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Retronasal triangle: a sonographic landmark for the screening of cleft palate in the first trimester

W. SEPULVEDA*†, A. E. WONG*, P. MARTINEZ-TEN‡ and J. PEREZ-PEDREGOSA‡

**Fetal Medicine Center, Department of Obstetrics and Gynecology, Clinica Las Condes and †Maternal-Fetal Medicine Unit, San Jose Hospital, University of Santiago de Chile, Santiago, Chile and ‡Delta-Ultrasound Diagnostic Center in Obstetrics and Gynecology, Madrid, Spain*

KEYWORDS: cleft palate; fetal palate; fetal sonography; first-trimester ultrasound; prenatal diagnosis

ABSTRACT

Objectives *To describe a new first-trimester sonographic landmark, the retronasal triangle, which may be useful in the early screening for cleft palate.*

Methods *The retronasal triangle, i.e. the three echogenic lines formed by the two frontal processes of the maxilla and the palate visualized in the coronal view of the fetal face posterior to the nose, was evaluated prospectively in 100 consecutive normal fetuses at the time of routine first-trimester sonographic screening at 11 + 0 to 13 + 6 weeks' gestation. In a separate study of five fetuses confirmed postnatally as having a cleft palate, ultrasound images, including multiplanar three-dimensional views, were analyzed retrospectively to review the retronasal triangle.*

Results *None of the fetuses evaluated prospectively was affected by cleft lip and palate. During their first-trimester scan, the retronasal triangle could not be identified in only two fetuses. Reasons for suboptimal visualization of this area included early gestational age at scanning (11 weeks) and persistent posterior position of the fetal face. Of the five cases with postnatal diagnosis of cleft palate, an abnormal configuration of the retronasal triangle was documented in all cases on analysis of digitally stored three-dimensional volumes.*

Conclusions *This study demonstrates the feasibility of incorporating evaluation of the retronasal triangle into the routine evaluation of the fetal anatomy at 11 + 0 to 13 + 6 weeks' gestation. Because fetuses with cleft palate have an abnormal configuration of the retronasal triangle, focused examination of the midface, looking for this area at the time of the nuchal translucency scan, may facilitate the early detection of cleft palate in the first trimester.*

INTRODUCTION

With current ultrasound equipment and improving sonographic technique, it is now possible to detect an increasing number of fetal anomalies at the time of the nuchal translucency scan at 11 + 0 to 13 + 6 weeks' gestation[1–5]. However, despite significant efforts to examine the mid-sagittal plane of the fetal face to determine the presence or absence of the nasal bone[6,7] and the frontomaxillary facial angle[8] for the screening of aneuploidy at this gestational age, prenatal detection of malformations affecting the midface in the first-trimester fetus is still a diagnostic challenge. In particular, detection of cleft lip and palate, the most common midfacial malformation, is very elusive, with only few reports so far describing the incidental diagnosis before 14 weeks' gestation in fetuses without other associated anomalies[9,10]. In another report, a cleft palate was found in nine of 23 (39%) first-trimester fetuses with proven trisomy 13[11]. In all these cases, the sonographic diagnosis was documented retrospectively by analysis of the transverse plane of the fetal face using digitally stored three-dimensional volumes.

In this report, we describe a new sonographic technique, visualization of the retronasal triangle, which is formed by the frontal processes of the maxilla and the palate in the coronal plane of the fetal face, to detect palate defects in the first trimester of pregnancy.

METHODS

The Fetal Medicine Center at Clinica Las Condes is a tertiary referral center for fetal diagnosis and therapy that provides first- and second-trimester sonographic screening for chromosomal abnormalities and structural defects to low- and high-risk populations. The first-trimester sonographic protocol used in our center

Correspondence to: Prof. W. Sepulveda, Fetal Medicine Center, Clinica Las Condes, Casilla 208, Santiago 20, Chile (e-mail: fetalmed@yahoo.com)

