Chapter 1

Pelvic and Fetal Cranial Anatomy and the Stages and Mechanism of Labour

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Introduction

Labour or parturition is the culmination of a period of pregnancy whereby the expulsion of fetus, amniotic fluid, placenta and membranes takes place from the gravid uterus of a pregnant woman. In a woman with a regular 28-day cycle, labour is said to take place 280 days after the onset of the last menstrual period. However, the length of human gestation varies considerably among healthy pregnancies, even when ovulation is accurately measured in naturally conceiving women [1].

Successful labour passes through three stages: the shortening and dilatation of the cervix; descent and birth of the fetus; and the expulsion of the placenta and membranes. Efficient uterine contractions (power), an adequate roomy pelvis (passage) and an appropriate fetal size (passenger) are key factors in this process.

Anatomy of the Female Pelvis

The bony pelvis consists of the two innominate bones, or hipbones, which are fused to the sacrum posteriorly and to each other anteriorly at the pubic symphysis. Each innominate bone is composed of the ilium, ischium and pubis, which are connected by cartilage in youth but fused in the adult (Figure 1.1). The pelvis has two basins: the major (or greater) pelvis and the minor (or lesser) pelvis. The abdominal viscera occupy the major pelvis and the minor pelvis is the narrower continuation of the major pelvis. Inferiorly, the pelvic outlet is closed by the pelvic floor.

The female pelvis has a wider diameter and a more circular shape than that of the male. The wider inlet facilitates engagement of the fetal head and parturition. Numerous projections and contours provide attachment sites for ligaments, muscles and fascial layers. This distinctive shape of the human pelvis is probably not only the result of an adaptation to a bipedal gait, but also a result of the need for a larger birth canal for a human fetus with a large brain [2].

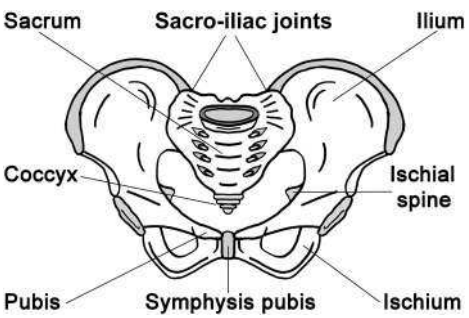

Figure 1.1 Bony female pelvis.

The female pelvis is tilted forwards relative to the spine and described as the deviation of the pelvic inlet from the horizontal in the sagittal plane. The pelvic 'tilt' or angle of inclination is measured as an angle between the line from the top of the sacrum to the top of the pubis, and a horizontal line in a standing radiograph (Figure 1.2).

The pelvic tilt is variable between different individuals and between different races; in adult Caucasian females the pelvis is usually about 55° to the horizontal plane. It is also position-dependent and increases with growth into adulthood [3].

Based on the characteristic of the pelvic inlet, it is classified into four basic shapes: the round (gynaecoid), the wedge-shaped (android), the longitudinal oval (anthropoid) and the transverse oval (platypelloid) type of inlet (Figure 1.3). However, a large

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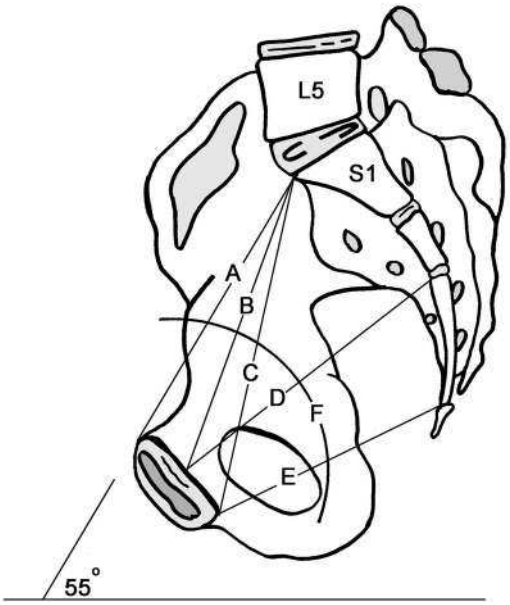

Figure 1.2 Sagittal section of the pelvis with 55° inclination. A: anatomical conjugate, B: obstetric conjugate; C: diagonal conjugate; D: mid-cavity; E: outlet; F: pelvic axis.

number of pelves appear to conform to intermediate shapes between these extreme types [4].

The true pelvis is a bony canal, through which the fetus must pass, and has three parts: the inlet, the pelvic cavity and the outlet. The pelvic inlet is bounded anteriorly by the pubic crest and spine; posteriorly by the promontory of the sacrum and ala; and laterally by the ilio pectineal line. In an adequately sized pelvis the inlet's diameter antero-posteriorly is usually more than 12 cm, and the transverse diameter is 13.5 cm.

