First-stage labor revisited

To allow the passage of the fetus, the cervix must vanish completely, accomplished by effacement and dilatation. These clinical phenomena are consecutive manifestations of one and the same process: the incorporation of the cervix into the lower segment of the uterus. In effective labor, the previously softened cervix first effaces completely (full effacement), followed by progressive dilatation until it has disappeared completely (full dilatation). From this point the uterus, its lower segment, and the vagina form a single open tube through which the baby can be born.

9.1 Normal pattern of dilatation

Current teaching and theoretical understanding of normal dilatation rates is still dominated by the work of Friedman, who deserves credit for being the pioneer in this field of research more than 50 years ago, but whose conclusions were actually incorrect. Friedman arbitrarily divided first-stage labor into three artificial sections – from 0 to 3 cm, from 3 to 8 cm, and from 8 cm to full dilatation – and subsequently analyzed these sections statistically, a novelty in those days. As a result he described a characteristic pattern for labor when cervical dilatation is graphed against time: “[The average dilatation curve] takes on the shape of a sigmoid curve: a relatively flat latent phase, followed by the acceleration phase, a steep phase of maximum slope, and ending in a deceleration phase.”

9.1.1 The Friedman doctrine defeated

Unfortunately, this classic Friedman curve is still reproduced today in most textbooks as the reference curve of “normal labor” in spite of its invalidity. Firstly, Friedman’s study population included patients with breech presentation, twins, oxytocin, heavy sedation, and a high rate of forceps delivery, and thus did not represent a “normal labor and delivery” population. Secondly, labor and delivery times do not follow a normal distribution, indicating that the use of parametric statistics (means) – as Friedman did – is not correct; it falsely lengthens the duration of labor, and the separate analysis of artificial sections gives the illusion of a sigmoid dilatation curve.

The sigmoid curve for normal dilatation is one of the many mistaken but persistent sacred concepts of conventional obstetrics and midwifery.

9.1.2 Fundamental reassessment

It was Charles Hendricks and co-workers who demonstrated significant differences between labors in practice and the description of labor found in most textbooks, dividing first-stage labor into a latent phase and an active phase. They also noted a large body of evidence in the obstetric literature on normal progression in dilatation which was at wide variance with the standard textbook
They boldly challenged and successfully disproved one of the sacred concepts of conventional obstetrics: Friedman’s sigmoid reference curve for normal dilatation. Their principal differences include:

1. Absence of a latent phase
2. Brevity of normal labor
3. No deceleration phase in normal labor

Hendricks and co-workers justifiably disputed the methodology of Friedman’s classic study: Friedman had divided each labor artificially into sections and extrapolated the onset of labor back to zero dilatation at time zero and subsequently the means of each section were derived. By arbitrarily dividing the data, extrapolating back, and obtaining means, a sigmoid curve was derived that does not represent the mean course of normal cervical dilatation time. It masks the true nature of normal dilatation – which is actually linear – and tends to be far too long in the initial part (the so-called “latent phase”). As Hendricks convincingly demonstrated, most women go into labor with an already effaced cervix, and the average dilatation of nulliparas at the onset of labor is actually 2.5 cm, while that of multiparas is 3.5 cm. He rightly disputed the very existence of a latent phase, because he carefully observed in his study that contractions in late pregnancy may come and go, and that effacement and incipient dilatation – presumed to be typical of the latent phase of labor – actually occur during the final four weeks before women go into clinical labor. In fact, labor is considerably longer when a latent phase is included. Even worse, primary dysfunctional labor is often misconstrued as “latent labor,” preventing adequate treatment of early labor disorders (Chapters 15, 17, 21).

9.1.3 The fallacy of the latent phase

Clearly, the so-called latent phase of first-stage labor is poorly understood and differentiating between a prolonged latent phase and false labor is difficult, if possible at all. In fact, such a distinction is only possible in retrospect. The mean duration of the latent phase – defined by Friedman to begin at the moment regular contractions occur and to end at 3 cm dilatation, at which point an acceleration of cervical dilatation is noted – was 8.6 hours (+2 SD 20.6 hours) for first labor and the range was 1–44 hours with a maximum of 20 hours still accepted as statically normal (sic!). Little wonder that a long “latent phase” of labor is strongly associated with poor labor outcomes: more fetal distress, undue maternal exhaustion, more interventions, and more surgical deliveries.