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strictly follows the guidelines established by The Fetal Medicine Foundation, UK[12–14], and was approved by our Institutional Review Board. Briefly, sonographic examination is performed transabdominally using high-resolution ultrasound equipment (Accuvix XQ, Medison Co., Ltd, Seoul, Korea; and Voluson 730 Expert and E8, GE Healthcare, Milwaukee, WI, USA), and includes measurement of the crown–rump length, fetal heart rate, nuchal translucency thickness and nasal bone length, as reported previously[15,16]. In addition, evaluation of the fetal anatomy for gross fetal anomalies is also performed as recommended by The Fetal Medicine Foundation[14]. If suboptimal views of the nuchal translucency thickness or nasal bone are obtained, or if a fetal structural defect is suspected, a transvaginal scan is offered to the patient. Information on second-trimester sonographic findings, antenatal course and pregnancy outcome, including the detection of chromosomal abnormalities, congenital defects or the presence of physical dysmorphic features at birth, was obtained by reviewing the cytogenetics laboratory logbook, delivery records and neonatal discharge summaries in cases delivering in our institution, or by contacting the referring obstetrician or the parents themselves in those delivering elsewhere.

During sonographic assessment of the fetal face, we have noted, under appropriate gain settings, that the coronal plane displays three easily recognizable echogenic lines corresponding to the two frontal processes of the maxilla and the primary palate (Figure 1). Because this area resembles an outlined triangle and is identified immediately posterior to the fetal nose, it was termed the retronasal triangle. This image can be achieved by obtaining a mid-sagittal view of the fetal face that includes the nasal bone, then rotating the transducer 90° and slightly tilting its orientation to bring the frontal processes of the maxilla and primary palate into the same plane. Alternatively, the retronasal triangle can be visualized by obtaining a transverse view of the fetal cranium and moving the transducer down to the face to achieve a coronal view in which the above anatomical landmarks are visualized.

In the first part of the investigation, we conducted a prospective study to assess the feasibility of visualizing the retronasal triangle in 100 consecutive singleton pregnancies undergoing routine first-trimester sonographic screening at 11 + 0 to 13 + 6 weeks. All these examinations were performed by a single fetal medicine specialist (W.S.) with extensive experience in first-trimester scanning, aiming to determine the retronasal triangle during the allocated time for the scan. In the second part of the study, our institutional obstetric database was searched for cases of cleft palate confirmed postnatally that had sonographic evaluation in the first trimester at our center. The ultrasound imaging documentation, including three-dimensional ultrasound volumes, was reviewed retrospectively and the retronasal triangle evaluated.

RESULTS

Among the 100 consecutive first-trimester examinations (median gestational age 12 (range, 11–13) weeks), none of the fetuses had cleft lip or palate. The retronasal triangle was identified in all but two cases. In one case, it was

