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### Original Article

## MORPHOLOGY AND MORPHOMETRIC ANALYSIS OF HUMAN PLACENTAE

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#### ABSTRACT

**Introduction:** Placenta is the vital organ which maintains the pregnancy and promotes the normal fetal development. It anchors the fetus to the uterine wall and allows the uptake of nutrients, elimination of waste, gas exchange via the mother's blood supply. In our study, we included 82 normal full term placentae and the placentae of 3 PIH, 2 GDM, 2 Anemia mothers. **Objective:** In our study, we included 82 normal full term placentae and the placentae of 3 PIH, 2 GDM, 2 Anemia mothers. Our main aim is to study the morphology and morphometry of these placentae and analyze how these parameters will help in assessing the fetal health. **Materials and Methods:** 89 Human placentae were collected from the department of Obstetrics and Gynaecology. The parameters studied are - shape, diameter, thickness, weight, maternal surface number of cotyledons, fetal surface vascular pattern, type of umbilical cord insertion, diameter of umbilical cord, number of umbilical vessels. **Results:** The predominant shape is round. Mean diameter is  $17.22 \pm 2.47$ . The mean thickness in the center is  $2.75 \pm 0.60$  and at the periphery is  $1.41 \pm 0.54$ . The average weight of the placenta is  $438.76 \pm 100.30$ . Mean no. of cotyledons =  $16.04 \pm 3.57$ . magistral type of vascular pattern on fetal surface was seen frequently. Eccentric and central type of umbilical cord insertion is seen in most of the placentae. The mean diameter of the umbilical cord is  $1.79 \pm 0.85$ . All the Placentae in our study showed two arteries and one vein. **Conclusion:** Variations in the morphology and morphometry of the placenta are usually associated with the fetal growth retardation, big babies, childhood hypertension, and various other pathological conditions. Hope our study adds knowledge to the placental parameters and help the Obstetricians, Embryologists, Radiologists, other clinicians and surgeons to understand the patho-physiological mechanisms of Placenta and design the treatment plans for a better maternal and fetal outcome.

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#### Introduction

Placenta is the vital organ which maintains the pregnancy and promotes the normal foetal development. It has abnormal shapes such as bilobed placenta, placenta duplex, placenta succenturiata, placenta zonaria and placenta membranacea. The average diameter is 22cm, the average thickness at the center in delivered placenta is 2.5cm and average weight is 470gm. These measurements show considerable inter individual variation and strongly depend on the mode of birth, timing of cord clamping and time between delivery and examination.<sup>2</sup> Also the maternal pathological conditions like Pregnancy Induced Hypertension (PIH), Gestational Diabetes Mellitus (GDM), Anaemia, RH positive etc.

In our study, we included 82 normal full term placentae and the placentae of 3 PIH, 2 GDM, 2 Anaemia mothers.

Our main aim is to study the morphology and morphometry of these placentae and analyze how these parameters will help in assessing the foetal health.

#### MATERIAL AND METHODS

89 Human placentae were collected from the department of Obstetrics and Gynaecology from July 2019 to June 2020.

For every specimen taken, the maternal history was recorded in detail regarding her age, parity, present and previous history of PIH, Diabetes mellitus and Anaemia.

All the Placentae were collected immediately after delivery from both normal and caesarian deliveries. The collected placentae were washed under running tap water. Then the placentae along with the cords were fixed in 10% formalin and stored in plastic containers. Each placenta was tagged with a number for identification before the study. The Parameters studied in Placentae were Shape - determined on thorough inspection

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**Diameter** – maximum diameter was measured using measuring scale. In oval shape the mean of two diameters was taken

**Thickness** – using long needle the thickness was taken at periphery and center and the mean for both values is calculated.

**Weight** – measured using electronic weighing scale

**Maternal surface number of cotyledons** – counted on thorough inspection

**Foetal surface vascular pattern** – analyzed with thorough inspection and divided into 3 types namely magistral, disperse and mixed.

Type of umbilical cord insertion – inspected and divided as central, marginal, eccentric, furcate.

**Diameter of umbilical cord** – measured using a Vernier calipers.

**Number of arteries and veins in Umbilical cord** – inspected and noted.

**OBSERVATIONS AND RESULTS**

Total of 89 placentae were studied and the parameters analyzed in the following way. (fig1) (table1) (fig2)

Shape of the placenta: The predominant shape is round (fig 3) and other shapes noted are oval (fig 4), triangular (fig 5), succenturiate (fig 6), bilobed (fig 7), trilobed (fig 8).

