Original Article
Sonographic assessment of placental location: a mere notional description or an important key to improve both pregnancy and perinatal obstetrical care?
A large cohort study

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Abstract: During a standard obstetrical sonogram, the assessment of placental location (PL) is often limited to a mere notional description without formulating any association to possible implications on pregnancy and childbirth. The aim of the study was to speculate if different sites of PL may have a role in influencing fetal presentation-(FP) at birth and if certain pregnancy-complications may be more closely associated with one rather than with another PL. We conducted an observational-prospective-cohort study on pregnant women referred to the Ob/Gyn Unit of Padua University for routine third-trimester ultrasound scan. For all eligible patients we evaluated the correlation between sites of PL and perinatal maternal/fetal outcomes. Non-cephalic presentation was found in 1.4% of anterior, 8.9% of posterior, 6.2% of fundal and 7.2% of lateral insertions. FP at the beginning of the third trimester as opposed to presentation at birth was concordant in 90.3% of anterior, 63.3% of posterior and 76.5% of lateral insertions. Considering only non-cephalic fetuses we observed a decreasing probability for spontaneous rotation in the following lies: 88% anterior-PL, 80% posterior-PL, 77% lateral-PL, and 70% fundal-PL. Patients with posterior-PL (significantly associated with previous-CS) had a significantly higher CS-rate (due to previous-CS and breech-presentation). Significant differences were found in terms of gestational-hypertension and fresh-placental-weight between different sites of PL. In conclusion our data showed that an understanding of the role that PL plays in influencing the incidence of certain maternal-fetal conditions may assist Clinicians in improving perinatal maternal/fetal outcomes.

Keywords: Placental location, perinatal care, obstetrical ultrasound, breech presentation, pregnancy complication

Introduction
Ultrasound imaging has become an integral component of routine prenatal medical care for most pregnant women. During an obstetrical ultrasound, evaluation of the fetus is chief priority but often, the other components (placenta, umbilical cord, and amniotic fluid) which represent an integral part of gestation, are arguably not given the attention they deserve [1].

Both the American College of Obstetricians and Gynecologists and the American Institute of Ultrasound in Medicine recommended that the standard obstetric sonogram in the second and/or third trimester should include the evaluation of placental position and morphology, the estimation of amniotic fluid volume, and the evaluation of both the morphology and function of the umbilical cord [2, 3].

While abnormalities in amniotic fluid volume and umbilical cord Doppler velocimetry immediately alert the sonographer (possible implications on the continuation of physiological pregnancy), sonographic assessment of placental location (PL), after exclusion of previa or marginal insertion (necessary to assess the option of vaginal delivery), is often limited to a mere notional description without any link to possible implications on pregnancy and childbirth [4-6].

There is a relative paucity of data regarding PL and subsequent pregnancy and delivery out-
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comes. Furthermore, studies of its association with specific obstetric complications have reached contradictory conclusions and no consensus has yet been achieved regarding the relationship between PL and non-vertex fetal presentation (FP) at term [7, 8].

We would speculate whether different sites of PL may have a role in influencing FP at birth and if some pregnancy complications may be more closely associated with one rather than with another insertion site.

Materials and methods

In the period between January-2012 and September-2013 we conducted an observational prospective cohort study on pregnant women referred to the Ob/Gyn Unit of Padua University for routine third trimester scan (gestational age 29-31 weeks).

Our Study was defined exempt from IRB after consultation of the local ethical committee. Approval from the local Institutional review board for health sciences is not required for observational/retrospective studies in which clinical and/or surgical management is not modified by the investigators. All patients were properly counselled regarding the aim of the study and gave written informed consent for the use of their data in respect to privacy law (Italian Law 675/96).

We considered eligible for the study single fetus pregnancies having complete clinical records of all antenatal visits beginning from the first trimester and defined as uncomplicated upon recruitment, patient proficiency in Italian language and with an expressed intention to continue pregnancy care until delivery at our Clinic. We excluded patients with incomplete clinical records and those who did not deliver at our Unit or dropped-out of the follow up program. We also excluded pregnancies with a maternal history of pre-gestational diabetes [9] and/or hypertension [10], patients on dietary calcium supplementation due to an estimated increased risk for preeclampsia [11, 12], history of previous uterine surgery (including both the cervix and corpus uteri), with the exception of uncomplicated cesarean section (CS), [13-18], patients who chose VBAC (vaginal birth after cesarean) or attempted external cephalic version [19-21], placenta previa, abnormalities in amniotic fluid volume (oligo and polihydramnios) and estimated fetal weight greater than 75° or lower than 25° centile. Patients participating in a concurrent study conducted at our Clinic regarding alternative maternal positions during labor were not included [22].

