivery, in nulliparous women with a second stage length of less than 2 hours, 2 to 4 hours, and longer than 4 hours is 98%, 81%, and 45%, respectively.[58]

Multiple factors influence the duration of the second stage, including epidural analgesia, nulliparity, older maternal age, longer active phase, larger birth weight, and excess maternal weight gain.[58,59] Modifiable factors that have been evaluated in the management of the second stage include maternal position, decreasing epidural analgesia (see Chapter 17), and delayed pushing. Two of three RCTs of decreased second-stage epidural analgesia found no difference in outcome or second-stage length.[65-67] One reported a decrease in second-stage length and operative delivery in the group that was randomized to reduced levels of epidural analgesia.[65] Epidural analgesia is clearly associated with an increased rate of operative delivery and associated perineal injury.[67,68] Delayed pushing has also been studied in nulliparas with epidural analgesia to determine if this strategy reduces the need for operative delivery, but little benefit has been demonstrated.[68-71] Only one trial reported a significant decrease in operative deliveries, and that was limited to midpelvic deliveries.[69] Conversely, the risk of delayed pushing appears to be negligible. Finally, the effect of maternal position has been evaluated.[72,73] Randomization to squatting using a birth cushion was associated with a significant reduction in operative deliveries and a significantly shorter second stage in nulliparas compared with delivery in the lithotomy position.[72] In a second trial randomizing women to either a routine delivery position or any upright position (squatting, kneeling, sitting, or standing per patient choice), no difference in operative deliveries was noted between groups but a significant increase in the percent of women with an intact perineum was noted in the upright group.[73] Therefore, allowing women to choose alternative positions during the second stage may be beneficial, especially in nulliparas.

SPONTANEOUS VAGINAL DELIVERY

Preparation for delivery should take into account the patient's parity, the progression of labor, fetal presentation, and any labor complications. Among women for whom delivery complications are anticipated (shoulder dystocia risk factors or multiple gestation), transfer to a larger and better equipped delivery room, removal of the foot of the bed, and delivery in the lithotomy position may be appropriate. If no complications are anticipated, delivery can be accomplished with the mother in her preferred position. Common positions include the lateral (Sims) position or the partial sitting position.

The goals of clinical assistance at spontaneous delivery are the reduction of maternal trauma, prevention of fetal injury, and initial support of the newborn, if required. When the fetal head crowns and delivery is imminent, gentle pressure should be used to maintain flexion of the fetal head and to control delivery, potentially protecting against perineal injury. Once the fetal head is delivered, external rotation (restitution) is allowed. If a shoulder dystocia is anticipated, it is appropriate to proceed directly with gentle downward traction of the fetal head before restitution occurs. During restitution, nuchal umbilical cords should be identified and reduced; in rare cases in which simple reduction is not possible, the cord can be doubly clamped and transected. **There is no evidence that DeLee suction reduces the risk of meconium aspiration syndrome in the presence of meconium; thus this should not be performed.**[74] The anterior shoulder should then be delivered by gentle downward traction in concert with maternal expulsive efforts. The posterior shoulder is delivered by upward traction. These movements should be performed with the minimal force possible to avoid perineal injury and traction injuries to the brachial plexus. The timing of cord clamping is usually dictated by convenience and commonly performed immediately after delivery. However, an ongoing debate exists about the benefits and risks of late cord clamping to the newborn. One meta-analysis of trials comparing late (greater than 2 minutes) to immediate cord clamping in term babies showed a significant increase in infant hematocrit, ferrintin, and stored iron levels at 2 to 6 months.[75] However, there was also a significant increase in neonatal polycythemia in the delayed group. After delivery, the infant should be wiped dry and kept warm while any mucus remaining in the airway is suctioned. Keeping the infant warm is particularly important, and, because heat is lost quickly from the head, placing a hat on the infant is appropriate. If possible all of these steps can best be done with the infant on the mother's abdomen.