9.1.4 Defining the beginning of labor

Most caregivers diagnose the beginning of labor – in accordance with Friedman’s vague definition – on the degree of discomfort associated with regular and painful contractions, while the significance of complete effacement for the diagnosis of labor is generally overlooked (Chapter 14). Williams Obstetrics states that with intact membranes and painful contractions, a cervical dilatation of at least 3–4 cm should be used to confirm labor and should serve as a convenient starting point of labor management. Such an approach would mean that labor cannot be reliably determined until most if not all the alleged “latent phase” has been completed. This sentiment is echoed in the ACOG bulletin on dystocia (2003), which avoids discussing the “latent phase” entirely and “focuses on labor subsequent to entering the active phase . . .” These contents leave the care provider with no current
guidelines for the approach of the alleged latent phase. As a result, most providers continue to use Friedman’s original classification system with all the associated vagueness and clinical indecisiveness during “latent labor.” For years, and even still today, the arbitrary concept of the latent phase provided the vague theoretical basis and false justification for the expectant attitude in early labor and the reluctance to perform amniotomy if early (“latent”) labor is slow. Clearly, the greatest challenge in the supervision of labor is recognizing its start (Chapter 14), and the concept of the “latent phase” of labor in particular has prevented progress in the conduct of labor for a very long time (see also Chapter 11).

9.1.5 Duration of normal labor

Our perception of the normal duration of first-stage labor may be clouded not only by the fallacious concept of the latent phase but also by the many clinical variables that affect the conduct of labor and the many routine measures and interventions that interrupt the natural course of labor in modern maternity units, such as induction, augmentation, sedation, and epidural analgesia.

Hendricks was the first to suggest that the duration of labor be measured from the time of admission to a delivery unit. Since then most studies on the timing of providing labor care and timing of labor interventions accordingly define the onset of labor as the time when the patient is admitted to the labor ward. This works extremely well, provided that strict criteria for admission are used, such as those promulgated by O’Driscoll and co-workers. Their criteria include painful contractions associated with any one of the following: ruptured membranes, bloody show, or complete effacement. These criteria for the diagnosis of labor will be addressed extensively in Chapter 14.

In nature, normal labor and delivery take any female of any mammalian species less than half a day (Chapter 7) and the human species is no exception: normal labor is short. In the 1970 study of Hendricks et al., the average time from admission to full dilatation was shown to be 4.8 hours for nulliparas and 3.2 hours for multiparas. Moreover, cervical dilatation progressed in a straight line. These findings were similar in all other studies on normal labor. For example, spontaneous labor was analyzed in 25 000 women who delivered at term in the Parkland Hospital in Dallas, Texas, in the early 1990s. Labor and delivery times did not follow a normal distribution. Parity (nulliparous or multiparous) and cervical dilatation on admission were significant determinants of the length of spontaneous labor. The median time from admission to spontaneous delivery was 3.5 hours and 95% of all women delivered within 10.1 hours. These results provide the ironclad evidence that normal human labor is relatively short for both nulliparas and multiparas, despite contradicting views by traditional midwives and conventional obstetricians. Proactive support of labor adheres to the strong evidence that normal dilatation progresses at least 1 cm/h from the very onset and most often much faster (Chapter 15). Expert labor care rests on the anticipation and proactive assurance of this normal dilatation rate (Section 3).

Normal labor is short: 95% of all women who deliver their babies spontaneously complete their labor and delivery within 10 hours (Evidence level B).