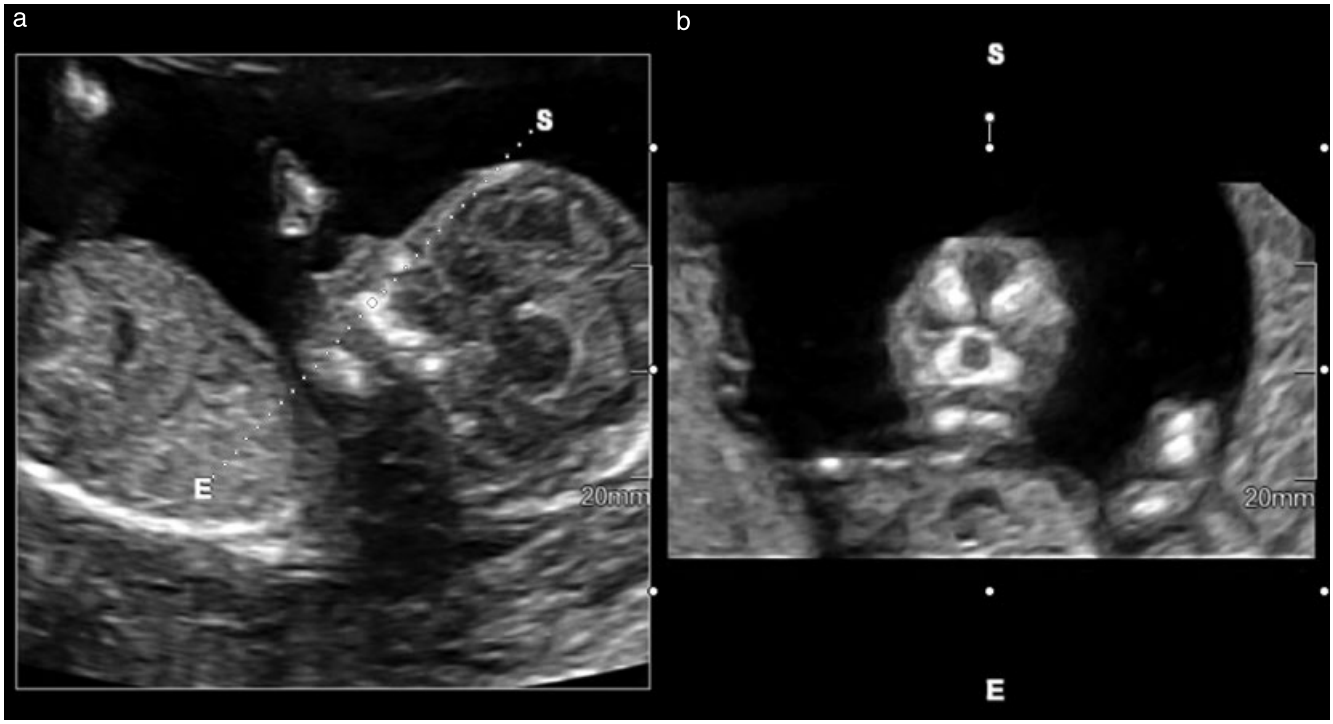

Figure 1 Retronasal triangle in a normal first-trimester fetus. Mid-sagittal view shows the fetal profile, nasal bone and palate (a). Oblique view technique shows the simultaneous coronal plane (b) at the level of the reference line (dotted line in (a)). Three echogenic lines formed by the frontal processes of the maxilla and the palate in the central part of the face are clearly demonstrated. E, end point; S, start point.

Table 1 Characteristics of five cases of cleft palate diagnosed in the first trimester

Case	*MA (years)*	*GA (weeks + days)*	*CRL (mm)*	*NT (mm)*	*First-trimester sonographic findings*	*Fetal karyotype*
1	35	13 + 3	79	3.9	Holoprosencephaly, proboscis, cleft palate	46,XX,del(18)(p11.2)
2	39	12 + 2	57	3.2	Holoprosencephaly, cleft lip and palate, abnormal four-chamber view, single umbilical artery	46,XX,i(18)(q10)
3	41	12 + 2	63	6.9	Cleft lip and palate, generalized subcutaneous edema	47,XY,+13
4	27	12 + 6	59	2.1	Cephalocele	46,XX
5	35	13 + 2	72	3.6	Cleft lip and palate, micrognathia, megacystis	46,XY

CRL, crown–rump length; GA, gestational age; MA, maternal age; NT, nuchal translucency.