The antero-posterior diameter of the pelvic *inlet* is also known as the true or anatomical conjugate. However, clinically the fetus must pass through the obstetric conjugate, which is the line between the promontory of the sacrum and the innermost part of the symphysis pubis, which is usually more than 10 cm. The conjugate that can be measured clinically is the diagonal conjugate, which is the line between the sacral promontory and the lowermost point of the symphysis pubis. This is about 1.5–2 cm greater than the obstetric conjugate (Figure 1.2).

The *mid-cavity* is a curved canal with a straight and shallow anterior wall which is the pubis. The posterior wall is bounded by the deep and concave sacrum and laterally by the ischium and part of the ilium. In the mid-cavity both antero-posterior (AP) and transverse diameters are usually approximately 12.5 cm.

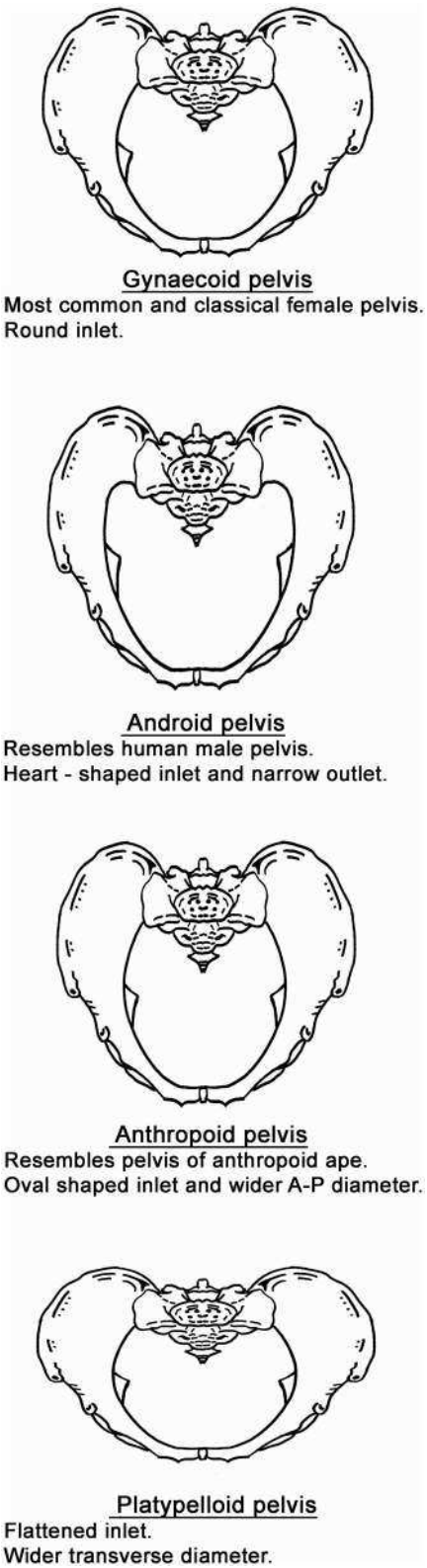

Figure 1.3 Four basic shapes of pelvis.

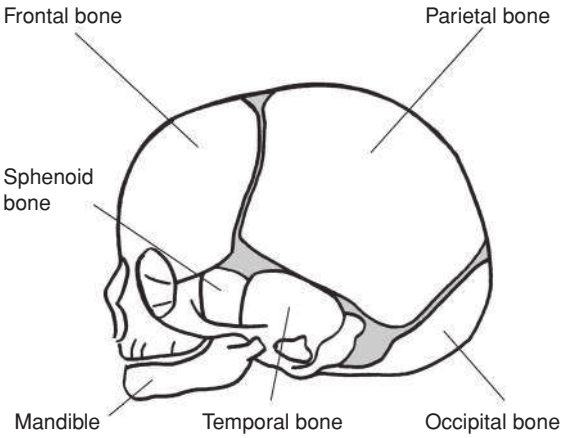

Figure 1.4 Fetal skull bones.

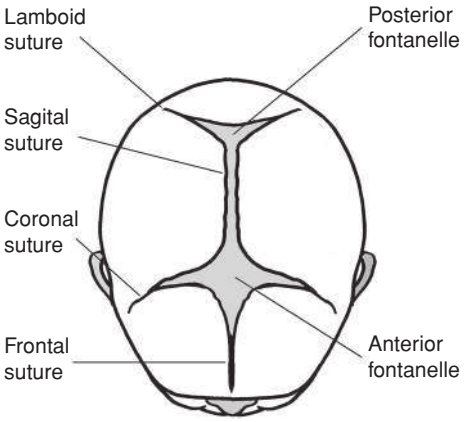

Figure 1.5 Sutures and fontanelles of the fetal skull.

