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Analysis of the Clinical Value of Two-Dimensional Plus Four-Dimensional Ultrasound in the Diagnosis of Fetal Facial Anomalies

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Abstract: *Objective:* To explore and analyze the clinical value of two-dimensional plus four-dimensional ultrasound in diagnosing fetal facial anomalies. *Methods:* To review and analyze the basic data of 50 fetuses with facet anomalies delivered in Maternal and Child Health Hospital of Jiangyan District from January 2017 to January 2023, and to analyze and compare the two-dimensional (2D) diagnostic results of all the fetuses (2D group), and the combined 2D and four-dimensional (4D) diagnostic results (combined group). *Results:* Taking the delivery results as the gold standard, 39 fetuses with facial anomalies were diagnosed in the 2D group, and 48 fetuses with facial anomalies were diagnosed in the combined group, which showed that the diagnostic compliance rate of the 2D group was significantly lower than that of the combined group, and the difference of $P < 0.05$ was statistically significant. The sensitivity and accuracy of the diagnostic efficiency of the combined group were significantly higher than that of the 2D group, and the difference was statistically significant at $P < 0.05$; the specificity of the diagnostic efficiency of the combined group and the 2D group was compared, and the difference was not statistically significant at ($P > 0.05$). *Conclusion:* 2D plus 4D ultrasounds are more accurate in diagnosing fetal facial anomalies, and the combined diagnosis is more clinically significant, so it is recommended to be widely used and promoted.

Keywords: Two-dimensional ultrasound; Four-dimensional ultrasound; Fetal facial anomalies

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1. Introduction

Fetal facial anomalies are congenital anomalies that occur mainly in the facial features of the fetus, with cleft lip and palate anomalies predominating [1,2]. Facial anomalies usually do not affect fetal survival, but they can have a serious impact on the aesthetics of the fetal face and can also affect facial growth and development. Severe anomalies of the facial region require termination of pregnancy, such as transverse cleft anomalies in fetuses [3,4]. Early screening of the fetal face is very critical, and early detection of fetal anomalies can be managed promptly [5]. Clinical examination of the facial region usually takes imaging examination, and ultrasonography is the examination of choice. 2D ultrasonography is a simple operation, and there is no limitation on the number of examinations, which will not affect the health of pregnant women and fetuses, but 2D ultrasonography is prone to misdiagnosis and omission, leading to

a lower accuracy [6]. Four-dimensional ultrasound is a more precise examination than two-dimensional ultrasound, which has a higher diagnostic accuracy and can provide more accurate diagnostic information. This paper aims to study and analyze the clinical value of two-dimensional plus four-dimensional ultrasound in diagnosing fetal facial anomalies. It is reported as follows.

2. General information and methods

2.1. General information

The basic data of 50 fetuses with facial anomalies delivered in the hospital from January 2017 to January 2023 were retrospectively analyzed, and all the fetuses received two-dimensional ultrasound and four-dimensional ultrasound diagnosis, and the results of the two-dimensional diagnosis were regarded as the two-dimensional group, and the combined diagnosis of the two-dimensional and the four-dimensional diagnosis was regarded as the combined group. All examined pregnant women gave consent to the content of this experiment, and the consent form was signed. The experiment complied with the regulations of the Ethics Committee.

Inclusion criteria:

(1) Singleton pregnancy;

(2) Standardized obstetric examination and complete obstetric examination data;

(3) Gestational age over 18 weeks.

Exclusion criteria:

(1) The fetus is accompanied by other congenital defects;

(2) The fetus is uncooperative and it is difficult to complete the diagnosis of 2D plus 4D ultrasound;

(3) The fetal heart is unstable, and there are diagnostic contraindications.

2.2. Methods

All fetuses were subjected to two-dimensional ultrasound examination and four-dimensional ultrasound examination.

Two-dimensional ultrasound examination: 2D abdominal probe 4C-D, frequency 1.5–4.6 MHz, carried out a multi-directional and multi-angle examination of the face of the fetus:

(1) Observe the lips, nose, eyes and other parts of the fetus;

(2) Rotate the probe and adjust the angle to observe the lips, nostrils, eyes and other parts of the fetus;

(3) Grasp the swallowing movement of the fetus;

(4) Observe the upper jaw.