Intervention

A standard ultrasound was performed on all eligible patients at the beginning of the third trimester of pregnancy (29-31 gestational weeks) and at term (38 gestational weeks). Patients who delivered preterm were evaluated sonographically upon delivery room admission.

The ultrasound examination was performed by one of the researchers (SG) previously trained in the use of intrapartum ultrasound. The transabdominal scan was performed in maternal supine position with a 3.5 MHz convex probe AB2-7-RS (Voluson e6 compact-GE Healthcare, GE Medical Systems Ltd, Hatfield, AL9 5EN).

Data collection

Data regarding maternal features (age, parity, mode of delivery in previous pregnancies, pre-gestational BMI, weight gain during pregnancy) was collected for all patients.

At recruitment, the following data was entered into a computerized database: spontaneous or assisted conception, gestational age, FP and eco-biometry, placental location (anterior, posterior, lateral, or fundal) and amniotic fluid index.

Following delivery, data regarding gestational age, third trimester pregnancy complications (gestational diabetes, hypertension/preeclampsia, threat of preterm birth, placental abruption, pPROM, preterm birth), fetal presentation, mode of delivery (vaginal spontaneous or operative, cesarean section elective or urgent), length and complications of the third stage of labour (for vaginal delivery alone) was collected for all patients included in our study.

We also considered neonatal sex, weight, umbilical pH values and necessity of intensive care.

Finally, we completed the dataset by recording information concerning placental fresh weight
Table 1. Data about maternal epidemiological features (Table 1A) and pregnancy characteristics at recruitment (Table 1B) stratified for all sites of placenta insertion

<table>
<thead>
<tr>
<th>Variables</th>
<th>Placental Site</th>
<th>Number</th>
<th>Mean ± SD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE (years)</td>
<td>ANTERIOR</td>
<td>579</td>
<td>33.35 ± 5.39</td>
<td>P: n.s</td>
</tr>
<tr>
<td></td>
<td>POSTERIOR</td>
<td>327</td>
<td>33.31 ± 5.71</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FUNDAL</td>
<td>81</td>
<td>32.74 ± 5.57</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LATERAL</td>
<td>69</td>
<td>33.78 ± 6.14</td>
<td></td>
</tr>
<tr>
<td>WEIGHT GAIN DURING PREGNANCY (kilograms)</td>
<td>ANTERIOR</td>
<td>579</td>
<td>13.13 ± 4.16</td>
<td>P: n.s</td>
</tr>
<tr>
<td></td>
<td>POSTERIOR</td>
<td>327</td>
<td>13.20 ± 4.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FUNDAL</td>
<td>81</td>
<td>13.09 ± 4.53</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LATERAL</td>
<td>69</td>
<td>12.67 ± 3.70</td>
<td></td>
</tr>
<tr>
<td>PRE-GESTATIONAL BMI (Kg/m²)</td>
<td>ANTERIOR</td>
<td>579</td>
<td>22.91 ± 3.66</td>
<td>P: n.s</td>
</tr>
<tr>
<td></td>
<td>POSTERIOR</td>
<td>327</td>
<td>23.07 ± 3.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FUNDAL</td>
<td>81</td>
<td>22.60 ± 3.22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LATERAL</td>
<td>69</td>
<td>23.44 ± 4.27</td>
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</table>