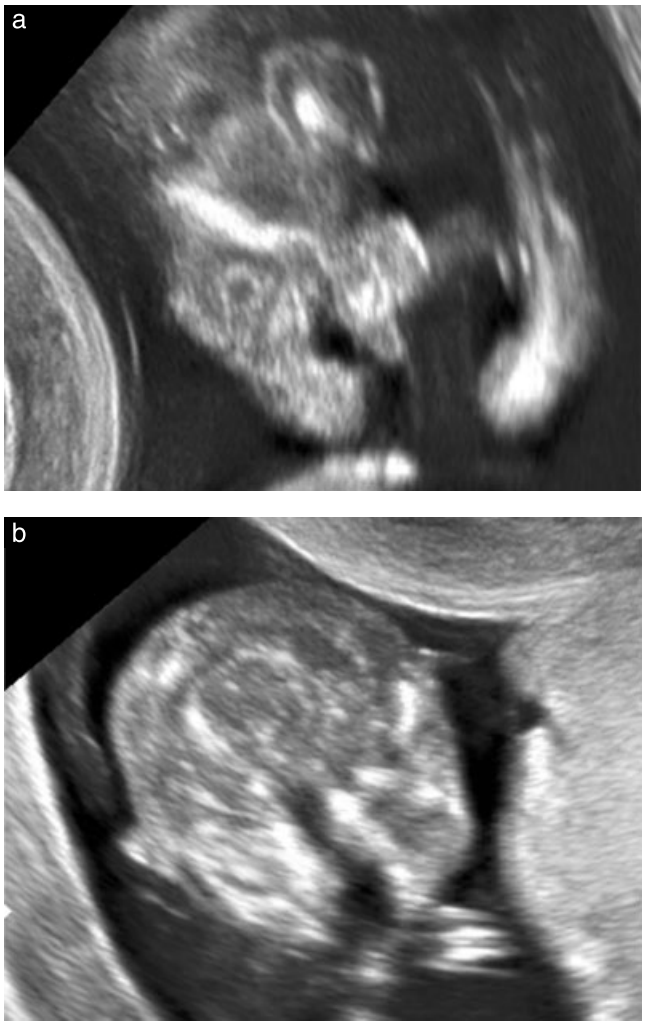

Figure 2 Transvaginal sonography in a first-trimester fetus with unilateral cleft lip and palate and associated encephalocele. Coronal (a) and transverse (b) views of the fetal palate showing severe orofacial clefting. Note the abnormal configuration of the retronasal triangle in the coronal view.

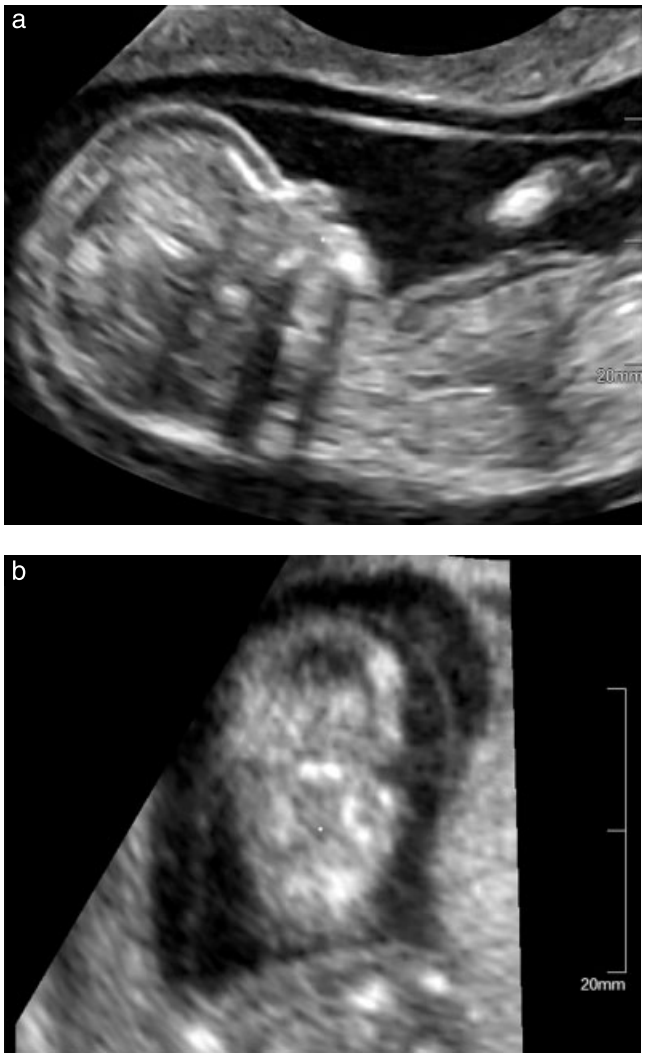

Figure 3 Transabdominal sonography in a fetus with bilateral cleft lip and palate and increased nuchal translucency at 12 + 2 weeks' gestation: mid-sagittal (a) and coronal (b) views obtained by multiplanar three-dimensional analysis. Note the abnormal configuration of the retronasal triangle in the coronal view.

not identified owing to the early gestational age at scanning (11 weeks), and in the second a persistent posterior position of the fetus impaired evaluation of the coronal plane of the face. Follow-up scans performed 1 week later in these two cases demonstrated the retronasal triangle in both fetuses. Although the evaluation of the retronasal triangle was not timed, it was estimated to take less

than 1 min once the nasal bone had been identified and measured[16].

