



# Discordant Crown Rump Length (CRL) in Twins: Is it a Matter of Concern?—The Indian Perspective

Brinda Sabu<sup>1</sup> · Sudarshan Suresh<sup>1</sup> · Suresh Seshadri<sup>1</sup>

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**Abstract** To evaluate the impact of discordant Crown Rump Length (CRL) noted in the first trimester on the outcome of monochorionic (MC) and dichorionic (DC) twin gestations and to establish its role as a predictor of adverse outcomes. This was a retrospective case control study carried out at a tertiary fetal medicine centre in South India between June 2013 and May 2018. Cases were obtained from the database of the centre. All viable monochorionic diamniotic (MCDA) and dichorionic diamniotic (DCDA) twin pregnancies scanned between 11 and 14 weeks gestational age after excluding fetuses with structural abnormalities were included in the study. The impact of discordant CRL  $\geq 10\%$  on the outcomes of twins was evaluated. Among 2627 twin pregnancies 2298 (87.5%) were dichorionic and 329 (12.5%) were monochorionic. Among the DC twin pregnancies CRL discordance  $\geq 10\%$  was found in 124 (5.4%) while 2174 (94.6%) were concordant. Among the MC twin pregnancies CRL discordance  $\geq 10\%$  was found in 20 (6.1%) while 309 (93.9%) were concordant. In DC twin pregnancies we found a significant association between CRL discordance of  $\geq 10\%$  and fetal loss ( $p = 0.001$ ), mean GA at delivery ( $p = 0.002$ ) and mean birth weight ( $p = 0.04$ ). However in MC twin pregnancies we did not find any association

between discordant CRL and adverse outcomes. When the CRL discordance cutoff was increased to  $\geq 16\%$  (95th centile), there was a significant increase in the aforementioned adverse outcomes in DC twin pregnancies while in MC twin pregnancies there was a significant increase in fetal loss ( $p = 0.027$ ). To evaluate CRL discordance as a predictor of adverse outcomes, receiver operating curves were created for each outcome studied. But they failed to show the predictive accuracy in both CRL  $\geq 10\%$  and CRL  $\geq 16\%$  groups. CRL discordance in DC twin pregnancies are more commonly associated with adverse outcomes than MC twin pregnancies and it significantly increases when CRL  $\geq 16\%$  (95th centile) was used as cutoff. Hence CRL discordance of  $\geq 16\%$  should be set as the cutoff to identify pregnancies at risk. However we reiterate that discordant CRL, irrespective of the cutoff used, is not a robust predictor of adverse outcomes.

**Keywords** CRL discordance · Twin pregnancy · Adverse pregnancy outcome · Fetal loss · Preterm delivery · Birthweight discordance

## Introduction

The incidence of twin pregnancies keeps increasing due to advanced maternal age and assisted reproductive techniques. Though twin births account only for 3% of all births, they contribute to a sizeable share of perinatal morbidity and mortality [1], mainly due to preterm birth, growth discordance, fetal anomalies and complications uniquely related to monochorionicity such as Twin-to-Twin Transfusion Syndrome (TTTS), Twin Reversed Arterial Perfusion sequence (TRAP), Twin Anemia Polycythemia Sequence (TAPS) and monochorionic

✉ Suresh Seshadri  
ssmediscan@gmail.com

Brinda Sabu  
brinda\_sabu@yahoo.co.in

Sudarshan Suresh  
drsudarsh@gmail.com

<sup>1</sup> Department of Fetal Medicine, Mediscan Systems, 197, Dr Natesan Road Kailasapuram, Mylapore, Chennai, Tamilnadu 600004, India

monoamniotic twins [2–6]. Crown rump length (CRL) is the length of the embryo or fetus from the top of its head to bottom of torso. Popularly called the Robinson's CRL curve, it is the most accurate estimation of gestational age in early pregnancy, owing to the little biological variability at that time [7]. Thus CRL measurement has become the universal pregnancy dating tool to avoid last menstrual date recall errors [7, 8].

In twins, 11–14 weeks USG plays a vital role in providing appropriate prenatal care by determining chorionicity, categorizing associated perinatal risks and monitoring for early detection of set complications [9, 10]. Significant discordance in crown–rump length (CRL) is associated with higher risk of adverse perinatal outcomes such as fetal loss, fetal anomalies, weight discordance and preterm delivery [11–18]. It has been hypothesized that impaired fetal growth in early pregnancy and the presence of underlying fetal chromosomal or structural anomalies may explain this phenomenon [19]. The guideline, as set by the Royal College of Obstetricians and Gynecologists, on the management of monochorionic twin pregnancy confirms that discordance of crown–rump length (CRL) of  $> 10\%$  is a risk factor for perinatal death [20].

