

The full-term, delivered placenta is, in more than 90% of the cases, a disk-like, flat, round to oval organ. In nearly 10%, it has abnormal shapes, such as placenta bilobata, placenta duplex, placenta succenturiata, and placenta membranacea (Torpin 1969). The average diameter is 22 cm, the average thickness in the center of the delivered organ 2.5 cm, and the average weight 470 g (see Appendix A.1). The respective measurements show considerable interindividual variation and strongly depend on such factors as the mode of birth, timing of cord clamping (see Appendix A.8), and time elapsed between delivery and examination.

2.1 Fetal Surface

The fetal (chorionic or amniotic) surface, facing the amniotic cavity, has a glossy appearance because of the intact epithelial surface of the amnion. This avascular membrane covers the chorionic plate, including the chorionic vessels. The latter branch in a star-like pattern centrifugally from the cord insertion over the fetal surface (Fig. 2.1a). Where arteries and veins cross, the arterial branches are usually superficial; they cross the veins on their amniotic aspect. Wentworth (1965) reported that only about 3% show the opposite condition. According to Boyd and Hamilton (1970), the superficial position of one or few venous branches at points of arteriovenous crossing is not unusual.

In the vicinity of the larger chorionic vessels, the chorionic plate normally has an opaque appearance because an increased number of collagen fibers accompany the vessels. Those areas of the chorionic plate located between the chorionic vessels are mostly transparent and are dark lilac to black because of the maternal blood in the intervillous space below. Opaque spots (bosselations) or large opaque areas independent of chorionic vessels usually point to large subchorionic deposits of Langhans' fibrinoid.

Near the placental margin, where the most peripheral branches of the chorionic vessels curve vertically toward the

marginal villous trees, the transparency of the chorionic plate decreases, resulting in a largely incomplete, opaque, subchorial closing ring that is a result of increased amounts of cytotrophoblast and collagen fibers (see Chap. 9). It connects the placenta with the membranes. In the case of a particularly broad and prominent subchorial closing ring, the specimen is called a placenta marginata. A placenta circumvallata is formed when the closing ring is peripherally undergrown by villous trees. In such cases, it does not represent the outermost margin of the placenta; rather, the membranes insert superficially from the fetal surface of the placenta.

Placental shape and cord insertion are sometimes regarded as structurally impressive but functionally unimportant parameters. Whether the normal placenta is considered round or elliptical depends heavily on the algorithms used to derive a shape index. Taking multiple radial markers leads to the conclusion that the placenta is round (Salafia et al. 2010), whereas taking the longest and shortest dimensions perpendicular to each other results in the conclusion that it is elliptical (Pathak et al. 2010). Increased variability in shape is related to a decreased efficiency of the placenta, as assessed by the ratio of placental and fetal weights, which may reflect either maternal uteroplacental or fetoplacental pathology (Salafia et al. 2007, 2010). Due to the orientation of the blastocyst at the time of implantation, with the animal pole associated with the inner cell mass adhering to the uterine epithelium, the cord is normally inserted near the center of the disk. A recent large study revealed in fact that the site of insertion is most commonly off-center (Pathak et al. 2010). Variations may therefore reflect aberrations in the initial process of attachment. Alternatively, it has been suggested that excessive villus regression, secondary to abnormal onset of the maternal arterial circulation toward the end of the first trimester, results in the cord being attached toward the margin of the remaining placental mass (Burton et al. 2010). Whatever the cause, eccentric insertion is associated with a lower fetoplacental weight ratio, again suggesting a less efficient placenta (Yampolsky et al. 2009). Whether this reflects