In the retrospective part of this study, five fetuses with a cleft palate were identified over a 40-month period from January 2006 to April 2009 (Table 1). All had associated findings, including increased nuchal translucency thickness in four, alobar holoprosencephaly in two[17], cephalocele in one and megacystis in one. Three fetuses had an associated chromosomal defect. In all of them, an abnormal fetal face was noted at the time of the first-trimester scan. Four of these cases had been evaluated in the first trimester by one of the authors (W.S.); the retronasal triangle was noted to be abnormal with conventional two-dimensional ultrasound imaging and confirmed by analyzing multiplanar and oblique views of digitally stored three-dimensional volumes. In the remaining case, the sonographic examination was performed by a different operator who was unaware of the technique reported here. However, three-dimensional volumes were obtained at the time of the nuchal translucency scan and, upon retrospective review of the multiplanar views, an abnormal retronasal triangle was indeed demonstrated. Representative views illustrating the first-trimester sonographic findings in these cases are shown in Figures 2–4.

DISCUSSION

This report describes a new sonographic technique that can be useful in screening for cleft palate in the first trimester. It is performed by visualizing the retronasal triangle, i.e. the simultaneous view of the frontal processes of the maxilla and palate, which at early gestational ages has a higher echogenicity than the surrounding tissue. Multiplanar orthogonal views of this area showed that the transverse component of the retronasal triangle is composed of the anterior part of the hard palate, which primarily corresponds to the primary palate (Figure 5). Multiplanar parallel views of coronal planes of the face demonstrated that the anterior portion of the secondary palate is also visualized in views of the retronasal triangle (Figure 6). However, when moving the transducer to capture more posterior views of the fetal face, the secondary palate continued to be visualized, but the retronasal triangle was no longer present owing to absence of the frontal processes of the maxilla. Because of the scarce amount of soft tissue present in the upper lip in early fetal development, identification of isolated cleft lip in more anterior views was not attempted. Therefore, this technique seems to be useful in detecting clefting that involves the alveolar ridge owing to the higher echogenicity of this area in comparison to the upper lip.

In the first trimester, detection of cleft lip and palate can be achieved with high-resolution sonography, but it requires obtaining optimal views of the fetal face and a high index of clinical suspicion. Gullino *et al.* described a case report of bilateral cleft lip and palate diagnosed with two-dimensional sonography at 11 + 5 weeks' gestation based on an abnormal protrusion of the nose and discontinuity between the nose and upper lip[9]. Recently, Ghi *et al.* described the use of three-dimensional ultrasound imaging in the first trimester