The pelvic *outlet* is the lower circumference of the lesser pelvis. It is very irregular and bounded by the pubic arch anteriorly, ischial tuberosities laterally and sacrotuberous ligament and the tip of the coccyx posteriorly.

In order to have a successful delivery the fetus has to pass through this bony canal; the axis through which the fetus travels is an imaginary line joining the centre points of the planes of the inlet, cavity and outlet.

Anatomy of the Fetal Skull

The human fetal skull is considered to be the largest compared to the pelvic size of all other living primates and the most difficult part of the fetus to pass through the mother's pelvic canal, due to its hard, bony nature [5].

The skull bones encase and protect the brain, which is very delicate and subjected to pressure when the fetal head passes down the birth canal. The fetal cranium is composed of nine bones (occipital, two parietal, two frontal, two temporal, sphenoid and ethmoid). Of these, the bones that compose the skull are of clinical importance during birth (Figure 1.4).

The fetal skull bones are as follows:

1. The *frontal bone*, which forms the forehead. In the fetus, the frontal bone is in two halves which fuse (join) into a single bone after the age of eight years.
2. The two *parietal bones*, which lie on either side of the skull and occupy most of the skull.
3. The *occipital bone*, which forms the back of the skull and part of its base. It joins with the cervical vertebrae.
4. The two *temporal bones*, one on each side of the head, closest to the ear.

Sutures are joints between these bones of the skull. The *lambdoid suture* forms the junction between the occipital and the parietal bones; the *sagittal suture* joins the two parietal bones together; the *coronal suture* joins the frontal bones to the two parietal bones; and the *frontal suture* joins the two frontal bones together.

A fontanelle is the space created by the joining of two or more sutures. It is covered by thick membranes and the skin on the fetal head, protecting the brain underneath. The anterior fontanelle (also known as the bregma) is a diamond-shaped space towards the front of the fetal head, at the junction of the sagittal, coronal and frontal sutures. The posterior fontanelle (or lambda) has a triangular shape, and is found towards the back of the fetal skull. It is formed by the junction of the lambdoid and sagittal sutures.

In the fetus they permit their movement and overlap during labour under the pressure on the fetal head as it passes down the birth canal. This process, called *moulding*, can decrease the diameters of the fetal skull. The suboccipito-bregmatic diameter is more sensitive to the changes of labour force than other fetal skull diameters [6]. Significant moulding with caput can be a sign of cephalo-pelvic disproportion and this should be ruled out before attempting an instrumental vaginal delivery [7]. During early childhood, these sutures

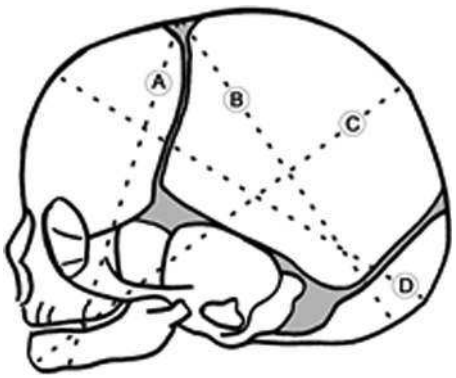

Figure 1.6 Fetal skull diameters. A: submento-bregmatic (9.5 cm); B: suboccipito-bregmatic (9.5 cm); C: mento-vertical (13.5 cm); D: occipito-frontal (11.5 cm).

harden and the skull bones can no longer move relative to one another, as they can to a small extent in the fetus and newborn.

The widest transverse diameter of the fetal skull is the biparietal diameter, which is 9.5 cm. The AP diameter of the fetal head is determined by the degree of flexion of the fetal head. This also determines which region of the fetal skull is presenting during labour, and it is described as lines that correspond to the diameter of the presenting region of the head (Figure 1.6). The suboccipito-bregmatic (fully flexed vertex) and the submento-bregmatic (face) are the narrowest AP diameters at 9.5 cm each. The widest AP diameter is 13.5 cm, and is with the fully extended head which is the mento-vertical of a brow presentation. The occipito-frontal (11.5 cm) diameter is seen with deflexed vertex presentation.

Identification of these regions and landmarks on the top of the fetal skull has particular importance for obstetric care when vaginal assessments are made during labour.

The Uterus During Pregnancy

After conception, the uterus provides a nutritive and safe environment for the embryo to develop as a fetus until delivery. The uterus undergoes extensive adaptations mainly with regards to size, shape, position, vasculature and its ability to contract.

Uterine Size

In an uncomplicated pregnancy by term, approximately the weight of the uterus increases 20-fold (from 70 g to 1000 g) and the volume by 500-fold (10 cc to 5000 cc). This increase of capacity can be expected to accommodate the fetus, placenta and amniotic fluid.