There is evidence that birthweight may be associated with embryonic size early in pregnancy [20, 21] and the ramifications of discrepant fetal size identified in the first trimester are less well understood [22, 23].

This is where first trimester CRL discrepancy comes in, as a correlation between it and birthweight discordance can be contributory in early detection and diagnosis of developmental and structural abnormalities. Though CRL discordance is usually a reason for counseling parents regarding adverse pregnancy outcome, the importance of discordance degree which is considered to be a predictor of pregnancy complications is still a matter for debate [24].

Assuming that discordant growth in twins exhibit as early as the first trimester of pregnancy, this study aimed at evaluating the impact of discordant CRL noted in the first trimester on the outcome of monochorionic and dichorionic twin pregnancies. We also focused to establish its role as a predictor for adverse outcomes.

## Methods

This is a retrospective case control study carried out at Mediscan Systems, Chennai, a tertiary fetal medicine centre in South India. Close to 9000 first trimester scans are performed in the dedicated first trimester unit every year with specific protocols. The period of the study was 5 years (June 2013–May 2018). Total number of first trimester scans in the abovementioned period was 44,483. Among these, there were 3,036 first trimester twins. The

cases were obtained from “Sonocare” database using the search string “discordant CRL”, “CRL discordancy”. The data retrieved was anonymised with respect to the contacts and names were identified by a unique ID. All viable monochorionic and dichorionic twin pregnancies scanned between 11 and 14 weeks gestation during the above-mentioned period were identified. Discordant CRL group from MC and DC twin pregnancies was defined as CASE. A concordant CRL group was chosen from both MC & DC twin pregnancies as CONTROL by systematic randomization at the ratio of 1:2.

CRL discordancy was defined as the difference between twins  $\geq 10\%$  and was calculated as  $100 \times (\text{larger CRL} - \text{smaller CRL}) / \text{larger CRL}$ . NT discordancy was defined as the NT difference between twins  $> 20\%$  and was calculated as  $100 \times (\text{larger NT} - \text{smaller NT}) / \text{larger NT}$ . Mean birth weight was derived from the sum of the two infants' individual weights divided by two. Birth weight (BW) discordance (%) was defined as the difference between twins  $> 20\%$  and was calculated as  $100 \times (\text{larger BW} - \text{smaller BW}) / \text{larger BW}$ . Spontaneous loss of at least one fetus was classified as miscarriage if there was a fetal loss before  $23 + 6$  weeks gestation and intrauterine fetal death (IUFD) after  $24 + 0$  weeks gestation. Neonatal death was defined as death within the first 28 completed days after delivery. Neonatal Intensive Care Unit (NICU) stay was also calculated and was considered significant if the stay duration is  $> 7$  days [13].

All twin pregnancies with a documented chorionicity (monochorionic and dichorionic) and confirmed viability with CRL between 45 and 84 mm were included in the study. Pregnancies with monochorionic monoamniotic twins, higher order multiples reduced to twins and structural anomalies identified in the initial scan were excluded.

The maternal characteristics were age, body mass index and method of conception. Maternal Body Mass Index BMI, reported at the 11–14-weeks scan, was categorized according to World Health Organization criteria: Underweight ( $< 18.5 \text{ kg/m}^2$ ); Normal weight ( $18.5\text{--}24.9 \text{ kg/m}^2$ ); Overweight ( $25.0\text{--}29.9 \text{ kg/m}^2$ ); Obese ( $\geq 30.0 \text{ kg/m}^2$ ). The method of conception was considered as either natural or assisted. The fetal characteristic considered was increased nuchal translucency.

The primary outcomes of the study were: birth weight discordance  $\geq 20\%$ , preterm delivery  $< 34$  weeks and fetal loss. The secondary outcomes were: gestational age at delivery, mean birth weight, NICU stay, single neonatal death, double neonatal death, infants surviving  $> 28$  days of life.

The twins were divided into two groups:

1. Concordant CRL group (Control)
2. Discordant CRL group (Case)

Results between the groups were compared and according to the degree of discordance and adverse outcomes a further subgroup was analysed. All patients were followed up and postnatal outcomes were obtained by contacting referring physicians, reviewing medical charts or through telephonic contact of parents.