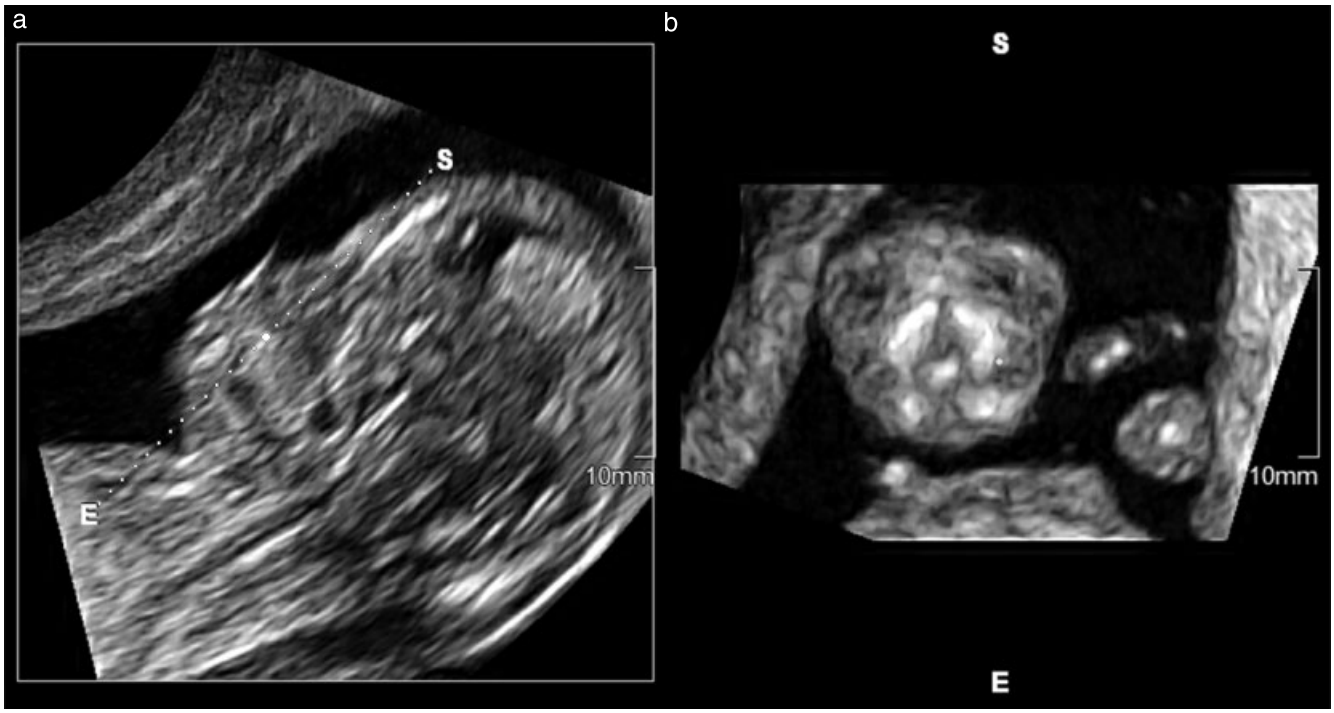

Figure 4 Transabdominal sonography in a first-trimester fetus with holoprosencephaly and cleft palate. The mid-sagittal view shows the fetal profile (a). The oblique view technique shows the simultaneous coronal plane (b) at the level of the reference line (dotted line in (a)). Note the abnormal configuration of the retronasal triangle. E, end point; S, start point.