Early in gestation, uterine hypertrophy probably is stimulated by the action of mainly estrogen and also of progesterone. Later in pregnancy hypertrophy of cells of the uterus is due to response to the biological mechanical stretching of uterine walls by the growing fetus and placenta [8]. In this process of hypertrophy, stretching of muscle cells along with accumulation of fibrous and elastic tissue plays a major role, and the production of new myocytes is limited.

Uterine Shape and Position

From its original pear shape, the uterus assumes a globular shape as the pregnancy advances. It becomes palpable abdominally by 12 weeks as it is too large to remain totally within the pelvis. From this point onwards it can be measured and palpated as it is in contact with the anterior abdominal wall (Figure 1.7). By term it almost reaches the liver and this exponential enlargement of the uterus displaces the bowels laterally and superiorly. In supine position it rests on the vertebral column and the adjacent great vessels, especially the inferior vena cava and aorta. It also undergoes *dextrorotation*, which is likely caused by the recto-sigmoid

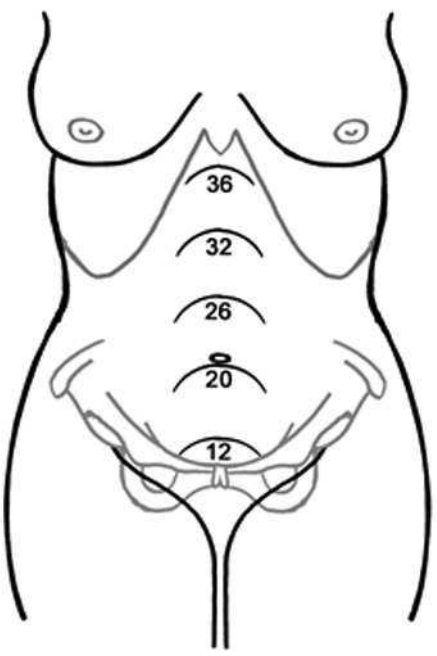

Figure 1.7 Height of the uterus at various weeks of pregnancy.

colon on the left side of the pelvis. As the uterus rises, tension is exerted on the broad and round ligaments.

Uterine Vascular Adaptations

The regulation of uterine vascular remodelling during pregnancy is part of the larger set of adaptive physiological processes required for a successful pregnancy outcome.

A multitude of physiological adaptations of the cardiovascular system takes place during pregnancy; the most notable changes are the increase in intravascular volume and cardiac output. Cardiac output increases from 3.5 to 6.0 l/min at rest, a rise of close to 40%. These changes begin as early as the first trimester of pregnancy.

The greatest changes, however, are those occurring in the uteroplacental circulation.

Haemochorial placentation in humans results in decreased downstream resistance and secretion of molecular signals. The former results in increased upstream flow velocity and initiates nitric oxide (NO) secretion as well as other effects that lead to changes in cell and matrix properties. The combination of vasodilation, changes in matrix enzymes and cellular architecture leads to an increase in lumen diameter without any change in wall thickness, decreased resistance and increased uteroplacental flow [9]. As a result, an even greater fall in vascular resistance preferentially directs some 20% of total cardiac output to this vascular bed by term, amounting to a 10-fold or greater increase over levels present in the non-pregnant state, such that, by term, uteroplacental flow may approach 1 l/min [10].

Uterine Contractility

Adaptations of human myometrium during pregnancy include cellular mechanisms that preclude the development of high levels of myosin light chain phosphorylation during contraction and an increase in the stress-generating capacity for any given level of myosin light chain phosphorylation. This process is said to be mediated through Ca^{2+} [11]. From the first trimester onward, the uterus undergoes irregular painless contraction that becomes manually detectable during the mid-trimester. These contractions vary in intensity and timing and are called *Braxton Hicks contractions* [12]. Gradually they increase in intensity and frequency during the last week or two and may cause some discomfort late in pregnancy.

Length of Pregnancy and Initiation of Labour

Length of Pregnancy

Length of pregnancy in humans averages 40 weeks. Little is known about the factors determining length of pregnancy, but it has been thought to be controlled by events occurring in late pregnancy that influence timing of parturition. Thus, preterm birth is a consequence of premature activation of parturition by a pathological process. In humans, timing of birth is associated with expression of the gene responsible for corticotrophin-releasing hormone (CRH) by the placenta. Maternal plasma concentration of CRH is a potential marker of this process. It has been postulated that a placental clock determines the timing of delivery [13].

Initiation of Labour

During pregnancy, the uterus is maintained in a state of functional quiescence through the integrated action of one or more of a series of inhibitors. Cervical ripening and myometrial contraction are main contributing factors for the initiation of labour, and they start a few weeks before the true labour. It is considered that there is an interaction between maternal and fetal factors that initiate labour in humans. Maternal endocrine and genetic factors and the influence of fetal factors play an important role.