Statistical analysis was done by using Statistical package for social sciences (SPSS software). All continuous variables were analyzed by using students paired t- test. For categorical variables Chi square test was performed. Univariate analysis was used to estimate the Odds ratio (OR) and their Confidence intervals (CI). The receiver operating characteristics (ROC) curve was used to evaluate CRL discordance as a predictor of fetal loss, intrauterine death, preterm delivery before 34 weeks gestation, birth weight discordance and neonatal survival > 28 days.  $p$  value < 0.05 was considered as statistically significant.

## Results

Data retrieval was done from a total of 2627 twin pregnancies over 5 years (June 2013–May 2018) at the 11–14 weeks scan that fulfilled the inclusion criteria. Among these, 2298 (87.5%) were DC twin pregnancies and 329 (12.5%) were MC twin pregnancies. Among the DC twin pregnancies, CRL discordance of  $\geq 10\%$  was found in 124

(5.4%), while 2174 (94.6%) were concordant. Among the MC twin pregnancies, CRL discordance  $\geq 10\%$  was found in 20 (6.1%), while 309 (93.9%) were concordant. Thus the number of DC and MC twin pregnancies in the discordant group was 144. The concordant group of 2483 was randomized systematically and a control group of 288 was selected at the ratio of 1:2 (Case:Control).

In our study, DC and MC twin pregnancies were equally distributed between the concordant and discordant groups. The maternal and fetal characteristics are shown in Table 1. Information about outcome was obtained in 84% of discordant twins and 89% of the concordant twins. Maternal age, mode of conception and BMI did not differ between the concordant and discordant groups in both MC and DC twin pregnancies. NT discordance was significantly more common in the discordant CRL group of both MC and DC twins. The odds ratios of adverse outcomes of both discordant and concordant groups in DC and MC pregnancies are listed in Table 2.

In DC twin pregnancies, the discordant CRL group of  $\geq 10\%$  differed significantly from the concordant group in terms of the primary outcomes—fetal loss (OR 4.3, 95% CI 2–9.2,  $p=0.001$ ). There was also a statistically significant difference noted in terms of single IUD (OR 4.7, 95% CI – 1.6 to 14.24,  $p=0.006$ ), GA at delivery ( $p=0.001$ ) and mean birth weight ( $p=0.004$ ) between the two groups. However, no significant difference was noted in preterm

**Table 1** Maternal and Fetal characteristics according to CRL discordance  $\geq 10\%$  in DC and MC twin pregnancies at the 11–14-week scan

Characteristics		DCDA			MCDA		
		Concordant (n = 253)	Discordant (n = 124)	$p$ value	Concordant (n = 35)	Discordant (n = 20)	$p$ value
Maternal age in years, median (IQR)		30.7 (24.8–36.6)	31 (25.6–36.4)	0.632	26 (21.9–30.1)	27.9 (23.3–32.5)	0.119
Mode of conception, n (%)	Natural	65 (26%)	34 (27%)	0.720	28 (80%)	15 (75%)	0.666
	Assisted	188 (74%)	90 (73%)		7 (20%)	5 (25%)	
BMI, n (%)	Underweight ( $< 18.5 \text{ kg/m}^2$ )	6 (2%)	3 (2%)	0.964	1 (3%)	1 (5%)	0.427
	Normal ( $18.5\text{--}24.9 \text{ kg/m}^2$ )	95 (38%)	43 (35%)		17 (49%)	6 (30%)	
	Overweight ( $25.0\text{--}29.9 \text{ kg/m}^2$ )	94 (37%)	51 (41%)		13 (37%)	8 (40%)	
	Obese ( $> 30.0 \text{ kg/m}^2$ )	50 (20%)	23 (19%)		3 (9%)	2 (10%)	
	Unknown	8 (3%)	4 (3%)		1 (3%)	3 (15%)	
Gestational age in weeks, median (IQR)		12.5 (11.6–13.1)	12.6 (12.1–13.1)	0.935	12.5 (12–13)	12.6 (12–13.2)	0.482
NT Discordant, n (%)		47 (19%)	58 (47%)	<b>0.000</b>	5 (14%)	14 (70%)	<b>0.000</b>
NT Concordant, n (%)		206 (81%)	66 (53%)		30 (86%)	6 (30%)	

$P$  value 0.000 is highly significant as it is < 0.001

**Table 2** Odds ratios (OR) of adverse outcomes in DC & MC twin pregnancies with CRL discordance of  $\geq 10\%$  at the 11 – 14 weeks scan