9.1.6 No deceleration phase

The Friedman curve is incorrect at both ends. When patients with dysfunctional labor are included in the computation of a reference dilatation curve, that graph inevitably tends to flatten out in its final proportion. The Friedman curve thus computed, while indeed being the mean dilatation...
curve, is not representative of the mean normal cervical dilatation curve. In actual practice, a sigmoid pattern of dilatation is hardly ever seen in normal labor. Proper non-parametric statistical analysis reveals a continuously accelerating dilatation rate without a final decelerative phase in normal labor. Normal dilatation proceeds at least in a straight line. Several reference labor graphs have been published since the work of Friedman, and the principal difference between these graphs is contingent on when labor is determined to begin. When labor is diagnosed at admission on the basis of strict criteria, rather than with onset of regular contractions, a remarkable similarity of individual labor curves becomes apparent. When a latent phase is excluded, dilatation proceeds in a straight line to full dilatation. The ACOG Task Force on Cesarean Delivery respectfully concluded a systematic review of the relevant literature with the understatement that “the Friedman curve may not be as applicable today as it once was thought to be.”

When graphed against time, normal dilatation proceeds in a straight line (Evidence level B).

9.2 Dynamics and mechanics of first-stage labor

While there may be many questions regarding the clinical definition, the relevance, and the very existence of the latent phase of labor, and while the rate of dilatation usually accelerates rather than decelerates when approaching full dilatation, an astute understanding of the classical distinction between the maximum slope and the deceleration phase of dilatation remains of critical importance for comprehension of the dynamics and mechanics of difficult labor.

9.2.1 Wedging action through descent

In order for first-stage labor to be successful, uterine force must be effectively transmitted to the cervix, for which the presenting fetal part – functioning as a blunt wedge – must be adequately applied to the cervical dilatation ring (Chapter 8). The pushing force is transmitted through the bulging amniotic sac or, in the case of ruptured membranes, directly by the fetal head. In order to maintain functional wedging action once dilatation has reached about 7–8 cm, the presenting fetal part must descend. Molding and formation of caput succedaneum additionally encourage adequate lock and impact on the dilatation ring, facilitating further dilatation. Descent and adequate impact of the fetal head are needed for proper wedging action to complete the last centimeters of dilatation.

Initially, descent of the fetal head is not a factor for the progress of dilatation. However, progress of the last centimeters to full dilatation surely requires descent of the presenting part.

9.2.2 Retraction phase and wedging (descent) phase of first-stage labor

On these physical grounds the first stage of labor is best subdivided into two phases with its transition at about 7 cm (Fig. 9.1). The defining nomenclature is open to debate. We prefer the terms retraction phase and wedging phase because the former emphasizes the explicit role of uterine force at that point, and the latter emphasizes the combined roles of force and mechanical cephalopelvic proportions in that phase. Other options could be the initial dynamic phase followed at about 7 cm by the mechanical phase, or descent phase, or pelvic phase of first-stage labor. What label one prefers is not really important. The crucial point is that in the context of the dynamics and mechanics of birth, two distinct phases can and must be distinguished in the first stage of labor, with transition at about 7 cm and its completion at the onset of the irresistible reflex to bear down (Fig. 9.1).

The physical distinction between the retraction phase and the wedging phase in first-stage labor
has significant clinical relevance in difficult labor only. While in normal labor the transition from retraction phase into wedging phase typically goes unnoticed, the existence of the wedging phase becomes clinically manifest in abnonormal labor, when dilatation has been satisfactory in the retraction phase up to about 7–8 cm but starts to decelerate or even stagnates after that point. This is called secondary protraction, or secondary failure to progress, and eventually secondary arrest (Chapter 21).

The first stage of labor is subdivided into the “retraction phase” and the “wedging phase.” The transition at 7–8 cm becomes apparent in abnormal labor only through a deceleration in dilatation rate.