Maternal Endocrine and Genetic Influence

The functional quiescence during pregnancy is maintained by the integrated action of one or more of a series of inhibitors, including progesterone, prostacyclin, relaxin, nitric oxide, parathyroid hormone-related peptide, calcitonin gene-related peptide, adrenomedullin and vasoactive intestinal peptide.

Change in the oestrogen:progesterone ratio, CRH, prostaglandins, oxytocin and contraction-associated proteins are some of the other factors that influence onset of labour [14]. Also it is noted that women who carried polymorphic tumour necrosis factor (*TNF* α-*308*) gene have a tendency to deliver preterm [15].

Fetal Influence

Initiation of labour at term or even preterm is also influenced by signals from the fetus. Its growth, resulting in uterine stretch, increased surfactant protein-A

secretion by the fetal lung and increased CRH secretion by the placenta, promotes release of pro-inflammatory cytokines and activation of uterine transcription factors, such as nuclear receptor transcription factor-κB (NF-κB) and other inflammatory transcription factors. The activated NF-κB, in turn, binds to enhancers in the regulatory regions of contractile genes, such as *COX-2*, resulting in transcriptional activation and the production of prostaglandins that promote uterine contractility [16].

Clinical Assessment During Pregnancy and Labour

Clinical assessment of a pregnant woman plays an important role to the obstetrician. These include the general examination and some specific examinations that are done exclusively in obstetric patients. A systematic examination of the abdomen of a pregnant woman would be with the aim of establishing the symphysio-fundal height, presentation and engagement, lie, position and attitude. Pelvic examination during pregnancy is used to detect a number of clinical conditions such as anatomical abnormalities, to evaluate the size of a woman's pelvis (pelvimetry) and to assess the uterine cervix. It is usually performed when the woman is thought to be in established labour unless indicated earlier for special reasons.

Abdominal Palpation

Abdominal examination can be conducted systematically with the aim of establishing the above-mentioned components; employing the four manoeuvres described by Leopold and Spörlinin in 1894 is of great value to current practice (Figure 1.8). The mother should be supine and comfortably positioned with her abdomen bared. These manoeuvres may be of limited value and difficult to interpret if the patient is obese, if there is excessive amnionic fluid or if the placenta is anteriorly positioned.

First Manoeuvre

The uterine fundal area is palpated with both hands in order to determine what part of the fetus is occupying the fundus. The breech gives the sensation of a large, nodular mass, whereas the head feels hard and round and is more mobile and ballottable.

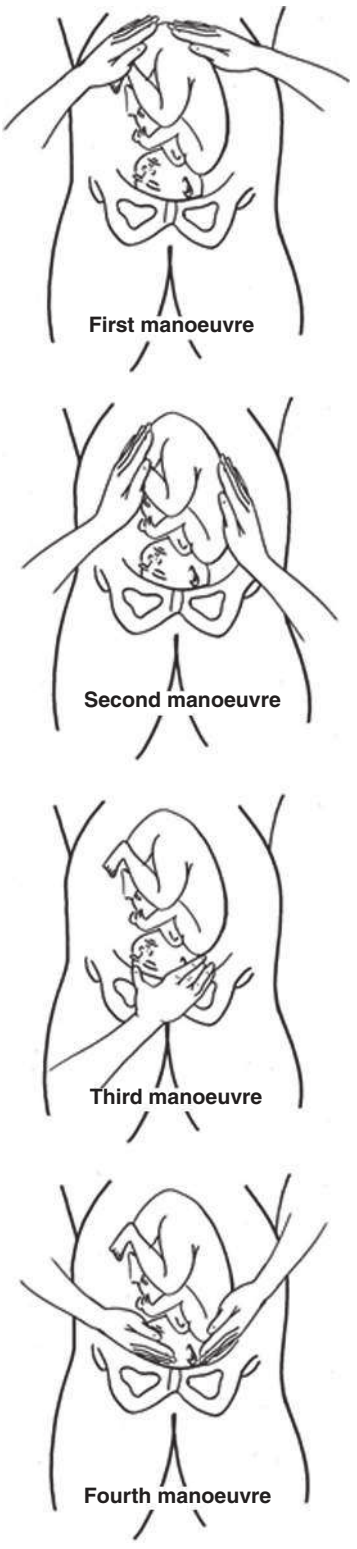

Figure 1.8 Leopold manoeuvres.

Second Manoeuvre

Facing the woman, the abdomen is palpated gently using the palm of the hands placed on either side of the maternal abdomen. The fetal back will feel firm and smooth while fetal extremities feel like small irregularities and protrusions. By noting whether the back is directed anteriorly, transversely or posteriorly, the orientation of the fetus can be determined.

Third Manoeuvre

A gentle grip using the thumb and fingers of one hand are placed on the area over the symphysis pubis to determine what part of the fetal head is lying over the pelvic inlet. The differentiation between head and breech is made as in the first manoeuvre and the amount of that presenting part that is palpable abdominally is determined. This manoeuvre may be uncomfortable for the pregnant woman and, if examination is performed in this way, it must be undertaken gently.