Outcome	Odds ratio (95% CI)	DCDA		
		Concordant (n – 218/ 253)	Discordant (n – 100/ 124)	p value
Fetal loss (Total)	4.29 (2–9.2)	12 (5.5%)	20 (20%)	< 0.001
Fetal loss < 24 weeks	2.7 (0.87–8.1)	6 (2.7%)	7 (7%)	0.086
Fetal loss > 24 weeks	Single	5 (2.3%)	10 (10%)	0.006
	Both	1 (0.5%)	3 (3%)	0.243
PTD $\leq 34$ weeks	1.56 (0.93–2.62)	54 (22.7%)	34 (32%)	0.080
Gestational age @ delivery		35.4 (33.4–37.4)	34.6 (32.3–36.6)	0.002
BW discordance $\geq 20\%$	0.74 (0.40–1.36)	34 (16%)	20 (20%)	0.332
BW (g)		2094 (1706–2547)	1982 (1513–2451)	0.040
NND	One infant	5 (2.3%)	3 (3%)	0.710
	Both	1 (0.5%)	1 (1%)	0.580
Two infants alive > 28 days	0.38 (0.19–0.80)	200 (92%)	74 (74%)	0.101
NICU stay	$\leq 7$ days	83 (69%)	38 (63%)	0.479
	> 7 days	38 (31%)	22 (37%)	
TOP	1.5 (0.2–8.9)	3 (1.4%)	2 (2%)	0.68
Outcome	Odds ratio (95% CI)	MCDA		
		Concordant (n – 30/ 35)	Discordant (n – 20/ 20)	p value
Fetal loss (total)	0.3 (0.03–3.3)	4 (13%)	2 (10%)	0.336
Fetal loss < 24 weeks	0.74 (0.06–8.7%)	2 (6.7%)	1 (5%)	0.808
Fetal loss > 24 weeks	Single	1 (3.3%)	1 (5%)	0.769
	Both	1 (3.3%)	0 (0%)	0.658
PTD $\leq 34$ weeks	0.69 (0.18–2.68)	8 (35.7%)	4 (20%)	0.619
Gestational age @ delivery		34.6 (33–37)	35.1 (34–37)	0.351
BW discordance $\geq 20\%$	2.78 (0.67–11.5)	4 (13.3%)	6 (30%)	0.308
BW (g)		2005 (1476–2534)	1720 (1235–2205)	0.060
NND	One infant	0 (0%)	1 (5%)	0.351
	Both			
Two infants alive > 28 days	0.83 (0.29–2.4)	23 (77%)	13 (65%)	0.724
NICU stay	$\leq 7$ days	9 (64%)	6 (55%)	0.622
	> 7 days	5 (36%)	5 (45%)	
TOP	2.25 (0.45–11.4)	3 (10%)	4 (20%)	0.326

delivery, birth weight discordance and other outcomes. In MC twin pregnancies, neither the primary outcomes nor the secondary outcomes were statistically significant in both the concordant and discordant groups.

The aim of our study also included in subgrouping the discordant CRL group and analysing the outcomes. A cutoff value of 16% was identified from literature as the 95th centile of CRL, above which an increasing trend in adverse outcomes was noted [24]. Accordingly, the discordant group was analysed with a cutoff set as  $\geq 16\%$ . The odds ratios of adverse outcomes are listed in Table 3.

In DC group, significant differences were noted in primary outcomes namely fetal loss (OR 4.5, 95% CI – 1.57

to 12.7,  $p=0.005$ ), preterm delivery < 34 weeks (OR 3.26, 95% CI – 1.28 to 8.32,  $p=0.013$ ) and birth weight discordance (OR 2.83, 95% CI – 1.06 to 7.56,  $p=0.037$ ) and also in other outcomes such as single IUD, GA at delivery, mean birth weight, double survivor > 28 days and NICU stay > 7 days. There was a significant difference in the incidence of fetal loss (spontaneous and induced) in MC twin pregnancy group (OR 4.2, 95% CI 0.32–55.1,  $p=0.027$ ). In MC twin pregnancies other outcomes could not be evaluated due to the small number of cases in this group.