Four-dimensional ultrasound examination: 4D abdominal volumetric probe 4-8-D, frequency 4.0–8.5 MHz, probe angle 70°, and carry out a series of examination:

(1) Adjust the sampling frame to meet the size of the face;

(2) In the process of the examination, the pregnant woman was reminded to hold her breath;

(3) Scanning with surface imaging;

(4) Generate a sonogram after the image is collected;

(5) Rotate the axis of the coordinates to observe the fetus's face and collect the dynamic three-dimensional map;

(6) If fetal movement occurs during the examination, the examination should be stopped immediately, and the examination will be carried out again after the fetus stops moving.

Both 2D and 4D ultrasound examinations are carried out by two doctors to complete the examination process and diagnose together. If ambiguity occurs between the two, it is necessary to invite another doctor to

discuss it together.

2.3. Observation indexes

(1) Compare the diagnostic results between the groups, take the delivery results as the gold standard, and count the number of diagnostic cases in the two groups. Compliance rate = number of detected cases of fetal facial anomalies/number of detected cases of the gold standard

(2) Compare the 2D group with the gold standard diagnostic results.

(3) Compare the combined group with the gold standard diagnostic results.

(4) Compare the combined group's diagnostic efficacy with that of the two-dimensional group, including sensitivity [true positive/(true positive + false negative)], specificity [true negative/(false positive + true negative)] and accuracy [(true positive + true negative)/*n*].

2.4. Statistical analysis

SPSS 21.0 statistical software was selected to process and analyze the data. The count data were expressed by the number of cases (*n*) and percentage (%). The χ^2 test was implemented, and the mean ± standard deviation (SD) expressed the measurement data. The *t*-test was implemented, and the difference of $P < 0.05$ was considered statistically significant.

3. Results

3.1. Comparative analysis of the diagnostic results of the fetal facial area

As the gold standard, the 2D group diagnosed 39 cases of fetal facial deformities, and the combined group diagnosed 48 cases of fetal facial deformities. Based on the gold standard, the diagnostic compliance rate of the 2D group was 78.00% (39/50), the diagnostic compliance rate of the combined group was 96.00% (48/50) ($\chi^2 = 7.1618$, $P = 0.0074$), and the difference was statistically significant. For details, see **Table 1**.

Table 1. Comparative analysis of diagnostic results between groups [*n*, %]

Type of facial deformity	Delivery results	2D group	Combined group
Cleft lip	18	16 (88.89)	18 (100.00)
Cleft lip and palate	13	12 (92.31)	13 (100.00)
Nasal bone dysplasia	4	2 (50.00)	3 (75.00)
Nasolacrimal duct cyst	3	1 (33.33)	3 (100.00)
Ocular dysplasia	1	1 (100.00)	1 (100.00)
Facial cross-linking	2	1 (50.00)	2 (100.00)
Hypoplastic ears	1	1 (100.00)	0 (0.00)
Ear dysplasia	1	0 (0.00)	1 (100.00)
Mandibular shortening inwards	1	1 (100.00)	1 (100.00)
Nasal bone loss	2	1 (50.00)	2 (100.00)
Pre-nasal skin thickening	1	1 (100.00)	1 (100.00)
One eye	1	0 (0.00)	1 (100.00)
Facial skin thickening	2	2 (100.00)	2 (100.00)
Total	50	39 (78.00)	48 (96.00)

3.2. Comparison of diagnostic results between the 2D group and the gold standard

In the two-dimensional group, there were 39 cases of positive diagnosis and 11 cases of negative diagnosis, of which 37 were true positive, 10 were false negative, 1 was true negative, and 2 were false positive, as shown in **Table 2**.

Table 2. Comparison of diagnostic results between groups is as follows [*n*, %]

Two-dimensional group	Outcome of labour and delivery		Total
	Positive	Negative	
Positive	37	2	39
Negative	10	1	11

3.3. Comparison of diagnostic results between the combined group and the gold standard

In the combined group, there were 48 cases of positive diagnosis and 2 cases of negative diagnosis, 47 of which were true positive, 0 false negative, 2 true negative, and 1 false positive, as shown in **Table 3**.