<table>
<thead>
<tr>
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<th>Number [%]</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE OF DELIVERY IN A PREVIOUS PREGNANCY</td>
<td>ANTERIOR PLACENTA</td>
<td>219 [73.2]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 CESAREAN</td>
<td>65 [21.7]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥ 2 CESAREANS</td>
<td>15 [5.1]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>POSTERIOR PLACENTA</td>
<td>84 [50.6]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 CESAREAN</td>
<td>66 [39.8]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥ 2 CESAREANS</td>
<td>16 [9.6]</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td></td>
<td>FUNDAL PLACENTA</td>
<td>27 [62.8]</td>
<td></td>
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<tr>
<td></td>
<td>1 CESAREAN</td>
<td>12 [27.9]</td>
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<td></td>
<td>≥ 2 CESAREANS</td>
<td>4 [9.3]</td>
<td></td>
</tr>
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<td></td>
<td>LATERAL PLACENTA</td>
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</tr>
<tr>
<td></td>
<td>1 CESAREAN</td>
<td>8 [22.2]</td>
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<tr>
<td></td>
<td>≥ 2 CESAREANS</td>
<td>2 [5.6]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ANTERIOR PLACENTA</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>PRIMIPAROUS</td>
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<tr>
<td></td>
<td>MULTIPAROUS</td>
<td>78 [13.5]</td>
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<tr>
<td></td>
<td>POSTERIOR PLACENTA</td>
<td>161 [49.3]</td>
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<tr>
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<td>PRIMIPAROUS</td>
<td>125 [38.2]</td>
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<tr>
<td></td>
<td>MULTIPAROUS</td>
<td>41 [12.5]</td>
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<tr>
<td></td>
<td>FUNDAL PLACENTA</td>
<td>38 [46.9]</td>
<td>P: n.s</td>
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<tr>
<td></td>
<td>PRIMIPAROUS</td>
<td>32 [39.5]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MULTIPAROUS</td>
<td>11 [13.6]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LATERAL PLACENTA</td>
<td>33 [47.8]</td>
<td></td>
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<tr>
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<td>PRIMIPAROUS</td>
<td>27 [39.1]</td>
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<tr>
<td></td>
<td>MULTIPAROUS</td>
<td>9 [13.1]</td>
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<tr>
<td>PARITY</td>
<td>ANTERIOR</td>
<td>563 [97.2]</td>
<td></td>
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<td></td>
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<td>323 [98.8]</td>
<td>P: n.s</td>
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<tr>
<td></td>
<td>FUNDAL</td>
<td>79 [97.5]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LATERAL</td>
<td>68 [98.5]</td>
<td></td>
</tr>
<tr>
<td>GESTATIONAL DIABETES</td>
<td>ANTERIOR</td>
<td>29 [5]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>POSTERIOR</td>
<td>28 [8.6]</td>
<td>P: n.s</td>
</tr>
<tr>
<td></td>
<td>FUNDAL</td>
<td>5 [6.2]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LATERAL</td>
<td>1 [1.4]</td>
<td></td>
</tr>
</tbody>
</table>
and macroscopic features (regular, bilobed, succenturiate lobed, circumvallate/circummarginate, velamentous cord insertion).

Endpoints

Primary endpoint was to evaluate the existence of a correlation between sites of PL and FP at birth.

Secondary endpoint was to evaluate if specific sites of PL were associated with spontaneous cephalic version before delivery in the cohort of patients with non-cephalic FP observed sonographically at the beginning of the third trimester of pregnancy.

Finally, we investigated possible correlations between the site of PL and maternal features (age, parity, smoking habits, pre-conceptional BMI, type of previous delivery), characteristics of pregnancy (spontaneous or assisted conception, pregnancy weight gain, gestational age at delivery, third trimester complications), delivery and neonatal outcome (mode of delivery, third stage complications, neonatal features and well-being at birth, placental features and morphology).

Statistical analysis

Statistical analysis was performed by SPSS software (Chicago, IL) for Windows version 19,
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applying parametric and non-parametric tests when appropriate. The Kolmogorov-Smirnov test was used to assess the normality of distribution. Continuous variables were expressed as absolute numbers, average ± standard deviation, and analyzed by Student-t test or Anova test when appropriate; categorical variables were expressed as percentages and analyzed through the $\chi^2$ test or the Fisher's exact test, when appropriate. Statistical significance was defined as $P$ values <0.05.

Results

In the time interval considered, 1056 patients satisfied the inclusion criteria and were enrolled in the study. Collected data pertaining to maternal epidemiological features and pregnancy characteristics at recruitment was reported in detail in Table 1 by stratifying the single variables for placental site. (Table 1A, 1B).

The mean gestational age at birth was 38.7 ± 1.3 weeks. Regarding the mode of delivery, 51.9% (548 patients) delivered spontaneously, 5.2% (55 patients) by operative vaginal delivery, 19.4% (205 patients) by elective-CS and 23.5% (248 patients) by urgent-CS.

The indications for CS (453 cases) were the following: previous-CS in 41.5%, breech presentation in 9.7%, abnormal fetal-heart-rate in 34.9%, and dystocia in 13.9%.