DELIVERY OF THE PLACENTA AND FETAL MEMBRANES

The third stage of labor can be managed either passively or actively. Passive management is characterized by patiently waiting for the classic signs of placental separation: (1) lengthening of the umbilical cord, and (2) a gush of blood from the vagina signifying separation of the placenta from the uterine wall. In addition, two techniques of controlled cord traction are commonly used to facilitate separation and delivery of the placenta: the *Brandt-Andrews maneuver* (in which an abdominal hand secures the uterine fundus to prevent uterine inversion while the other hand exerts sustained downward traction on the umbilical cord) or the *Créde maneuver* (in which the cord is fixed with the lower hand while the uterine fundus is secured and sustained upward traction is applied using the abdominal hand). Care should be taken to avoid avulsion of the cord. Active management with uterotonic agents such as oxytocin administered at delivery hasten delivery of the placenta and may reduce the incidence of postpartum hemorrhage and total blood loss.[76] Conversely, other studies have shown no benefit to active management in the second stage.[77]

After delivery, the placenta, umbilical cord, and fetal membranes should be examined. Placental weight (excluding membranes and cord) varies with fetal weight, with a ratio of approximately 1 : 6. Abnormally large placentae are associated with such conditions as hydrops fetalis and congenital syphilis. **Inspection and palpation of the placenta should include the fetal and maternal surfaces and may reveal areas of fibrosis, infarction, or calcification.** Although each of these conditions may be seen in the normal term placenta, extensive lesions should prompt histologic examination. Adherent clots on the maternal placental surface may indicate recent placental abruption; however, their absence does not exclude the diagnosis. A missing placental cotyledon or a membrane defect (suggesting a missing succenturiate lobe) suggests retention of a portion of placenta and should prompt further clinical evaluation. There is no need for routine manual exploration of the uterus after delivery unless there is suspicion of retained products of conception or a postpartum hemorrhage.

The site of insertion of the umbilical cord into the placenta should be noted. Abnormal insertions include marginal insertion (in which the cord inserts into the edge of the placenta) and membranous insertion (in which the vessels of the umbilical cord course through the membranes before attachment to the placental disk). The cord itself should be inspected for length, the correct number of umbilical vessels (normally two arteries and one vein), true knots, hematomas, and strictures. The average cord length is 50 to 60 cm. A single umbilical artery discovered on pathologic examination is associated with other fetal structural anomalies in 27% of cases.[78,79] Therefore, this finding should be relayed to the attending neonatologist or pediatrician. Any abnormalities of the placenta or cord should be noted in the mother's chart.

EPISIOTOMY, PERINEAL INJURY, AND PERINEAL REPAIR

Following delivery of the placenta, the vagina and perineum should be carefully examined for evidence of injury. If a laceration is seen, its length and position should be noted and repair initiated. Adequate analgesia (either regional or local) is essential for repair. Special attention should be paid to repair of the perineal body, the external anal sphincter, and the rectal mucosa. Failure to recognize and repair rectal injury can lead to serious long-term morbidity, most notably fecal incontinence. The cervix should be inspected for lacerations if an operative delivery was performed or if there is significant bleeding with or after the delivery.

Perineal injuries, either spontaneous or with episiotomy, are the most common complications of spontaneous or operative vaginal deliveries. **A first-degree tear is defined as a superficial tear confined to the epithelial layer and may**