9.2.3 Relationship between dilatation and descent

Lessons should be learned from observations in the nineteenth century, when pelvic deformations caused by rickets were endemic and hydrocephaly remained undetected until birth. In instances when the fetal head could not possibly descend because of an absolute anatomical obstruction, dilatation actually progressed readily to about 7–8 cm, but at that point progress of labor definitively arrested.\textsuperscript{12,13} It follows that in the retraction phase, it is uterine force and cervical resistance that are the key factors for labor progress. There is still no relationship between the degree of descent and the speed of the first 7 cm of dilatation (Fig. 9.1). The conclusion must be that slow progress in the retraction phase is not at all indicative of fetopelvic disproportion; slow progress of the first 7–8 cm is the result of ineffective uterine force and must be treated accordingly. However, the achievement of the last centimeters of dilatation requires the continuation of adequate wedging, which requires descent (and compliance) of the presenting fetal part, which in turn requires force. The clinical significance of this is that a genuine cephalopelvic disproportion will manifest itself only in the wedging phase in the form of a secondary arrest of dilatation at about 7–8 cm. Labor arrest due to cephalopelvic disproportion (CPD) will never occur prior to the wedging phase and rarely later. Nonetheless, nowadays insufficient uterine force is still the most likely cause of secondary protraction in first labors – even at this late juncture – and must therefore be treated accordingly (Chapter 21). A reliable diagnosis of CPD cannot be established before the wedging phase of labor and never without forceful contractions (Chapter 22). In first labors, this diagnosis usually requires the use of oxytocin (Chapters 15, 17).

The only phase in which the mechanical cephalopelvic relationships play a role in the progression of birth is the wedging phase of the first stage of labor: from 7–8 cm dilatation to the natural start of expulsion when the head is fully engaged; never earlier and rarely later.
9.2.4 Fetal adaptations to negotiate the birth canal

While descent requires force, the ability of the fetal head to descend also depends upon cephalopelvic proportions. While the pelvic dimensions are essentially static, those of the fetal head are not. The largest diameter entering the pelvis is determined by the head’s absolute size, its ability to mold, and the fetus’s ability to bend its neck (flexion). In case of relatively unfavorable cephalopelvic proportions even extreme hyperflexion occurs so that the fetus presents the smallest diameter of its head (suboccipito-bregmatic diameter) and the smaller posterior fontanel is presented centrally in the pelvic axis (extreme hyperflexion). The largest head diameter to enter the pelvis is made as small as necessary by flexion or as possible by extreme hyperflexion. Adaptation of the fetal head to negotiate the birth canal requires uterine force. This is a reciprocal phenomenon: substantial caput succedaneum formation, molding, and extreme hyperflexion offer clinical proof that uterine contractions are (or have been) forceful during the wedging phase. The reverse is also true: failure to descend and to achieve complete dilatation in the absence of these clinical signs indicates that uterine force is insufficient and must be treated accordingly (Chapter 21).

Caput succedaneum, molding, and extreme hyperflexion of the fetal head are manifestations of uterine force.

9.3 Natural threshold between first- and second-stage labor

At the beginning of the wedging phase (at about 7 cm) the head is still relatively high in the pelvis (Fig. 9.1) and the occiput is in the transverse or diagonal position (Fig. 10.2 in the next chapter). The vagina is not yet stretched. Normally, the fetal head only then begins to descend, facilitating progression of dilatation until completion. Neither the laboring woman nor her attendants are aware of any significant change at that point. Indeed, the fact that the cervix has reached full dilatation would pass entirely unnoticed unless a chance vaginal examination is performed at this juncture.

9.3.1 Misleading and obsolete definition

Unfortunately, leading textbooks still mark full dilatation as the beginning of the second stage of labor.7,14 This persistent fallacy is based on the obsolete mechanistic view of birth that goes back to the nineteenth century when nothing could be done to improve uterine performance and cesarean section was life-threatening to the mother. For these reasons the approach to slow labor was expectant by default and, eventually, full dilatation marked the point from which difficult labor could be resolved by instrumental vaginal delivery.