Receiver Operating characteristics (ROC) curves were created to describe the ability of CRL discordance  $\geq 10\%$

**Table 3** Odds ratios (OR) of adverse outcomes in DC & MC twin pregnancies with CRL discordance of  $\geq 16\%$  at the 11 – 14-weeks scan

Outcome	Odds ratio (95% CI)	DCDA		
		CRL D < 16% (n – 299)	CRL D $\geq 16\%$ (n – 19)	p value
Fetal loss (total)	4.84 (1.7–13.8)	26 (8.6%)	6 (31.6%)	0.003
Fetal loss < 24 weeks	1.3(0.16–10.8)	12(4%)	1(5%)	0.790
IUD	Single	11 (3.7%)	4 (21%)	0.002
	Both	3 (1%)	1 (5.2%)	0.149
PTD $\leq 34$ weeks	3.26 (1.28–8.32)	76 (25%)	10 (52%)	0.013
Gestational age @ delivery		35.3 (33.2–37.3)	33.3 (30.6–35.6)	0.008
BW discordance $\geq 20\%$	2.83 (1.06–7.56)	51 (19.5%)	7 (53.8%)	0.037
BW (g)		2076 (1630–2522)	1816 (1343–2289)	0.042
NND	Single	8 (4%)		
	Both	2 (0.7%)		
Two infants alive > 28 days	0.31 (0.11–0.88)	261 (87.3%)	13 (68.4%)	0.027
NICU stay	$\leq 7$ days	116 (69%)	5 (35.7%)	0.010
	> 7 days	51 (31%)	9 (64.3%)	
TOP				
Outcome	Odds ratio (95%CI)	MCDA		
		CRL D < 16% (n – 47)	CRL D $\geq 16\%$ (n – 3)	p value
Fetal loss (total)	4.2 (0.32–55.1)	5 (10.6%)	1 (33%)	0.027
Fetal loss < 24 weeks	11.2 (0.69–182.6)	2 (4.2%)	1 (33%)	0.088
IUD	Single	2 (4%)		
	Both	1 (2%)		
PTD $\leq 34$ weeks		12 (25.5%)		
Gestational age @ delivery		35 (33.1–36.6)		
BW discordance $\geq 20\%$		9 (25%)		
BW (g)		1902 (1377–2427)		
NND	Single	1 (2%)		
	Both			
Two infants alive > 28 days		36 (76.6%)		
NICU stay	$\leq 7$ days	14 (58%)		
	> 7 days	10 (42%)		
TOP	16.8 (1.28–220)	5 (10.6%)	2 (67%)	0.031

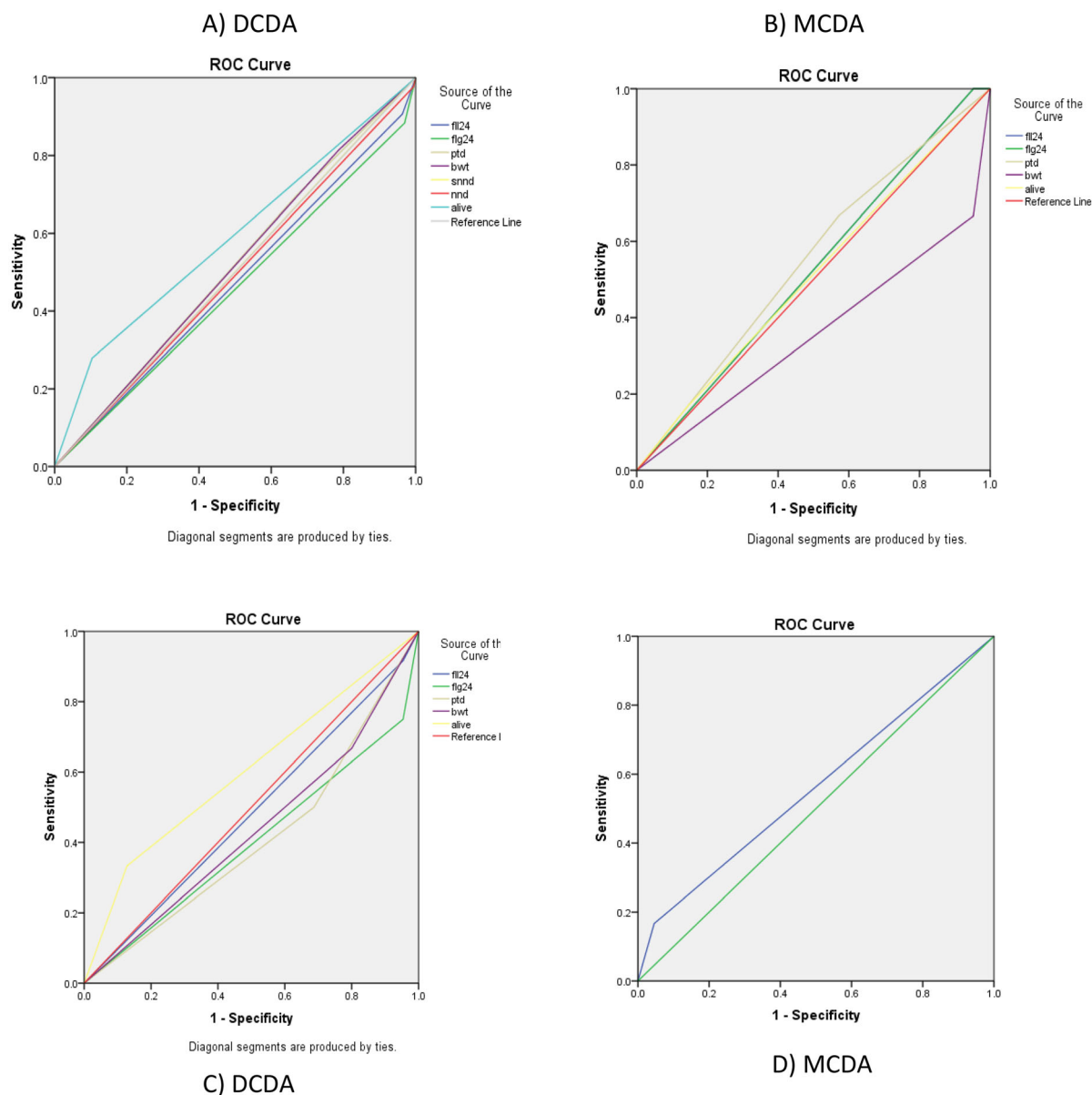
and  $\geq 16\%$  to predict adverse outcomes in DC and MC twin pregnancies (Fig. 1A–D). The sensitivity, area under curve and 95% CI are given in Tables 4 and 5.