Concerning newborn characteristics, 54.5% were male and 45.5% were female, mean birth weight was 3300.2 ± 446.5 g, mean umbilical pH value was 7.28 ± 0.1 and only 0.3% required (32 cases) intensive care.

The mean value of fresh placental weight was 611.76 ± 116.82 grams. Histological evaluation of the placenta showed regular findings in

![Figure 1. Correlation of data regarding site of placenta insertion and fetal presentation observed at birth (Figure 1A), at the beginning of the third trimester (Figure 1B), $\Delta$ variation of non-cephalic presentation and the estimation of the probability of spontaneous rotation (Figure 1C).](image-url)
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99.9% with structural abnormalities observed in only 12 cases (0.1%) (8 velamentous and 1 marginal cord insertions, 2 bilobed and 1 succenturiate placenta).

The correlation of data regarding the site of PL and FP at birth showed significant statistical differences between anterior and non-anterior insertions. (P<0.05). In detail, pregnancies with an anterior PL had a 1.4% of non-cephalic fetuses (8/579 pregnancies, all breech presentations) as opposed to 8.9% (29/327 pregnancies, 7.9% breech and 1.0% transverse presentations) in posterior, 6.2% (5/81 pregnancies, all breech presentations) in fundal and 7.2% (5/69) in lateral insertions (Figure 1A).

Similarly, the correlation of data regarding placental site and FP observed at the beginning of the third trimester showed a statistically significant difference between anterior and non-anterior locations. (P<0.001). The percentages of non-cephalic fetal presentations according to placental lie are the following: 11.1% (64/579 pregnancies with 54 breech and 10 transverse presentations) of anterior, 44.3% (145/327 pregnancies, 134 breech and 11 transverse presentations) of posterior, 29.6% (24/81 pregnancies, 23 breech and 1 transverse presentations) of fundal and 31.9% (22/69 pregnancies, 18 breech and 4 transverse presentations) of lateral insertions (Figure 1B).

In comparing data regarding FP at the beginning of the third trimester as opposed to presentation at birth, we observed that in anterior PL fetal presentation was concordant in 90.3% of cases while in posterior and lateral insertions the concordance dropped to 63.3% and 76.5% respectively (P<0.001).

Considering only non-cephalic fetuses, after stratification of data according to spontaneous cephalic version at birth in relation to PL, we found a statistically significant decreasing probability for spontaneous cephalic version in

Figure 2. Stratification of data regarding Cesarean Section rate according to the indication for all the sites of placental insertion.

Figure 3. Stratification of data regarding fresh placental weight according to the sites of placental insertion.
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the following placental locations: 88% in anterior, 80% in posterior, 77% in lateral, and 70% in fundal insertion sites \((P<0.05)\) (Figure 1C).

Considering maternal obstetrical history, we found a significant association between previous CS and posterior PL in the following pregnancy. \((P<0.05)\). In the cohort of patients who delivered by CS we observed a posterior PL in 37.1% versus 25% observed in the cohort of those who delivered vaginally. Additionally, patients with posterior PL showed a significantly higher rate of CS when compared to those with PL in different uterine sites (27.5% versus 18.6%, respectively). \((P<0.01)\) As expected, patients with a posterior PL had a significantly higher rate of CS with the indication of status post CS (51.7% versus 41.7%, respectively) and breech presentation (17.7% versus 10.4%) as opposed to those with a non-posterior insertion site \((P<0.05)\) (Figure 2).

Considering pregnancy outcome in relation to PL, we found significant differences only in the diagnosis of gestational hypertension which was identified in 5.5% of posterior insertions, 3.1% of anterior insertions, 1.2% of fundal insertions and no cases observed in pregnancies with a lateral insertion \((P<0.05)\).

Finally, significant differences were also found in terms of fresh placental weight, with the highest weight detected anteriorly (mean value 632.22 ± 112.39 grams) and the lowest posteriorly (mean value 582.56 ± 121.08) \((P<0.05)\) (Figure 3).

No other significant differences were found when comparing the remaining maternal epidemiological features, pregnancy characteristics, delivery trends, and neonatal outcomes.

**Discussion**

Advances in technology and the development of real-time three/four dimensional ultrasonography has initiated a new era in obstetrical diagnosis. The visualization of in-uteru fetal activity during the various stages of gestation may help Perinatologists comprehend the existing relationships between fetal behavior and neurological development and maturation [23].