Diameter of Placenta: The mean diameter of the Placentae in our study is 17.22±2.47 (table 2, fig 9)

Thickness of Placenta: The thickness of the placenta at the centre and the periphery is measured. The mean thickness in the center is 2.75±0.60 and at the periphery is 1.41±0.54 (table 3, fig 10)

Weight of the Placenta: The average weight of the placenta is 438.76±100.30 (table 4, fig 11)

Maternal surface number of cotyledons: Mean no. of cotyledons = 16.04±3.57 (table 5, fig 12)

Foetal surface vascular pattern: Vascular pattern varied from magistral to disperse to mixed type. In our study magistral type was seen frequently. (table 6, fig 13, 14, 15, 16)

Type of insertion of Umbilical cord: Eccentric (fig 7), Central (fig 17), Marginal (fig 18), Furcate (fig 19), Velamentous (fig 20). (table 7)

Diameter of Umbilical cord : The mean diameter of the umbilical cord is 1.79±0.85 (table 8, fig 21)

Number of Umbilical Arteries and veins: All the Placentae in our study showed two arteries and one vein

In our study on a total of 89 Placentae, 7 placentae were pathological. Because our sample size was not enough for the comparison the p value is not significant. (table 9)



Figure 1 Total Placental specimen studied

Shape of placenta	Number	Percentage
Round	52	58.4%
Oval	21	23.6%
Bilobed	05	5.6%
Triangular	05	5.6%
Succenturiate	03	3.4%
Circular	02	2.2%
Trilobed	01	1.2%

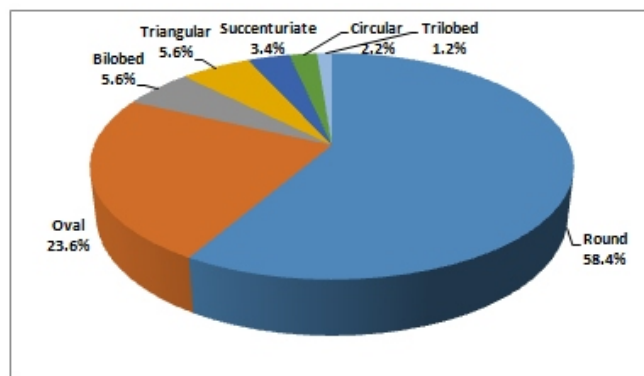


Figure 2: Percentage Different Shapes of Placenta



Figure : Round shaped Placenta, also a twin placenta.



Figure : Oval Shaped Placenta



Figure : Bilobed Placenta



Figure : Triangular shaped Placenta



Figure Trilobed Placenta



Figure : Placenta succenturiata

Diameter of Placenta	Number	Percentage
9 cm	01	1.1%
10-15 cm	20	22.5%
16-20 cm	62	69.7%
21-25 cm	06	6.7%

Table : Percentage of diameters of Placentae

Mean diameter = 17.22±2.47

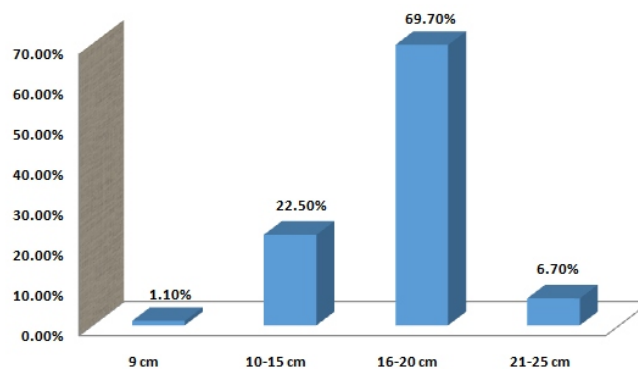
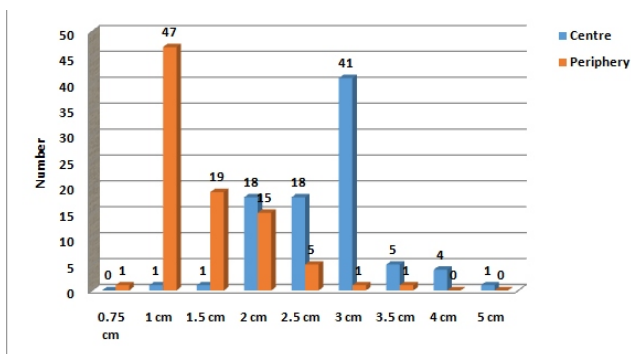