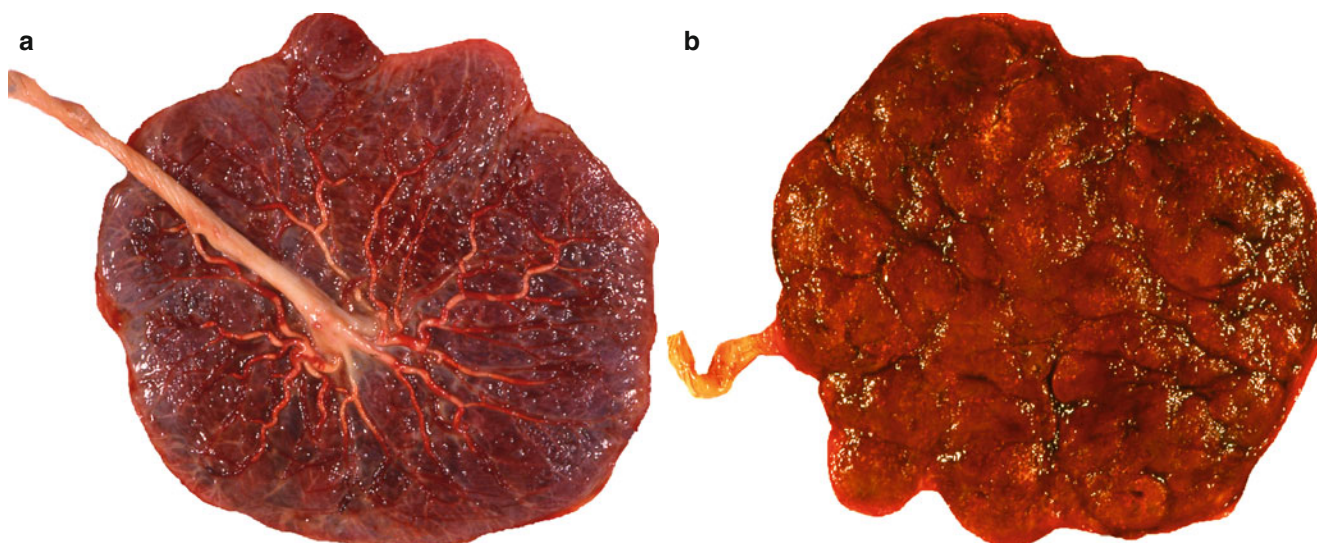


Fig. 2.1 Apical (a) and basal (b) views of a freshly delivered, mature human placenta. Note the slightly eccentric insertion of the umbilical cord, which is the most usual location. The chorionic arteries (white

because of postpartum injection of milk) cross over the corresponding veins (dark). The basal surface (b) is subdivided into placental lobules of varying size by an interrupted net of dark grooves $\times 0.4$

compromise of the maternal vascular supply or a reduced exchange capacity on the fetal side is not known, but eccentric cord insertion is generally associated with a higher resistance in the umbilical circulation (Nordenvall et al. 1991).

2.2 Maternal Surface

The uterine (maternal) surface of the placenta is opaque, as it is an artificial surface originating from laminar degenerative processes within the junctional zone that led to the separation of the organ. This separation process subdivides the junctional zone between placenta and uterine wall into

- The basal plate which is attached to the placenta and represents the maternal, uterine surface of the organ
- The placental bed which remains in utero

The basal plate and the maternal surface of the placenta could not be identified before placental separation in the *in situ* specimens that were fixed before onset of labor (see Fig. 4.6). It is composed of a heterogeneous mixture of trophoblastic and decidual cells embedded into prevailing amounts of extracellular debris, fibrinoid, and blood clot.

An incomplete system of grooves subdivides the basal surface of the placenta into 10–40 slightly elevated areas called maternal lobes or cotyledons (Figs. 2.1b and 2.2). Internally, these grooves correspond to the placental septa, folds of the basal plate which project into the intervillous space (see Fig. 4.6). In histological sections, the septa can often be seen to be indented at their basal surfaces. It is likely that these grooves and the respective basal indentations of the septa are the postpartal results of tearing at sites of minor mechanical resistance, as the basal central parts of

the septa are often characterized by necrotic zones, clefts, and local pseudocysts. Despite their possibly artifactual genesis, the grooves delineate the lobes and mark the position of the septa. As is described in Chap. 9, the septa must not be misunderstood as separating structures that subdivide the intervillous space into chambers; rather, they are irregular pillars or short sails that only trace the lobar borders.

The lobes show fairly good harmony with the position of the fetal lobules or cotyledons. From the chorionic plate at term, 60–70 villous stems arise, each branching into one villous tree (or lobule) (see Figs. 4.6 and 7.18). Thus, according to Boyd and Hamilton (1970) and Kaufmann (1985), each lobe is occupied by one or several villous trees. When a radioangiograph of the villous trees is projected onto a basal view of the same placenta (Fig. 2.2), the borderlines of the lobes usually coincide with the borderlines of single villous trees or small groups of trees. Small marginal lobes are likely to be occupied by only a single villous tree and thus correspond to what Schuhmann (1981) and his group described as representing a placentone.

2.3 The Terms “Fetal Placenta” and “Maternal Placenta”

When describing human placentation, terms such as “fetal placenta” and “maternal placenta” must be avoided because they are misleading and often cause misinterpretation. The terms originate from study of the noninvasive placentas of many domestic species, where a fetal component interacts with a clearly defined maternal component, and the two can