Table 3. Comparison of diagnostic results between groups is as follows [*n*, %]

Combined group	Outcome of labour and delivery		Total
	Positive	Negative	
Positive	47	1	48
Negative	0	2	2

3.4. Comparison of diagnostic energy efficiency between the combined group and the 2D group

The sensitivity and accuracy of the diagnostic energy efficiency of the combined group were significantly higher than those of the two-dimensional group, and the difference was not statistically significant. The specificity of the diagnostic energy efficiency of the combined group and the two-dimensional group was also compared, and the difference was not statistically significant. See **Table 4** for details.

Table 4. Comparison of diagnostic energy efficiency between groups is as follows [*n*, %]

Groups	Sensitivity	Specificity	Accuracy
Combined group	100.00 (47/47)	33.33 (1/3)	76.00 (38/50)
Two-dimensional group	78.72 (37/47)	66.67 (2/3)	98.00 (49/50)
χ^2-value	11.1905	0.6667	10.6985
P-value	0.0008	0.4142	0.0011

4. Conclusion

In recent years, the incidence of fetal anomalies has been increasing. The facial features are the part with a high incidence of anomalies, which can occur in the ears, eyes, mouth, nose, etc., among which the mouth and nose anomalies are more common, especially cleft lip and palate, which is the highest incidence of facial anomalies [7,8]. Fetal facial anomalies not only affect the normal growth pattern of the face but also impede the normal function of the organs. Simple facial deformities can be corrected by surgery, but some surgeries need

to be performed several times, increasing the burden on the family [9,10]. Screening for facial anomalies at an early stage can reveal the extent of the anomalies and determine whether the fetus should be retained. Some anomalies can affect the health of the pregnant woman, such as those caused by chromosomal anomalies, which should lead to early termination of pregnancy [11,12]. Fetal facial anomaly screening uses ultrasound examination technology. 2D ultrasound is the basic examination means to check fetal facial anomalies. The application of this examination technology is very wide, but it is displayed in a two-dimensional section. The judgment of the three-dimensional structure is poor and cannot comprehensively observe the complex malformation situation, so the incidence of misdiagnosis and omission of diagnosis is higher. Based on the combination of 4D ultrasound co-diagnosis, the diagnosis of malformation diagnostic reliability can be improved [11,12]. On this basis, combined with four-dimensional ultrasound co-diagnosis, the reliability of anomaly diagnosis can be improved [13,14]. Four-dimensional ultrasound is a more advanced ultrasound examination method, strengthening computer and image processing technology. The images collected by scanning are more comprehensive. They can be observed from multiple angles, with richer image information, providing sufficient reference information for diagnosing facial deformities. The combined application of 2D and 4D ultrasound can enhance the judgment of fetal facial anomalies, and the accuracy of diagnosis is almost close to the delivery results [15].

The results of this study suggest that the gold standard is the result of delivery. 50 cases of fetal facial anomalies were detected, 39 cases were positive in the 2D group, and 48 cases were positive in the combined group. The diagnostic compliance rate between the groups was statistically significant when compared with the diagnostic compliance rate of the combined group, with a difference of $P < 0.05$. The sensitivity and accuracy of the diagnostic efficiency of the combined group were significantly higher than that of the 2D group, and the difference was statistically significant at $P < 0.05$. The specificity of the diagnostic efficiency of the combined group and the 2D group was compared, and the difference at $P > 0.05$ was not statistically significant. Two-dimensional ultrasound plus four-dimensional ultrasound examination is more sensitive and accurate, can be observed in multiple sections of the fetus' face, and complex anomalies can also be clearly observed, reducing the incidence of missed diagnosis and misdiagnosis to provide a strong clinical reference significance.

Analyzing the reasons for the above results, four-dimensional ultrasound can achieve three-dimensional positioning and multiple axial imaging; three-dimensional imaging is more intuitive and dynamic, with real-time observation of the fetus's body and head and other activities, with a high degree of image clarity. Moreover, 4D ultrasound has a cutting function, which can focus on retaining the ultrasound image and reconstructing the suspicious part of the image to improve the detection rate of facial anomalies. In addition, 4D ultrasound can assess the growth and development of the fetus from multiple angles and directions. It can use the rotation function to carry out multi-faceted observation, thus assessing the anatomical relationship between different levels of foci and accurately detecting the anomaly type.

In conclusion, 2D plus 4D ultrasound is more accurate in the diagnosis of fetal facial anomalies, and it is recommended that this diagnostic method be applied in clinical practice, which has a certain degree of promotion and application value.

Disclosure statement

The author declares no conflict of interest.

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