9.3.2 Natural demarcation point

Full dilatation is not an end in itself nor is it a natural demarcation line between the first and the second stages of labor. In nature, no laboring mammal knows when she is fully dilated and neither do women who deliver their babies spontaneously without professional attendance (in global perspective, the great majority until recently). Every parturient does, however, invariably notice the often cataclysmic sensation provoked by the descending fetal head the moment it applies pressure to her pelvic floor. This arouses an uncontrollable reflex that compels her to bear down. Evidently, the second stage of labor naturally begins at the moment the irresistible pushing reflex is activated, not earlier. This occurs when the fetal head reaches at least the level of the ischial spines to which the levator muscle is attached (0-station). True reflexive expulsion action is mostly stimulated when the fetal head reaches the pelvic floor, applying pressure on the lower rectum. An inclination to push when the head is still above 0-station should always be regarded with suspicion (Chapter 21).
It is not full dilatation that is the natural demarcation line between the first and second stages of labor, but the occurrence of the reflexive, irresistible urge to push after full dilatation has been reached.

An adequate pelvic inlet almost invariably implies an adequate midpelvis and a normal pelvic outlet. As soon as the true expulsion reflex occurs, the fetal head is fully engaged, meaning that its largest diameter has already well passed the pelvic inlet and the entire fetal skull is in the pelvis, making the rest of the birth a matter of pure expulsive force and resistance of the pelvic soft tissues (Chapter 10). This is the true second stage of labor. The natural threshold is the occurrence of the irresistible pushing reflex after full dilatation has been reached and not earlier. As isolated pelvic outlet contraction is exceedingly rare, cephalo-pelvic proportions no longer play a decisive role in the true expulsion stage for the successful conclusion of birth (Chapter 10); a safe vaginal delivery is a near-certain possibility. Thus, the mechanical or pelvic phase of labor, in which passenger-to-passage relationships are decisive factors for progress of labor, represents the last phase of the first stage (wedging phase) and does not transgress into the (properly defined) second stage of labor (Fig. 9.1).

9.3.3 Clinical implications

Although complete dilatation often coincides with the initiation of the woman’s reflex to bear down, this is not always the case. If the woman still feels no urge to push after reaching full dilatation, she is still in the first stage of her labor. She should not be encouraged to bear down at this point, because pushing in the first stage of labor results in an unnecessarily long expulsion effort, leading to exhaustion of the mother and instrument-assisted delivery. Continued absence of the pushing reflex at full dilatation is a problem in the first stage of labor and must be treated accordingly. The first step in nulliparous labor is augmentation of labor using oxytocin, and when this fails to give the desired effect, a cesarean section is the only safe option (Chapters 17, 21, 22).

Any interval between a chance assessment of full dilatation and the onset of the irresistible pushing reflex still belongs to the first stage of labor.

The traditional tenet that marks full dilatation as the beginning of the second stage may have rather unfortunate consequences for women. Too many obstetricians still regard full dilatation as the demarcation line between an abdominal and a vaginal delivery. Whenever there is a need for intervention at this juncture, an instrument-assisted delivery is all too often viewed as a permissible procedure, not to mention a challenge to the obstetrician’s manual dexterity. This approach must change. Traction with forceps or vacuum extractor before the natural and true second phase of labor has begun can be genuinely traumatic for both child and mother, because the head is still high, with its largest diameter at or above the pelvic inlet, and the vaginal wall and pelvic floor are yet to be stretched. For this reason, one should never attempt to force a vaginal delivery by instrumental traction in first-stage labor, even if the cervix is fully dilated. Whenever the need for an urgent delivery arises with a fetal head at high station, it should be done by a cesarean.

Attempts at vacuum or forceps delivery late in the first stage of labor are evidence of an archaic mechanistic view of birth. This practice must be renounced.

9.3.4 The evidence

Strong clinical evidence supports our redefinition for the onset of second-stage labor. A large randomized, multicenter study (n = 1862) documented that delayed pushing is an effective means of reducing “difficult deliveries” in nulliparous women. The relative risk (RR) was 0.79 with a 95% confidence interval (CI) between 0.66 and 0.95.
The greatest effect was on midpelvic operative vaginal deliveries (RR = 0.72; 95% CI 0.55–0.93).

Waiting for deep descent and the natural expulsion reflex to occur before commencement of active pushing reduces instrumental deliveries (Evidence level A).