Figure : Percentage of Diameter of Placenta

Thickness of Placenta	At centre	At periphery
0.75 cm	--	01
1 cm	01	47
1.5 cm	01	19
2 cm	18	15
2.5 cm	18	05
3 cm	41	01
3.5 cm	05	01
4 cm	04	--
5 cm	01	--
Mean thickness (cm)	2.75±0.60	1.41±0.54

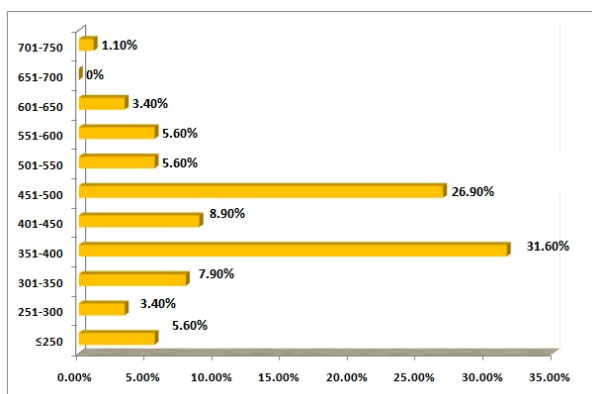
**Table : Thickness measured at the center and periphery**



**Figure : Thickness of the placenta compared between center and periphery**

Weight of Placenta in Grams	Number	Percentage
≤250	05	5.6%
251-300	03	3.4%
301-350	07	7.9%
351-400	28	31.6%
401-450	08	8.9%
451-500	24	26.9%
501-550	05	5.6%
551-600	05	5.6%
601-650	03	3.4%
651-700	--	--
701-750	01	1.1%

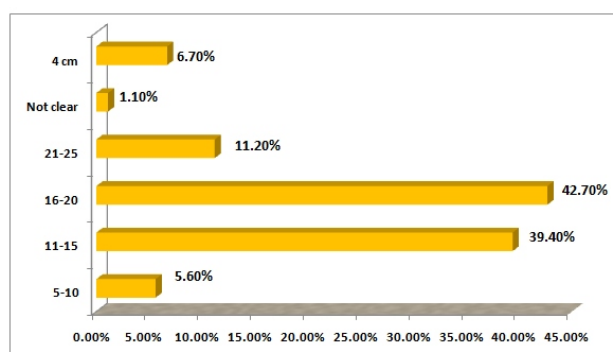
**Table : Weight of the Placenta**  
Mean weight= 438.76±100.30



**Figure : Percentage of Weight of Placentae**

No. of cotyledons on maternal surface	Number	Percentage
5-10	05	5.6%
11-15	35	39.4%
16-20	38	42.7%
21-25	10	11.2%
Not clear	01	1.1%

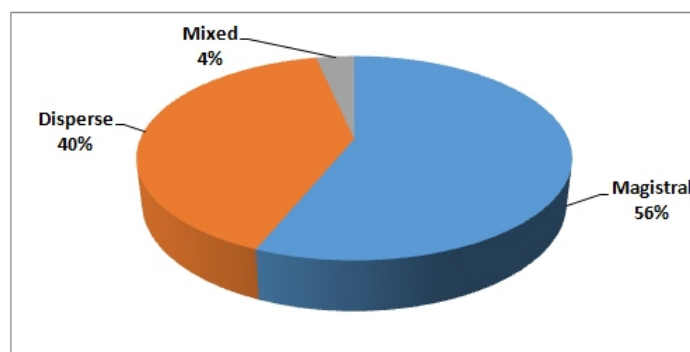
**Table : Percentage of Cotyledons on maternal surface**  
Mean no. of cotyledons = 16.04±3.57



**Figure : Comparison between the no. of cotyledons on maternal surface**

Fetal surface-vascular pattern	Number	Percentage
Magistral	50	56.2%
Disperse	36	40.4%
Mixed	03	3.4%