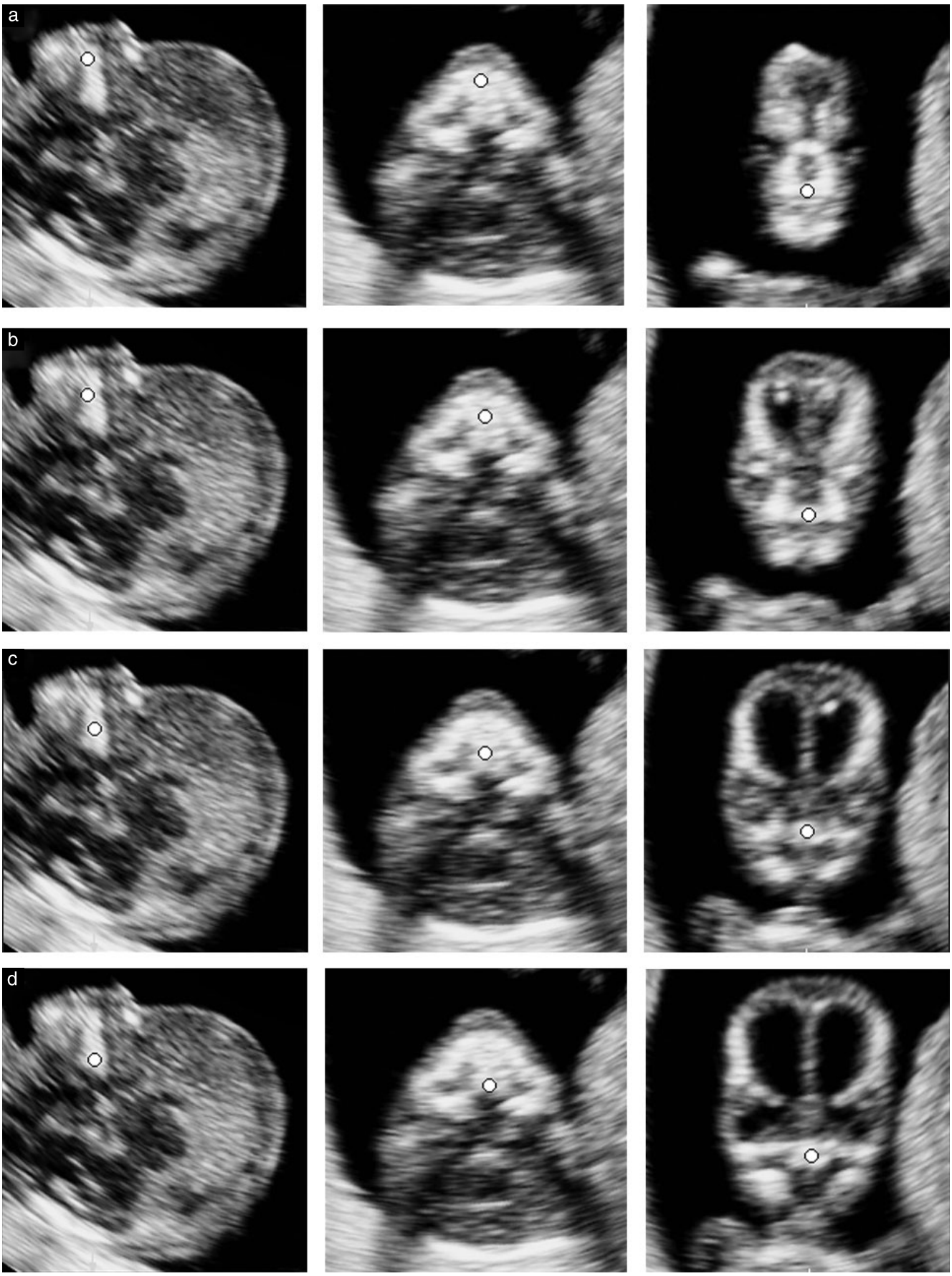

Figure 5 Sonographic views obtained from multiplanar orthogonal planes of the face in a normal fetus at 12 weeks' gestation. Left, middle, and right panels represent the mid-sagittal, transverse and coronal planes, respectively. The reference dots show the intersection of the orthogonal planes, which have been moved to progressively deeper planes to show the relationship between the retronasal triangle and the palate (a–d). Note that the retronasal triangle is obtained only at the level of the primary palate, particularly at the level of the alveolar ridge (a, b).