9.4 Labor dynamics versus labor mechanics

Since the social conditions that gave rise to rickets were eradicated almost a century ago, nearly all women in the post-industrialized world now have a normally shaped pelvis. For this reason, failure to progress is nearly always a result of insufficient uterine force and/or a lack of remaining expulsive force. Today, true CPD is exceedingly rare (much less than 1%, Chapters 22 and 29). This fact is demonstrated on a daily basis when a fetus is born vaginally with the aid of traction or when the mother – given the chance – spontaneously delivers an equally large or even larger child on a subsequent birth. If a baby can be safely delivered by instrumental traction, then it also, in principle, should have been possible by propulsion, provided the woman had enough strength left.

If a woman’s pelvis is truly too small, she will not even reach the expulsion stage.

From what has been discussed thus far, it is clear that it is not so much the mechanical cephalopelvic proportions that determine whether or not spontaneous delivery will occur, but rather the dynamic factors, i.e., effective force. In addition, the relationship between the physical and emotional exertion of the woman and her endurance determines the remaining power available for the successful conclusion of birth by expulsion. This epitomizes the importance of a tolerable and therefore short first stage of labor.

In conclusion: the most important physical factor in labor is the ratio of force to resistance that must be overcome at the various phases and stages of labor and delivery. This holds for both stages of the birthing process. The mechanical proportions between the size of the fetal head and the bony pelvis play a role in the wedging phase of first-stage labor only. The resistance in the correctly defined second stage of labor consists only of soft pelvic tissues (Chapter 10). In summary:

Physical factors determining the progression of labor

<table>
<thead>
<tr>
<th>FIRST STAGE</th>
<th>Dynamic factors:</th>
<th>Mechanics: (in wedging phase only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(in both retraction and wedging phases)</td>
<td>– Uterine force</td>
<td>– Pelvic size and structure</td>
</tr>
<tr>
<td></td>
<td>– Cervical resistance</td>
<td>– Dimensions and attitude of the fetal head</td>
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<td></td>
<td>– Transmission of force onto the cervix</td>
<td>– Compliance of the fetal head</td>
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| SECOND STAGE | Dynamic factors: | – Force from the abdominal muscles |
| | – Uterine force | – Resistance of the pelvic soft tissues |

The architecture of the bony pelvis is not the factor, with rare exceptions, that limits vaginal delivery (Chapters 21, 22). The most common cause of secondary protraction and arrest disorders in nulliparous labor is insufficient uterine force (Chapter 21), whereas in multiparas it is mechanical obstruction caused by malposition or relative macrosomia (Chapter 22). The fundamental differences between nulliparous and parous labor will be further elaborated in Chapter 13.

9.5 Summary

- The sigmoid Friedman curve as reference for a normal dilatation pattern is based on arbitrary
hypotheses, dubious extrapolations, a miscellaneous population, and erroneous statistics, and is thus incorrect.

- The hypothetical concept of the latent phase of labor has no clinical relevance, is deluding, and should be discarded.
- If graphed against time, normal dilatation proceeds in a straight line.
- Normal labor is short.
- In most cases, it is not so much the mechanical fetopelvic proportions that determine the physiological or pathological course of labor. Rather it is the dynamic interaction between uterine force and the resistance of the cervix and the soft birth canal.
- Although both traction and wedging action contribute to dilatation, there is a clear distinction between the retraction phase (dilatation up to 7–8 cm) and the wedging phase (the final centimeters until the arousal of the reflexive urge to push).
- In the retraction phase adequate uterine force is the sole factor of labor progress, while in the wedging phase it is uterine force in relation to fetopelvic mechanical proportions.
- True fetopelvic disproportion manifests itself only in the wedging phase of first-stage labor through a secondary arrest, never earlier and seldom later.
- The threshold between the first and second stages of labor is redefined: the deciding criterion is not full dilatation but the onset of the irresistible pushing reflex after full dilatation has been achieved.
- The architecture of the bony pelvis is not the factor, with very rare exceptions, that limits vaginal delivery once the natural second stage of labor has been attained.

REFERENCES