## Discussion

In our study the CRL discordance of  $\geq 10\%$  was associated with increased incidence of fetal loss, single intrauterine fetal demise, decreased mean GA at delivery and decreased mean birth weight in DC twin pregnancies which was statistically significant. However there was no significant increase in adverse outcomes in the MC twin

pregnancies which could probably be due to frequent monitoring and timely interventions. The number of interventions done in our study were 8 (4 DCDA and 4 MCDA). Out of the four MCDA twins, Laser endoscopic procedure was done in three cases of TTTS and radiofrequency ablation was done in one patient in view of multiple markers. Four cases in DCDA group had selective fetal reduction, out of which 2 were for increased NT, 1 for multiple markers and 1 for severe oligohydramnios. All had successful outcomes.

When collating results, the identification of threshold of discordance associated with adverse outcomes is pertinent. The level of discordance in different studies [23] vary



**Fig. 1** A, B - ROC curves of DC and MC twins for CRL discordancy  $\geq 10\%$  as a predictor of fetal loss  $< 24$  weeks, preterm delivery, birthweight discordance, babies alive after 28 days. C - ROC curves of DC twins for CRL discordancy  $\geq 16\%$  as a predictor of fetal loss

$< 24$  weeks, preterm delivery, birthweight discordance, babies alive after 28 days, D - ROC curve as a predictor for fetal loss in MC twins where the discordancy is  $\geq 16\%$

between 5 and 20%. The reason we chose  $\geq 10\%$  (91st centile) was that, it was helpful to compare outcomes with other studies and also to avert a large proportion of twin pregnancies from being classified as discordant.

In the discordant CRL  $\geq 16\%$  group, we had identified 27 twin pregnancies, out of which we had follow up details for 22 pregnancies. 19 were DC and 3 were MC twin pregnancies. Out of the 3 MCDA twins, two underwent termination of pregnancy and 1 a spontaneous loss. 21 out

of 22 pregnancies had at least one of the adverse outcomes already mentioned.