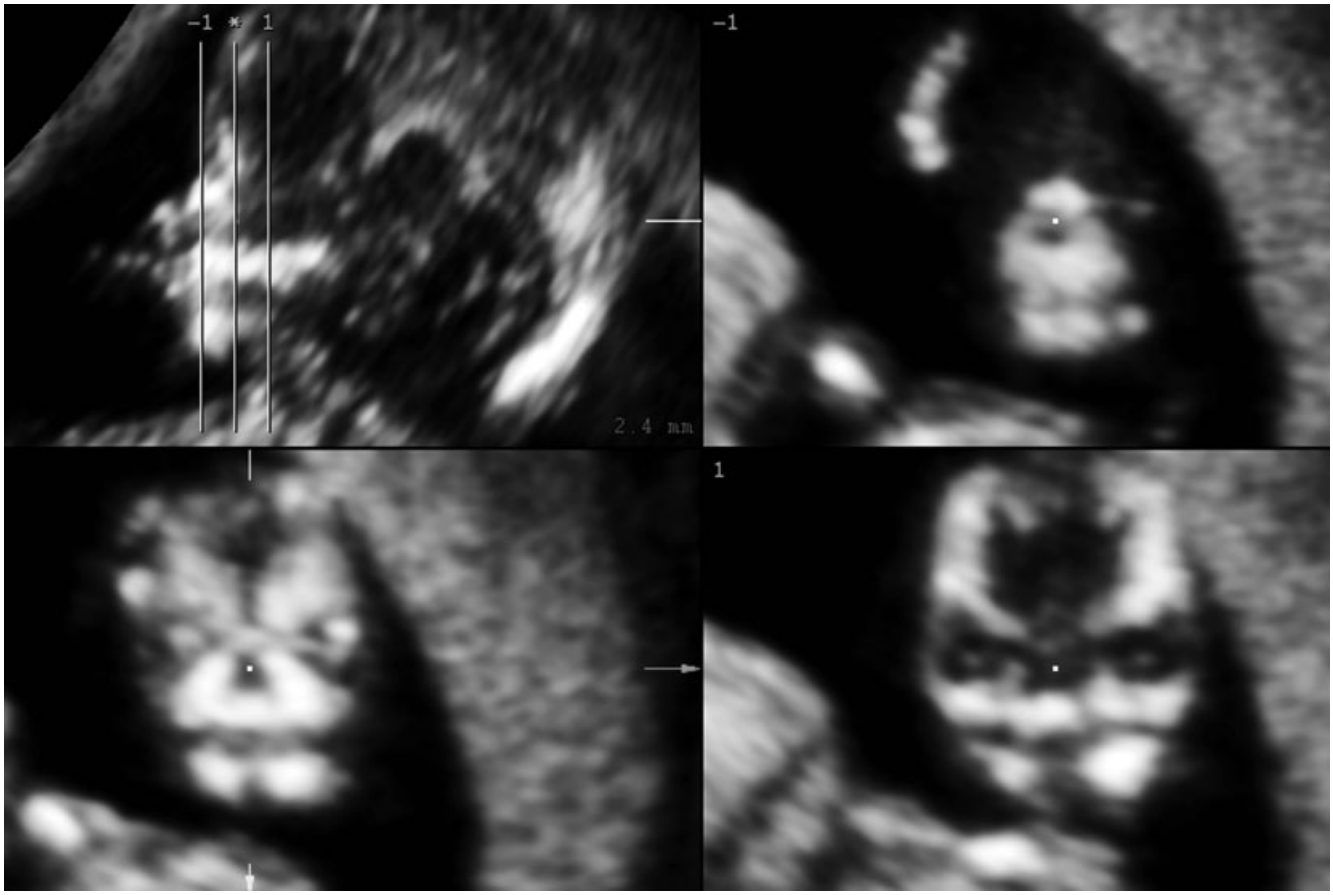

Figure 6 Parallel coronal views of the fetal face showing the retronasal triangle. Note that this area represents the most anterior part of the palate (primary palate and anterior aspect of the secondary palate). Although the rest of the hard palate can be visualized with more posterior views, the retronasal triangle can no longer be identified.

to diagnose cleft lip and palate[10]. In this case, two-dimensional sonography revealed a bulging in the mid-maxillary region, and three-dimensional sonography was used to confirm clefting. An additional nine cases of cleft palate were described in association with trisomy 13[11], but it is not clear if the diagnosis was made at the time of the actual scan or only after retrospective analysis of three-dimensional volumes.

Our study focused on examination of the area termed the retronasal triangle and demonstrates that screening for cleft palate may be possible in the first trimester. Although sonographic evaluation of the palate alone in a transverse view may also yield the diagnosis, shadowing from the surrounding facial bony structures is a potential problem. Our technique is similar to that described by Suresh *et al.* in second- and third-trimester fetuses[18], which identifies the 'premaxillary triangle' as an inverted 'V' formed by the nasal bones and the premaxillary tissue. Ours involves a more posterior coronal section as our goal was to observe the primary and secondary palate and not the premaxillary area, as in the study of Suresh and colleagues, which primarily aimed to detect cleft lip. Nevertheless, the diagnosis of cleft lip in the second trimester can be achieved by the examination of coronal and transverse views of the fetal face, where the nostrils, upper lip and alveolar ridge are easily imaged with a proper ultrasound technique. In contrast, identification of the secondary palate with conventional two-dimensional sonography is far more challenging, if not impossible.

With the advent of three-dimensional ultrasound technology, evaluation of the secondary palate in the second and third trimesters is now feasible[19–21], but this technique is still far from optimal. However, the use of three-dimensional surface rendering technology in the first trimester is likely to be limited, as the soft tissue is scarce and the bones are not yet ossified, reducing the likelihood of an early prenatal diagnosis. It remains to be proven whether analysis of three-dimensional multiplanar orthogonal views of the fetal face, as presented in Figures 5 and 6, may potentially overcome the difficulties in evaluation of the secondary palate in the first trimester.

In conclusion, our study demonstrates that evaluation of the retronasal triangle is feasible in almost all fetuses during the first-trimester scan and that fetuses with cleft palate have abnormalities in this anatomical area that can be identified in the first trimester. This examination does not significantly increase the scanning time once the appropriate views for assessing the nasal bone have been obtained. Although further studies with larger populations are needed to demonstrate the sensitivity and specificity of this potential sonographic screening technique in the diagnosis of cleft palate in the first

trimester, especially in fetuses without other associated structural abnormalities and chromosomal defects, we recommend including visualization of the retronasal triangle as part of the anatomical evaluation of the first-trimester fetus.

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