**Table : percentage of vascular pattern noted on foetal surface of the placenta**



**Figure : Comparison between different types of vascular pattern on foetal surface of the Placenta**

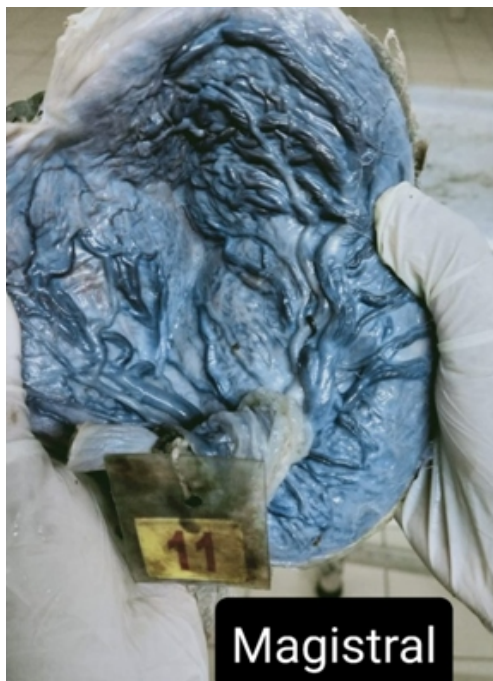


Figure : Magistral type of vascular pattern on foetal surface of the placenta



Figure : Disperse type of vascular pattern on foetal surface of the placenta



Figure : Mixed type of vascular pattern on the foetal surface of the placenta

Type of insertion of Umbilical cord	Number	Percentage
Eccentric	32	35.9%
Central	27	30.4%
Marginal	16	17.9%
Furcate	10	11.4%
Central furcate	01	1.1%
Furcate eccentric	01	1.1%
Marginal & furcate	01	1.1%
Velamentous	01	1.1%
Total	89	100%

Table : Types of insertion of Umbilical cord



Figure : Central insertion of the Umbilical cord



Figure : Marginal insertion of the Umbilical cord



Figure : Furcate insertio of Umbilical cord



Figure : Velamentous insertion of the Umbilical cord

Diameter of Umbilical cord	Number	Percentage
1 cm	25	28.1%
1.5 cm	30	33.7%
2 cm	19	21.3%
3 cm	07	7.9%
3.5 cm	02	2.3%
4 cm	06	6.7%

Table : The diameter of the Umbilical cord

Mean diameter = 1.79±0.85

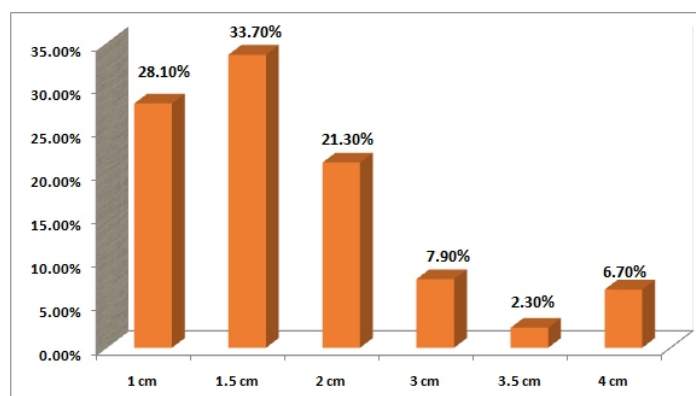


Figure : Comparison of Diameter of the Umbilical cord

Variables		Mean	T value	P value	
Placental weight	Normal cases	438.72±97.02	0.014	0.2	Not significant
	Cases with medical disorders	439.28±132.86			
Placental diameter	Normal cases	17.26±2.33	0.5715	0.06	Not significant
	Cases with medical disorders	16.71±3.65			
Thickness at centre	Normal cases	2.76±0.61	0.6127	0.4	Not significant
	Cases with medical disorders	2.64±0.44			
Thickness at periphery	Normal cases	1.42±0.56	0.5186	0.2	Not significant
	Cases with medical disorders	1.28±0.36			
Cotyledons	Normal cases	16.08±3.41	0.2722	0.3	Not significant
	Cases with medical disorders	14.57±4.20			
Diameter of Umbilical cord	Normal cases	1.80±0.88	0.7897	0.03	Significant
	Cases with medical disorders	1.71±0.36			

Table : Comparison of Morphometry of Placenta & Umbilical cord between Normal cases and cases with medical disorders (PIH, Anemia & Diabetes)

## DISCUSSION

Shape of the placenta: Normal shape of the placenta is discoidal with two surfaces, maternal and foetal. It continuously undergoes change in shape, weight, structure and functions. Abnormalities of shape like bidiscoidal, lobed, diffused, placenta succenturiata, fenestrated placenta, circumvallate, circummarginate Placenta have been encountered in literature.<sup>3</sup> The abnormal shape of the placenta is often associated with reduced placental efficiency that may lead to impaired placental and foetal development.