### Comparison With Existing Literature

In the systematic review of 17 studies [23], it was concluded that twin pregnancies discordant for CRL  $> 10\%$  are at significantly higher risk of fetal loss  $> 24$  weeks ( $p$  value 0.006), birth weight discordance ( $p$  value  $< 0.001$ ) and preterm delivery ( $p$  value  $< 0.001$ ). There was no



**Table 4** ROC table for CRL discordancy  $\geq 10\%$ 

Chorionicity	Fetal outcome	Sensitivity	AUC	Asymptotic 95% confidence interval	
				Lower bound	Upper bound
Dichorionic	Fetal loss	0.62	0.675	0.57	0.77
	Preterm	0.39	0.548	0.38	0.62
	Birth weight discordancy	0.5	0.605	0.41	0.72
	Single IUD	0.67	0.684	0.54	0.83
	Double IUD	0.75	0.719	0.47	0.97
	Single survivor	0.14	0.496	0.05	0.54
	Double Survivor	0.31	0.397	0.25	0.74
Monochorionic	Fetal Loss	0.33	0.476	0.21	0.9
	Single IUD	0.5		0.14	0.97
	Preterm	0.33	0.452	0.27	0.64
	Birth weight discordancy	0.6	0.643	0.43	0.82

**Table 5** ROC table for CRL discordancy  $\geq 16\%$ 

Chorionicity	Fetal outcome	Sensitivity	AUC	Asymptotic 95% confidence interval	
				Lower bound	Upper bound
Dichorionic	Fetal loss	0.19	0.398	0.15	0.68
	Preterm	0.12	0.406	0.07	0.08
	Birth weight discordancy	0.12	0.433	0.05	0.62
	Single IUD	0.27	0.401	0.2	0.78
	Double IUD	0.25	0.562	0.2	0.91
	Single survivor	0.14	0.154	0.05	0.54
	Double survivor	0.31	0.603	0.21	0.74
Monochorionic	Fetal loss	0.17	0.184	0.1	0.8

significant increase in the fetal loss  $< 24$  weeks ( $p$  value 0.130). However the predictive accuracy of discordant CRL  $> 10\%$  is low as a screening parameter and hence not to be used routinely in clinical practice. The comparative analysis of the outcomes of the systematic review and our study is given in Table 6.

In our study, we conclude that at a cutoff of CRL  $\geq 10\%$ , in DC twin pregnancies, fetal loss was significantly increased ( $p$  value—0.001), with a significant increase in fetal loss  $> 24$  weeks ( $p$  value—0.006). The mean birthweight at delivery and gestational age at delivery were significantly decreased ( $p$  value—0.040 and 0.002 respectively) which affected the perinatal outcome adversely. But in MC twins neither primary, nor secondary outcomes were statistically significant. The flat ROC - curves with small area under curves (AUC) and low sensitivities prove that CRL discordancy of  $\geq 10\%$  is not a strong predictor of any of the primary outcomes we had

studied. Similar results have been shown by Johansen et al. [13] and D'Antonio et al. [5] The ROC curves also depict the area under the curve (AUC) to be ranging between 0.5 and 0.7 indicating the poor predictive value.

However when CRL discordancy cutoff was increased to  $\geq 16\%$ , there was a significant increase in fetal loss, preterm delivery, birth weight discordance, mean birth weight and mean GA at delivery in DC twin pregnancies and increased fetal loss in MC twin pregnancies. Nevertheless, the flat ROC with small area under curves (AUC) and low sensitivities prove that CRL discordancy of  $\geq 16\%$  also is not a strong predictor of any of the outcomes we had studied.

### Strengths and Limitations

The strengths of our study are: firstly, our large sample size ( $n = 120$ ) gave us adequate power to examine the common

**Table 6** Comparison of the predictive accuracy of CRL discordance  $\geq 10\%$  detected at the 11–14-week scan for the different outcomes analyzed in the systematic review and meta-analysis by D'Antonio et al. [23] and the present study