Alternatively and in preference, the necessary clinical information may be obtained through the fourth manoeuvre.

Fourth Manoeuvre

The examiner faces the mother's feet and the fingers of both hands are moved gently down the sides of the uterus towards the pubis to confirm the presentation and on which side is the prominence of the presenting part. The side where the resistance to the descent of the fingers towards the pubis is greatest is where the brow is located. If the head of the fetus is well flexed, it should be on the opposite side from the fetal back. If the fetal head is extended, the occiput is instead felt and is located on the same side as the back.

Abdominal palpation using the above manoeuvres can be performed throughout the latter months of pregnancy and during and between the labour contractions. With experience, fetal malpresentations can be identified with high sensitivity and specificity.

Symphysio-Fundal Height

Measurement of symphysio-fundal height is simple, inexpensive and widely used during antenatal care. It can be achieved more objectively by using a tape measure in centimetres from 24 weeks onwards. When a tape measure is used, the measurement is made by identifying the variable point, the fundus, and then measuring to the fixed point of the top of the symphysis pubis, with the option of centimetre values being hidden by keeping the non-marked side of the tape facing the examiner [17].

This can be used as a screening method for identifying fetuses that are growth restricted, unusually large and for the detection of multiple pregnancies. High detection rates can be achieved if serial measurements are plotted on customized charts for recording with standardized training and protocols to manage the patient [18].

Presentation

Fetal presentation refers to the fetal part that directly overlies the pelvic inlet. Any presentation other than cephalic (vertex) is considered malpresentation and by term or 37 completed weeks 96% of pregnancies will have cephalic presentation. Commonest malpresentation at term is breech and its incidence reduces from approximately 20% at 28 weeks to 3–4% at term.

Engagement

Engagement of the fetal head is one of the most important signs for the obstetrician to decide on mode of delivery. Engagement occurs when the widest part of the fetal head passes through the pelvic inlet. Parity, ethnicity, cephalo-pelvic disproportion, malposition and placental location are some of the factors that determine engagement of the fetal head. In different groups of the pregnant population engagement of the fetal head for primigravida and multigravida has been shown to takes place at different periods of gestation [19]. Engagement of the fetal head occurs in the majority of nulliparous women prior to labour, but not so for the majority of multiparous women. In nulliparous women, engagement usually takes place from the middle of the third trimester onwards, but in some of these women, and in most multiparous women, engagement may not take place until the onset of labour. Maternal height and birth weight of fetus also may play a significant role in determining the time at which the fetal head engages and need to be considered when assessing a patient [20]. Non-engagement at the onset of the active phase of labour is a predictor of the risk of caesarean section, which emphasizes the importance of assessing a pregnant woman for engagement of the fetal head, especially when she is in labour [21].

It is customary to describe the amount of the fetal head that is palpable outside the pelvis; when all of the fetal head is palpable above the pelvis it is described as 5/5 (five-fifths palpable). This is based on how many finger breadths are needed to cover the head above the

pelvic brim. When the fetal head is engaged, it is usually two-fifths palpable, and when it is deeply engaged it is zero-fifths palpable.

Lie

Fetal lie refers to the long axis of the fetus relative to the longitudinal axis of the uterus. This can be longitudinal, transverse or oblique. Over 99% of singleton term babies have a longitudinal lie and factors such as prematurity, multiparity, multiple pregnancies, placenta praevia, polyhydramnios, uterine fibromatas, congenital uterine anomalies, intrauterine fetal death and extra uterine masses obstructing the birth canal predisposes a pregnant woman to have persistent abnormal lie.

Compared to those fetuses presenting with a longitudinal lie at the onset of labour, fetuses who are in transverse lie have been found to have a lower absolute pH, more frequent chance of developing severe acidosis, lower birth weight and are more likely to sustain birth trauma and long-term residual effects [22].

Position

Fetal position refers to the relationship of a nominated site of the fetal presenting part to a denominating location on the maternal pelvis. For example, in a cephalic presentation, the fetal site used for reference is typically the occiput (e.g. right occiput anterior). In a breech presentation, the sacrum is used as the designated fetal site (e.g. right sacrum anterior). Any fetal position that is not right occiput anterior, occiput anterior or left occiput anterior is referred to as a malposition.

Attitude

Fetal attitude describes the degree of flexion or extension of the fetal head in relation to the fetal spine. Adequate flexion (chin to chest) is necessary to achieve the smallest possible presenting diameter in a cephalic presentation. Deflexion in the early stages of labour may be corrected by the architecture of the pelvic floor and uterine contractions.