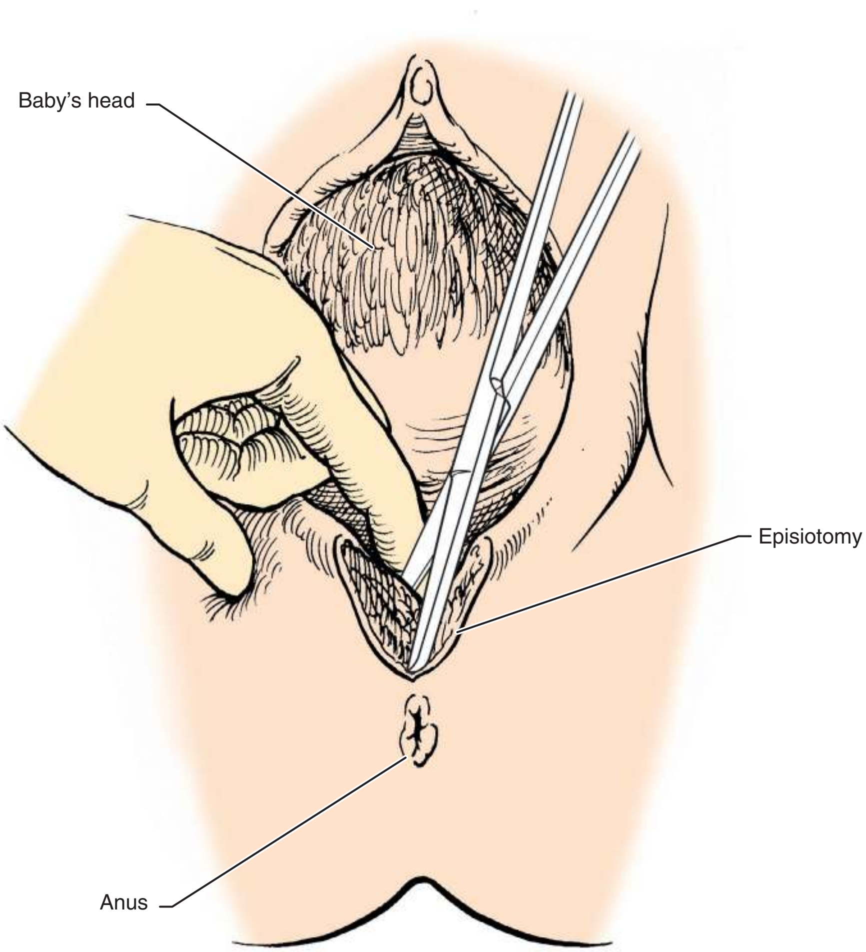


FIGURE 13-15. Cutting a midline episiotomy.

or may not need to be repaired generally depending on amount of bleeding. Second-degree tears extend into the perineal body, but not into the external anal sphincter. Third-degree tears involve superficial or deep injury to the external anal sphincter, whereas a fourth-degree tear extends completely through the sphincter and the rectal mucosa. All second-, third-, and fourth-degree tears should be repaired. Significant morbidity is associated with third- and fourth-degree tears, including risk of flatus and stool incontinence, rectovaginal fistula, infection, and pain. Primary approximation of perineal lacerations affords the best opportunity for functional repair, especially if there is evidence of rectal sphincter injury. The external anal sphincter should be repaired by direct apposition or overlapping the cut ends and securing them using interrupted sutures.

Episiotomy is an incision into the perineal body made during the second stage of labor to facilitate delivery. It is by definition a second-degree tear. Episiotomy can be classified into two broad categories: median (midline) and mediolateral. Median episiotomy refers to a vertical midline incision from the posterior forchette toward the rectum (Figure 13-15). After adequate analgesia, either local or regional, has been achieved, straight Mayo scissors are generally used to perform the episiotomy. Care should be taken to displace the perineum from the fetal head. The size of the incision depends on the length of the perineum but is generally approximately half of the length of the perineum and should be extended vertically up the vaginal mucosa for a distance of 2 to 3 cm. Every effort should be made to avoid direct injury to the anal sphincter. **Complications of median episiotomy include increased blood loss (especially if the incision is made too early), fetal injury, and localized pain.** With a mediolateral episiotomy, the incision is made at a 45-degree angle from the inferior portion of the hymeneal ring (Figure 13-16). The length of the incision is less critical than with median episiotomy, but longer incisions require lengthier repair. The side to which the episiotomy is performed is usually dictated by the dominant hand of the practitioner. Because such incisions appear to be moderately protective against severe perineal trauma, they are the procedure of choice for women with inflammatory bowel disease, if an episiotomy is needed, because of the critical need to prevent rectal injury. Historically, it was believed that episiotomy improved outcome by reducing pressure on the fetal head, protecting the maternal perineum from extensive tearing, and subsequent pelvic relaxation. However, consistent data since the late 1980s confirm that midline episiotomy does not protect the perineum from further tearing and data do not show that episiotomy improves neonatal outcome.[64,80,81] Midline episiotomy was associated with a significant increase of third- and fourth-degree lacerations in spontaneous vaginal