Outcome	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	Positive Likelihood ratio (95% CI)	Negative likelihood ratio (95% CI)	Odds ratio (95% CI)
D'Antonio et al. [23]					
Fetal loss < 24 weeks	20.2 (10.3–33.6)	89.6 (88.4–90.7)	2.06 (0.8–6.1)	0.92 (0.76–1.11)	2.30 (0.7–8.0)
Fetal loss > 24 weeks	34.4 (13.1–61.7)	89 (87.7–90.3)	3.16 (1.6–6.3)	0.75 (0.53–1.06)	4.23 (1.5–12)
PTD ≤ 34 weeks	13.7 (11.2–16.5)	91.2 (90.3–92.1)	1.54 (1.2–1.9)	0.95 (0.93–0.98)	1.63 (1.3–2.1)
BW discordance ≥ 20%	20.7 (17.6–24)	91.2 (90.3–92.1)	2.49 (1.9–3.3)	0.86 (0.80–0.93)	2.92 (2.0–4.3)
DCDA					
Outcome	Sensitivity (%) (95% CI)		Specificity (%) (95% CI)	Positive likelihood ratio (95% CI)	Negative likelihood ratio (95% CI)
Present study (2019)	Sensitivity (%) (95% CI)		Specificity (%) (95% CI)	Positive likelihood ratio (95% CI)	Odds ratio (95% CI)
Fetal loss < 24 weeks	53.9 (25.1–80.8)		69.5 (64–75)	1.8 (1.04–3)	0.66 (0.37–1.2)
Fetal loss > 24 weeks	68 (43.5–87.4)		71 (65–76)	2.35 (1.7–3.4)	0.45 (0.23–0.87)
PTD ≤ 34 weeks	32 (23.3–41.8)		77.3 (71.5–82.5)	1.4 (0.98–2.03)	0.88 (0.76–1.02)
BW discordance ≥ 20%	20 (12.7–29.2)		84 (78.9–88.9)	1.28 (0.78–2.11)	0.95 (0.85–1.06)
MCDA					
Outcome	Sensitivity (%) (95% CI)		Specificity (%) (95% CI)	Positive likelihood ratio (95% CI)	Negative likelihood ratio (95% CI)
Present study (2019)	Sensitivity (%) (95% CI)		Specificity (%) (95% CI)	Positive likelihood ratio (95% CI)	Odds ratio (95% CI)
Fetal loss < 24 weeks	33 (0.84–90.6)		59.5 (44.3–73.6)	0.82 (0.16–4.2)	1.12 (0.49–2.58)
Fetal loss > 24 weeks	33 (0.84–90.6)		59.5 (44.3–73.6)	0.82 (0.16–4.2)	1.12 (0.49–2.58)
PTD ≤ 34 weeks	20 (5.7–43.7)		63.6 (40.7–82.8)	0.55 (0.2–1.6)	1.26 (0.86–1.85)
BW discordance ≥ 20%	30 (11.9–54.3)		86.7 (69.3–96.2)	2.25 (0.7–6.98)	0.81 (0.59–1.11)
					2.78 (0.67–11.5)



as well as rare outcomes while using a definition of CRL discordance of more than 10%. Secondly, we had included both dichorionic and monochorionic pregnancies in the study which will help us to counsel the parents-to-be and cater their issues as there are only few studies which have included both groups. Finally, the data collection though was retrospective, provided a robust dataset with complete followup of 100% in discordant MC and 81% in discordant DC twin pregnancies who underwent routine first-trimester ultrasound at our facility.

The limitations of our study are, firstly, we had limited power to detect differences in the outcomes of monochorionic twin pregnancies (CRL discordance > 16%) owing to the small number observed. Secondly, we did not have long term outcome for these babies. Hence the outcome of the significant number of single fetal demise ( $n = 11$ ) was not evaluated. This could be an area of research.

### Implications on Clinical Practice

What our study has proved is that in DC twin pregnancies, CRL discordance  $\geq 10\%$  is associated with increased fetal loss > 24 weeks, decrease in mean birth weight and GA at delivery but there is no significant increase in adverse outcomes in MC twin pregnancies probably due to more frequent monitoring and timely intervention. However, when CRL discordance cutoff was set at a 95th centile of 16%, there was a significant increase in all the adverse outcomes of fetal loss, preterm delivery, birthweight discordance, decreased mean birth weight and gestational age at delivery in DC twin pregnancies and increased fetal loss in MC twin pregnancies. However both these discordant cutoffs (CRL  $\geq 10\%$  and CRL  $\geq 16\%$ ) failed to show the predictive accuracy and hence cannot be used routinely in our clinical practice.

### Conclusion

Our study shows that in DC twin pregnancies with CRL discordance  $\geq 10\%$ , the odds of fetal loss is fourfold, single IUD is fivefold and preterm delivery is twofold when compared to concordant group. However, when the cutoff is increased to  $\geq 16\%$  the odds of fetal loss is fivefold, single IUD is sevenfold, preterm delivery and birth weight discordance is threefold. In MC twin pregnancies, with a CRL discordance of  $\geq 10\%$  there was no significant increase in adverse outcomes. But when the cutoff was increased to  $\geq 16\%$ , the odds of having fetal loss is elevenfold. There was inadequate power to analyse other adverse outcomes.

A cutoff of  $\geq 16\%$  would be ideal to identify the pregnancies at risk and thus to be monitored closely for timely intervention. It should be reiterated that our study results do not consider CRL discordance to be a robust predictor of adverse outcomes irrespective of the cutoff. Hence this should be weighed against the needless apprehension and stress on the parents to be caused by the finding of a discordant CRL.

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### Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

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