Asynclitism

Asynclitism describes the relationship of the sagittal plane of the fetal head to that of the coronal planes of the symphysis pubis and the sacral promontory. Usually the planes are not parallel and a slight degree of asynclitism is the normal. Significant asynclitism occurs with relative cephalo-pelvic disproportion, as the fetal head rocks on entering the pelvis in an attempt to make progress. If the tilt of the sagittal plane is directed towards the symphysis pubis, then more of the posterior aspect of the fetus' head is felt vaginally during examination; this is called posterior asynclitism. Anterior asynclitism occurs if more of the anterior part of the fetal head is felt on examination.

Abdominal palpation using the described manoeuvres can be performed throughout the latter months of pregnancy and during and between the labour contractions. On completion of a clinical examination it is usual to describe, in order: the symphysio-fundal height; fetal lie; presentation; and engagement. The fetal heart should be auscultated.

Pelvic Examination

Pelvic examination during pregnancy is used to detect a number of clinical conditions such as anatomical abnormalities, to evaluate the size of a woman's pelvis (pelvimetry) and to assess the uterine cervix, but it must be avoided when there is any suspicion of placenta praevia. A sterile speculum examination, allowing visual inspection, is indicated in cases of preterm labour, vaginal bleeding and suspected rupture of membranes. In addition, samples could be obtained for bacteriological tests when indicated.

Clinical Pelvimetry

Assessment of the size of a woman's pelvis (pelvimetry) can be achieved by clinical examination where the bony pelvis is digitally examined to identify prominent structures that may cause obstructed labour. The aim of pelvimetry in women whose fetuses have a cephalic presentation is to detect the possibility of cephalopelvic disproportion and therefore the need for caesarean section before or during labour. Other imaging techniques like X-rays, computerized tomography (CT) scanning or magnetic resonance imaging (MRI) are also used to assess the size of the pelvis. One should keep in mind that the dimensions of the pelvis and of the fetal head will change with the dynamic of labour.

During the clinical assessment, the diagonal conjugate is obtained by placing the tip of the middle finger at the sacral promontory and measuring to the point on the hand that contacts the symphysis. This is the closest clinical estimate of the obstetric conjugate and is 1.5–2.0 cm longer than the obstetric conjugate. The bi-ischial diameter is the distance between the ischial tuberosities, with a distance greater than 8 cm considered adequate. Other qualitative pelvic characteristics

Table 1.1 Bishop's score

	0	1	2	4
Dilatation of cervix (cm)	0	1–2	3–4	5+
Length of cervix (cm)	3	2	1	0
Station of vertex	–3	–2	–1,0	+1,+2
Cervical consistency	Firm	Medium	Soft	
Position	Posterior	Mid	Anterior	

include angulation of the pubic arch (more than 90° or accepts more than two fingers), prominence of the ischial spines, size of the sacrospinous notch (assessed by the sacrospinous ligament at more than three finger breadths) and curvature of the sacrum and coccyx (not being straight).

Clinical pelvimetry is not routinely practised in all pregnant women with cephalic presentation, but it is considered a useful tool in certain circumstances.

Cervical Assessment

Cervical assessment with a sterile speculum and digital vaginal examination allows the examiner to visually inspect the cervix, obtain samples for bacteriological tests and to assess certain factors of the cervix called Bishop's score (Table 1.1).

During the digital vaginal examination it is customary to start with an assessment of the effacement or cervical length, dilatation, consistency, position and the presentation and station of the presenting part relative to the ischial spines. In the 1960s Dr Edward Bishop developed a pelvic scoring system using these components, which remains the most commonly used system to assess for pre-induction readiness [23].

Currently even a simplified Bishop's score comprising dilatation, station and effacement attains a similarly high predictive ability of successful induction as the original score [24].

Cervical Effacement

The normal prelabour cervical length is 3–4 cm. The cervix is said to be 50% effaced when it shortens to approximately 2 cm, and fully effaced when there is no length and it is as thin as the adjacent lower segment of the uterus. Effacement is determined by assessing the length of the cervix from the external to the internal os. Complete cervical effacement is associated with a characteristic and profound alteration in the gene expression profile of cervical cells. The majority of these genes encode cytokines, transcription factors and cell-matrix-associated proteins [25].

The process of cervical effacement and dilatation differs between primigravida and multiparous patients. In the latter, effacement and dilatation occurs simultaneously, while in the case of primigravidae, effacement precedes dilatation.

Cervical Dilatation

During labour the cervix dilates progressively and the primary factors leading to cervical dilatation are the traction forces of the myometrial contractions, and the pressure of the fetal head or the presenting part on the cervix. From full effacement and 4 cm dilatation to full dilatation or 10 cm, the cervix usually dilates at a rate of 1 cm per hour.

Cervical Position

Cervical position describes the location of the cervix in relation to the maternal pelvis. During labour, the position progresses from posterior to mid-position and then to anterior.