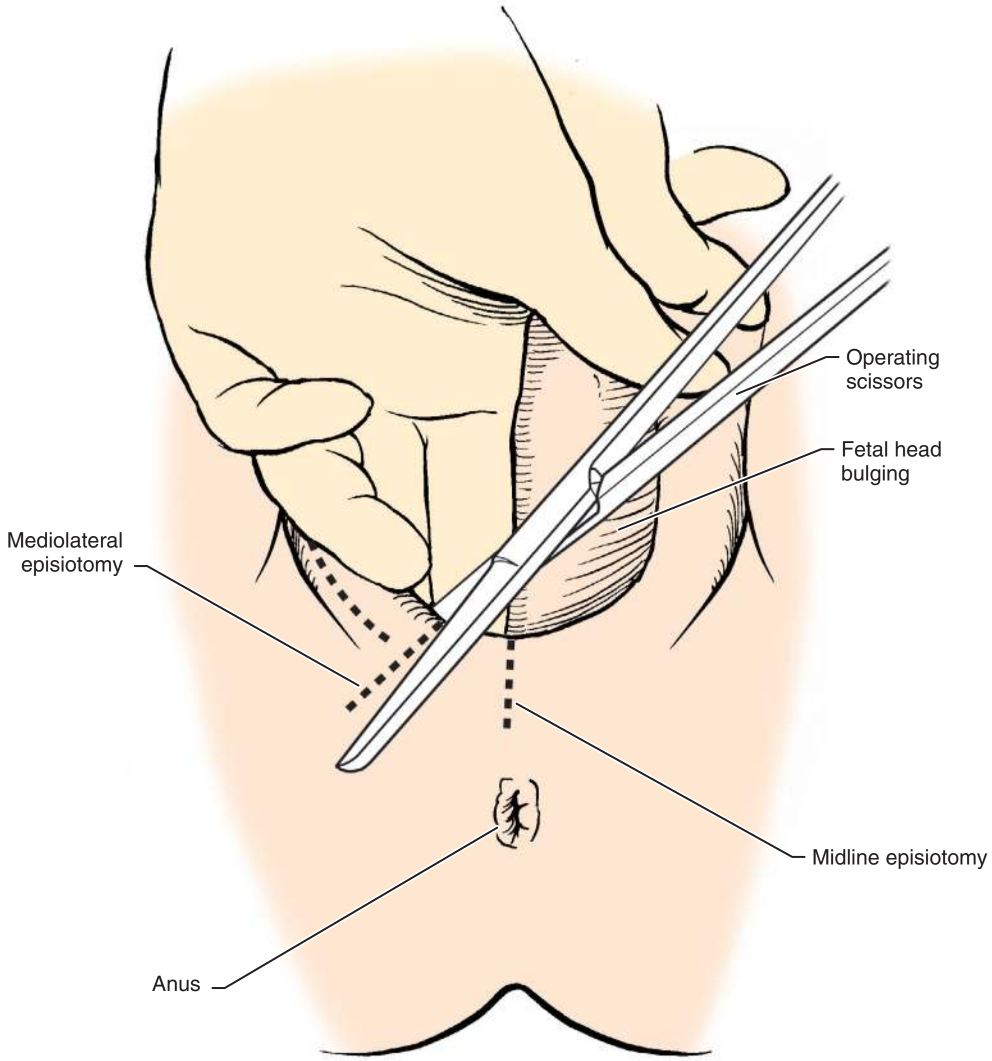


FIGURE 13-16. Cutting a mediolateral episiotomy.