In our study on 89 placentae 14 placentae have shown abnormal shapes.

Vandana et al stated 52% of round shape, 42% oval, 6% irregular shaped placentae in their study.<sup>4</sup> Our study almost correlates with their study.

Micheal et al and Asra et al's study was similar to our study.<sup>5,6</sup>

Asra anjum et al stated that the placentae of diabetic mothers showed increased diameter and weight.<sup>6</sup> In our study diabetic placentae showed bilobed and oval shapes. PIH and Anaemia did not show any abnormality in the shape.

**Diameter of the placenta:** Placenta is described as the mirror which reflects the intrauterine status of the foetus.<sup>7</sup> Hypertension and other pathological conditions complicating pregnancy result in change of morphology and morphometry of the placenta. Which in turn affect the outcome of pregnancy. Udania et al stated that the diameter of the placenta is reduced in PIH cases. Our study had two placentae of mothers with PIH. And they have shown to have decreased diameter compared to the normal placentae.

Manirul et al stated that not much difference is seen in the mean diameter of placenta between normal and PIH cases.<sup>8</sup>

**Thickness of the placenta:** The maximum placental thickness was 42.2 mm at 38 weeks and the minimum was 13.9 at 12 weeks. The average placental thickness was  $28.4924\text{mm} \pm (1.03)$  for all the trimesters. Karthikeyan et al stated that Placental Thickness can be used as a predictor of the Gestational age. The subnormal Placental thickness for the corresponding gestational age should be evaluated for any disease condition.<sup>9</sup> Our study showed the mean thickness to be  $2.75 \pm 0.60$  cms. The difference in the mean thickness between their study and ours could be due to the formalin fixed placentae in our study where as Karthikeyan et al studied the placental thickness with the help of Ultrasonography.

**Weight of the placenta:** Cunningham et al stated that the ability of the foetus to grow and thrive in utero depends on the placental function and the average weight of the placenta at term is 508 g. The ratio between placenta weight and birth weight of the newborn is 1:6.3 our study has shown the mean weight of placenta as  $438.76 \pm 100.30$  which correlates with Cunningham et al.

**Maternal surface cotyledons:** David et al stated that heavier birthweight was associated with a greater number of cotyledons. Increased blood pressure in childhood was associated with reduced cotyledons.<sup>10</sup>

**Vascular pattern on foetal surface:** In the dispersal type - the umbilical vessels undergo successive division with gradually diminishing calibre towards periphery, while in magistral type the umbilical vessels is characterized by the arteries that traverse to the edge of placenta without appreciable decrease in diameter of vessels.<sup>11</sup> Our study showed Magistral type of vascular pattern on foetal surface in most of the placentae.

**Type of insertion of umbilical cord:** Ismail et al stated that abnormal placental cord insertion (PCI) includes marginal cord insertion (MCI) and velamentous cord insertion (VCI). VCI has been shown to be associated with adverse pregnancy outcomes.<sup>12</sup> Our study has shown one VCI and 16 MCI. And eccentric as well as central type of Umbilical cord insertions are frequently seen.

**Umbilical cord diameter:** Proctor et al stated that the umbilical cord diameter shows a strong association with placental and infant birth weight.<sup>13</sup> The mean diameter in our study was  $1.79 \pm 0.85$  cm.

**Number of umbilical vessels:** The umbilical cord normally contains two umbilical arteries, a single umbilical vein, an obliterated allantois duct, all surrounded by Wharton's jelly and contained within an outer layer of amnion. The structure of the umbilical cord can vary in the number of umbilical arteries, the length and diameter of the cord, and the direction and number of spirals of the cord.<sup>14</sup> All the placentae in our study showed two Umbilical arteries and one umbilical vein.

Any change in the number of umbilical vessels is often associated with various congenital anomalies.

## CONCLUSION

Variations in the morphology and morphometry of the placenta are usually associated with the foetal growth retardation, big babies, childhood hypertension, and various other pathological conditions. Hope our study adds knowledge to the placental parameters and help the Obstetricians, Embryologists, Radiologists, other clinicians and surgeons to understand the patho-physiological mechanisms of Placenta and design the treatment plans for a better maternal and foetal outcome. Ultrasonography has made it easy to study the necessary placental parameters in utero these days.

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**Conflicts of Interest:** None

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