Speculations regarding the role of PL in determining FP at birth as well as the impact that the different sites of PL may have on pregnancy development may be considered by the majority of Obstetricians as anachronistic and of little value.

Although PL has been systematically included in standard ultrasound reports for the past 30 years, unfortunately, only few studies (frequently with contrasting results) have been conducted with the aim of investigating the impact of PL on pregnancy outcome (excluding research on low-lying placenta/placenta previa).

In the era in which “reducing the primary cesarean delivery rate represents a worldwide priority”, [24, 25] an investigation focused on PL and its impact on fetal presentation at term should be considered relevant.

A very recent ACOG consensus strongly recommends offering pregnant woman with non-cephalic FP after 36 gestational weeks the option of external cephalic version [25].

Considering that our data, in agreement with the small number of available studies [26-28], clearly demonstrated that PL may have a strong impact on non-cephalic FP at birth, it may be appropriate that Obstetricians begin considering this information before counseling patients regarding birth plan.

Up until 24 gestational weeks, the frequencies of breech and cephalic presentations are equal within the longitudinal situs [29]. From the 25th to 36th week of gestation there is an increase in the frequency of cephalic presentation with a proportional decrease in breech presentation [29].

We may speculate that placental location may behave as an intrauterine factor potentially capable of influencing the physical conditions (gravity, maternal posture, fetal neurological development) that favor the fetal body axis posture that is manifested by cephalic presentation.

We found that, beginning in the third trimester of pregnancy, the anterior PL was associated with a significantly lower rate of non-cephalic presentation (11.1%) when compared to all the remaining locations with a rate ranging from 29.6% in fundal to 44.3% in posterior positions.

Despite the fact that the exact mechanisms involved in facilitating fetal rotation into cephal-
ic presentation are not precisely understood, it has been postulated that the fetus performs a change of lie and presentation by sudden extension of the legs and active whole body movements (such as kicking), and perhaps by body rolling. All these actions require a certain degree of neuromuscular and sensorial maturation which is usually present by the end of the second trimester of pregnancy in the human species [29].

The possibility that certain sites of PL (anterior) rather than others (fundal, posterior, lateral) may favor early fetal alignment in cephalic presentation leads us to hypothesize on a possible placental intrauterine spatial hindrance effect. Likely the anterior site of PL is associated with a greater placental volume as opposed to other insertion sites, as indirectly demonstrated by our data which showed a significantly higher fresh weight in the anterior sites.

Stating that while this evidence requires further confirmation, it may be possible to hypothesize that fetuses with an anterior PL at the beginning of the third trimester may “passively” assume (by body rolling rather than by sudden extension of the legs and/or by kicking due to low fetal weight and immaturity of the central nervous system) the most convenient position as influenced by gravity.

In cephalic presentation the fetal upper body segments (the hypotonic-atonic part of the body) are in caudal direction while the lower body segments take a cranial position. In other words, assuming a cephalic presentation brings the body axis along the direction of gravity [29].

Our data clearly demonstrated that while only 11.1% of fetuses with anterior PL were found to be in breach presentation at the beginning of the third trimester of pregnancy, by delivery this cohort of fetuses had demonstrated the highest rate of spontaneous rotation into the cephalic position. This fact probably confirms the assumption that in the event of an anterior placental location, the most “spontaneous and natural” convenient behavior for the fetus is that of assuming cephalic presentation.

On the contrary, fetuses with posterior, fundal, or lateral PL, shift from breach to cephalic later in intrauterine life (around the first half of the third trimester of pregnancy). This fact might be explained by two theoretical assumptions: the first being that, when the placenta in located in a non-anterior site, the fetuses has the “need” to assume a “gravity position” later in gestation, the second is that in a non-anterior placental site, a cephalic positioning generally requires an “active” fetal involvement that depends on a higher degree of neuromuscular development typically reached in later stages of gestation.

The higher rate of non-cephalic fetuses at birth in non-anterior PL may be explained by the assumption that ongoing pregnancy in the third trimester is associated with a decrease in the rate of fetal weight gain and a reduction in amniotic fluid volume (frequently idiopathic), both factors which potentially reduce the likelihood of spontaneous rotation [4].

This assumption was indirectly confirmed by data recently reported in studies which evaluated the predictors of successful external cephalic version in non-cephalic fetuses [30, 31].

We are aware of the fact that our speculations regarding the association between PL and FP in the third trimester of pregnancy warrant confirmation by further multicenter studies involving a very large cohort of patients.