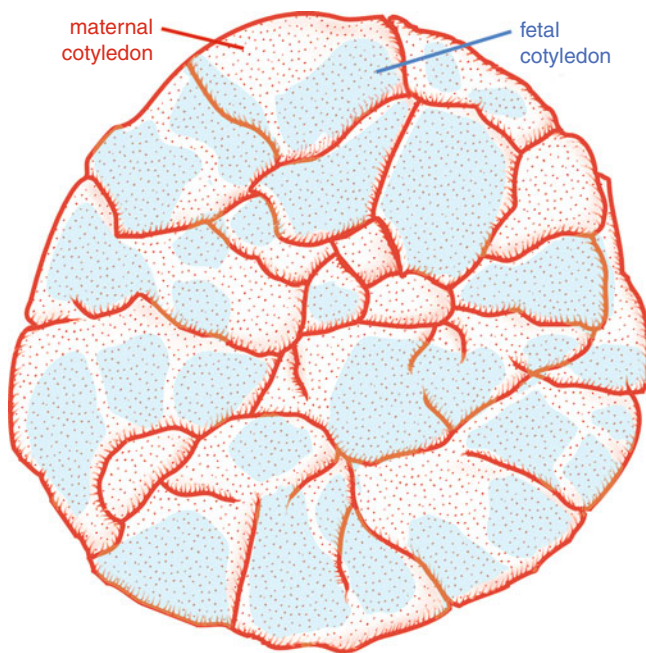


Fig. 2.2 Basal view of the placenta, drawn in combination with a radiograph of the same placenta after injection of a radiopaque medium into the fetal vessels. The borderlines of the placental lobules (maternal cotyledons, *red stippled*) are marked by *red lines* corresponding to the grooves. The radiographic projections of 29 villous trees are represented by *blue stippled areas*. This combination demonstrates a fairly good harmony of villous trees and maternal lobes. One to three villous trees (fetal cotyledons) are projected on one lobe (maternal cotyledon) (From Kaufmann and Scheffen (1992), with permission; based on photographs by Boyd and Hamilton (1970))

be cleanly separated at delivery. Such a separation cannot be achieved in the invasive form of human placentation. This point becomes important as soon as morphologically inexperienced biochemists, endocrinologists, and others isolate respective parts of the organ, then place trust in their putative and designated origin, and draw functional conclusions.

- A typical example is that of the basal plate, often erroneously referred to as “maternal placenta.” It is not exclusively composed of maternal cells but rather represents a colorful mixture of trophoblastic (fetal) and endometrium-derived (maternal) cells.
- A corresponding warning is necessary regarding the placental bed. It is often thought to represent only the maternal remains of the placental site after separation of the placenta. Trophoblastic streamers deeply invade the

endometrium, however, and even penetrate the myometrium. They remain in utero long after delivery and can be found as fetal admixtures in the placental bed.

- The term “fetal placenta” is also inappropriate. With the possible exception of the central parts of the chorionic plate, there are no placental structures for which the pure fetal composition can be ensured. The marginal zone of the chorionic plate contains decidua, and the same is true for parts of the cell islands and septa. Because the latter may be attached to the villous trees, one is never certain that preparations of it are devoid of maternal tissues, even if we disregard maternal blood and fibrinoid deposits that are partly maternal blood clot products.

References

- Boyd JD, Hamilton WJ (1970) The human placenta. Heffer, Cambridge
- Burton GJ, Jauniaux E, Charnock-Jones DS (2010) The influence of the intrauterine environment on human placental development. *Int J Dev Biol* 54:303–312
- Kaufmann P (1985) Basic morphology of the fetal and maternal circuits in the human placenta. *Contrib Gynecol Obstet* 13:5–17
- Kaufmann P, Scheffen I (1992) Placental development. In: Polin R, Fox W (eds) Neonatal and fetal medicine-physiology and pathophysiology, vol 1. Saunders, Orlando, pp 47–55
- Nordenvall M, Ullberg U, Laurin J, Lingman G, Sandstedt B, Ulmsten U (1991) Placental morphology in relation to umbilical artery blood velocity waveforms. *Eur J Obstet Gynecol Reprod Biol* 40:179–190
- Pathak S, Hook E, Hackett G, Murdoch E, Sebire NJ, Jessop F, Lees C (2010) Cord coiling, umbilical cord insertion and placental shape in an unselected cohort delivering at term: relationship with common obstetric outcomes. *Placenta* 31:963–968
- Salafia CM, Zhang J, Miller RK, Charles AK, Shrout P, Sun W (2007) Placental growth patterns affect birth weight for given placental weight. *Birth Defects Res A Clin Mol Teratol* 79:281–288
- Salafia CM, Yampolsky M, Misra DP, Shlakhter O, Haas D, Eucker B, Thorp J (2010) Placental surface shape, function, and effects of maternal and fetal vascular pathology. *Placenta* 31:958–962
- Schuhmann R (1981) Plazenton: Begriff, Entstehung, funktionelle Anatomie. In: Becker V, Schiebeler TH, Kubli F (eds) Die Plazenta des Menschen. Thieme, Stuttgart, pp 199–207
- Torpin R (1969) The human placenta. Thomas, Springfield
- Wentworth P (1965) Some anomalies of the foetal vessels of the human placenta. *J Anat* 99:273–282
- Yampolsky M, Salafia CM, Shlakhter O, Haas D, Eucker B, Thorp J (2009) Centrality of the umbilical cord insertion in a human placenta influences the placental efficiency. *Placenta* 30:1058–1064

<http://www.springer.com/978-3-642-23940-3>

Pathology of the Human Placenta

Benirschke, K.; Burton, G.J.; Baergen, R.N.

2012, XVIII, 941 p. 704 illus., 164 illus. in color.,

Hardcover

ISBN: 978-3-642-23940-3