Cervical Consistency

Cervical consistency ranges from firm to soft. Cervical softening during pregnancy is a unique phase of the tissue remodelling process characterized by increased collagen solubility, maintenance of tissue strength and up-regulation of genes involved in mucosal protection [26]. During this process, the junction between the fetal membranes and the decidua breaks down, and an adhesive protein – fetal fibronectin – enters vaginal fluids. This is a clinically useful predictor of imminent delivery [14].

The Station

The station of the presenting part describes the distance of the leading bony part of the fetal head relative to the ischial spines. The usual method is to measure the distance above and below the spines in centimetres, with the areas above being given a minus sign and those below the spines being given a positive sign. For example, '0' indicates that the lowest part of the fetal head is at the level of the ischial spines, while '+1' indicates that the head is 1 cm below the level of the spines (Figure 1.9).

Identifying the position of the presenting part is accomplished by identifying the bony sutures of the fetal head, following the suture until it leads to a fontanelle and then identifying the sutures radiating

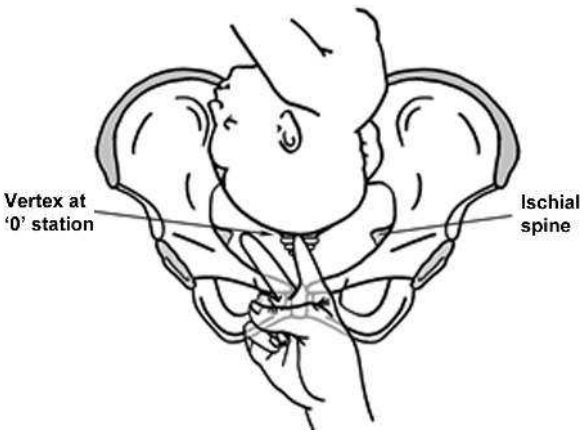

Figure 1.9 Clinical assessment of the station of the presenting part.

from it. Provided the head is low and the patient has good pain relief, it may also be possible to locate the ear of the fetus and to assess to which side it faces. The nose and mouth can usually be identified in a face presentation, while the sacrum, genitalia and anus should be identifiable with a breech presentation.

At the end of the examination the following should be described and noted: inspection of vulva and vagina to ascertain/establish the presence or absence of any liquor, blood or discharge; and palpation of the cervix to establish its length, thickness and position (anterior, mid-position or posterior).

In the active stage of labour, the clinician assesses the progress of cervical dilatation, and effacement, the station and position of the presenting part and whether there is any asynclitism, caput succedaneum and moulding.

Stages and Duration of Normal Labour

Although labour is a continuous process, it is divided into three stages to facilitate monitoring and to assist in clinical management.

First Stage

The *first stage* is said to begin with the onset of regular painful uterine contractions resulting in cervical changes, and ends when the cervix is fully dilated at 10 cm. It has been further subdivided into latent and active phases according to the rates of cervical dilatation [27].

The *latent phase* is defined as the period of time, not necessarily continuous, when there may be painful contractions as well as cervical change, including cervical effacement and with cervical dilatation up to 4 cm. It is characterized by slow cervical dilatation and is of variable duration. The established, *active phase* of labour begins when there are regular painful contractions and there is progressive cervical dilatation from full effacement and 4 cm dilatation onwards. The length of the labour duration or curve does not differ among ethnic or racial groups, but there are significant differences between nulliparous and multiparous women [28]. The length of the active first stage of labour in nulliparous women is on average 8 hours and is unlikely to be over 18 hours. Second and subsequent labours last on average 5 hours and are unlikely to last more than 12 hours [29].

By comparing a labouring woman's rate of cervical dilatation with the normal profile described by Friedman, it is possible to detect abnormal labour patterns and identify pregnancies at risk for adverse events. This task can be facilitated by use of a partogram, which is a graphic representation of the labour curve against which a patient's progress in labour is plotted. In this way, abnormal labour patterns can be identified easily and appropriate measures taken.

Second Stage

The *second stage* starts when the cervix is fully dilated at 10 cm and is characterized by descent of the presenting part through the maternal pelvis. It ends with the delivery of the fetus. It is characterized by an increase in bloody show, maternal desire to bear down with each contraction and a feeling of pressure on the rectum accompanied by the desire to defecate.

The safe duration desirable for the second stage in the presence of an uncompromised fetus for a nulliparous patient without regional anaesthesia is said to be two hours (three hours with regional anaesthesia). For a multiparous woman the recommendation is one hour and two hours, respectively [29].

Third Stage

The third stage of labour refers to the time from delivery of the fetus to separation and expulsion of the placenta and fetal membranes. It is characterized by signs of placental separation, namely lengthening of the umbilical cord, a gush of blood from the vagina, which signifies separation of the placenta from the uterine wall, and a change in the shape of the uterine fundus from discoid to globular, with elevation of the