Regarding the correlation between maternal epidemiological features and obstetrical history with specific PL, our data showed a significant association only between history of previous CS and posterior PL.

Our data further confirmed previous evidences by Naji et al. [32] demonstrating that the presence of CS scars in the uterine wall is associated with an increase in the number of posterior or PL and a reduced number of implants in the fundal portion of the uterine cavity. Furthermore, the same study group demonstrated that the probability of miscarriage in the pregnancy following a CS is inversely associated with the distance between the uterine scar and the site of implantation [33]. This association of evidences leads us to consider if perhaps the detection of a significantly higher rate of posterior PL in pregnancies following CS may be due to a higher rate of pregnancy loss due to implantation near the uterine scar or simply due to a casual implantation in the posterior uterine wall.
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Regarding the association between placental location and adverse pregnancy outcomes, our data, though collected on a large study population (1056 patients), failed to demonstrate any relationship as previously reported in literature [7, 34, 35].

Devarajan et al in 2012 reported that PL was not associated with differences in newborn weight or in any other perinatal outcome [36], while previously various Authors demonstrated that a posterior PL may be a contributory risk factor for stillbirth [33] and that pregnancies complicated by IUGR are significantly more likely than non-IUGR pregnancies to have lateral placentation [37].

In 2011 Fung et al analyzed 16236 patients to determine whether PL in the second trimester of pregnancy is associated with adverse pregnancy outcomes found that women with a ‘fun-dal’ placenta were at an increased risk of the following: pre-eclampsia, preterm delivery before 34 weeks, non-vertex presentation, small for gestational age fetuses and manual removal of the placenta following vaginal delivery. Likewise similar results were reported for lateral placentation. Authors therefore concluded that “non-central PL” in the second trimester is associated with an increased risk of adverse obstetric outcomes [7].

Unexpectedly, in our study group none of the patients with a lateral PL developed hypertension or preeclampsia versus an average 5% rate occurring in other insertion sites.

Regarding intrapartum outcomes, in addition to the differences observed in terms of FP between the different insertion sites, we found that in women with a posterior placenta the overall CS rate was higher than in the non-posterior sites. However this finding requires further investigation since this event may be affected by the bias linked to a higher rate of recurrent CS. As stated above, the cohort of patients with posterior placenta showed a higher rate of previous CS.

Excluding FP, incidence of gestational hypertension, and placental weight at birth, we did not find any differences between the various sites of insertion and pregnancy-related complications, intrapartum adverse events, neonatal wellbeing, and placental morphology.

Most likely our results were affected by a selection bias due to that fact that we defined as eligibility criteria for study inclusion an “uncomplicated pregnancy until the moment of recruitment” which occurred at the beginning of the third trimester of pregnancy.

Other potential bias may include: exclusion of patients with an estimated increased risk of developing preeclampsia and assuming dietary calcium supplementation, exclusion of patients assuming alternative positions during labor as well as the lack of data regarding the fetal occiput and spinal position before delivery which may influence the occurrence of intrapartum adverse events [38, 39], and lack of consideration of differences in obstetrical history which may affect the overall rate of “recurrent CS” which indirectly influences the placental weight at delivery (typically heavier in CS as opposed to vaginal delivery, probably due to uterine contractions during labor which squeeze maternal blood from the placental parenchima) [40].

As points of strength we report: strict inclusion criteria, interesting findings regarding the impact of obstetrical history in determining the site of PL in turn responsible for the significant differences found in terms of FP at birth, the formulation of a possible explanation of the mechanism by which PL facilitates an earlier or later cephalic version of the fetus and the hypothesis of the important contribution that fetal neuromuscular development, dependent on the gestational age, has in the fetus assuming a cephalic or non-cephalic presentation.

In conclusion, considering the placenta as an “active and integral part of gestation” may help us comprehend the physiopathological mechanisms responsible for events previously considered as “casual or idiopathic”. In the modern obstetrical care setting in which new evidences are constantly set forth, the persistence in under-investigating and misunderstanding the potential impact that the various placental sites may have in influencing pregnancy, peripartum and neonatal outcomes may be considered anachronistic.

We believe that comprehending the role that PL has in increasing or diminishing the incidence of certain maternal-fetal adverse events may allow us to decrease the number of pregnancy
and perinatal conditions currently treated by symptomatic therapy or by an empirical approach.

**Disclosure of conflict of interest**

None.

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Perinatal outcomes according to the placental location