delivery in nulliparous women with both spontaneous and operative vaginal delivery.[81-87] Episiotomy had the highest odds ratio (OR 3.2; CI 2.73-3.80) for anal sphincter laceration in a large study of nulliparous women when compared to other risk factors, including forceps delivery.[88] Fewer papers reported that midline episiotomy was associated with no difference in fourth-degree tears compared to no episiotomy.[89] **Based on the lack of consistent evidence that episiotomy is of benefit, there is no role for routine episiotomy in modern obstetrics.**[80,81,90,91] In fact, a recent evidence-based review recommended that episiotomy should be avoided if possible, based on U.S. Preventive Task Force quality of evidence.[48] Based on these data and ACOG recommendations,[91] rates of midline episiotomy have decreased, although episiotomies are performed in 10% to 17% of deliveries, suggesting that elective episiotomy continues to be performed.[83,92] Decreasing episiotomy rates from 87% in 1976 to 10% in 1994 were associated with a parallel decrease in the rates of third- or fourth-degree lacerations (9% to 4%) and an increase in the incidence of an intact perineum (10% to 26%).[83] Randomized trials comparing routine to indicated use of episiotomy report a 23% reduction in perineal lacerations requiring repair in the indicated group (11% to 35%).[92] Finally, a recent Cochrane review of eight randomized trials comparing restrictive to routine use of episiotomy showed a significant reduction of severe perineal tears, suturing, and healing complications in the restrictive group.[93] Although the restrictive episiotomy group had a significantly higher incidence of anterior tears, there was no difference in pain measures between the groups. All of these findings were similar whether median or mediolateral episiotomy was used.

The relationship of episiotomy to subsequent pelvic relaxation and incontinence has been evaluated, with no studies suggesting that episiotomy reduces risk of incontinence. Clearly, fourth-degree tears are associated with future incontinence.[94] Neither midline nor mediolateral episiotomy was associated with a reduction in incontinence.[95] **Therefore, there are no data to suggest that episiotomy protects the woman from later incontinence and avoidance of fourth-degree tear should be a priority.**

If an episiotomy is deemed indicated, the decision of which type to perform rests on their individual risks. It does appear that mediolateral episiotomy is associated with fewer fourth-degree tears compared to median episiotomy.[96-98] However, other studies do not show benefit of mediolateral over median for future prolapse.[95] Chronic complications such as unsatisfactory cosmetic results and inclusions within the scar may be more common with mediolateral episiotomies, and blood loss is greater. Finally, it must be remembered that neither episiotomy type has been shown to reduce severe perineal tears compared to no episiotomy.

Although there is no role for routine episiotomy, indicated episiotomy should be performed in select situations and providers should receive training in the skill.[89] Indications for episiotomy include the need to expedite delivery in the setting of fetal heart rate abnormalities or for relief of shoulder dystocia.

KEY POINTS

- Labor is a clinical diagnosis that includes regular painful uterine contractions and progressive cervical effacement and dilation.
- Active labor is diagnosed as the time when the slope of cervical change increases, which is more difficult to identify in nulliparas.
- Active labor and latent labor should be managed differently.
- The fetus likely plays a key role in determining the onset of labor, although the precise mechanism by which this occurs is not clear.
- The ability of the fetus to successfully negotiate the pelvis during labor and delivery is dependent on the complex interaction of three variables: uterine force, the fetus, and the maternal pelvis.
- Labor length is affected by many variables, including parity, epidural use, fetal position, fetal size, and BMI.
- Routine median episiotomy is associated with a significant increase in the incidence of severe perineal trauma and should be avoided.

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