The Absence of the Vomer in the First and Early Second Trimester of Pregnancy – A New Marker of Trisomy 21 and Trisomy 13

Fehlen des Vomer im ersten und frühen zweiten Trimenon der Schwangerschaft – ein neuer Marker für Trisomie 21 und Trisomie 13

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Key words
- ultrasound
- pregnancy
- vomer
- trisomy
- frontomaxillo-facial angle

Zusammenfassung

Ziel: Ziel der Studie war die Messung der 2 frontomaxillo-fazialen (FMF) Winkel: FMF mit dem Vomer (FMF-v) und FMF mit dem Palatum (FMF-p) sowie die Darstellung des Vomers im ersten und frühen zweiten Trimenon, um deren Wertigkeit als Marker für die Diagnose einer Trisomie 21 und Trisomie 13 zu beurteilen.

Patienten und Methoden: Mittels eines 2-D-Ultraschalls wurden mit linearer, konvexer oder endovaginaler Sonde 340 Patientinnen mit normaler und 12 Patienten mit nicht normaler Schwangerschaft untersucht.

Ergebnisse: Die FMF-Winkel konnten innerhalb 1 – 5 min bei 253 (73 %) der Patientinnen mit der Linearsonde dargestellt werden. Der FMF-v-Winkel war signifikant kleiner als der FMF-p-Winkel (79,8° vs. 89,7° bzw. 71,5° vs. 84,5° für die 2 Trimena). Beide Winkel wurden im zweiten Trimenon kleiner. In keinem Falle einer Trisomie konnte das Vomer im ersten oder frühen zweiten Trimenon dargestellt werden. Der FMF-p-Winkel erlaubte keine Unterscheidung zwischen normalen Schwangerschaften und solchen mit Trisomien (89,5°). In keinem Falle einer Trisomie (21 oder 13) konnte das Vomer oder der FMF-v-Winkel im ersten oder frühen zweiten Trimenon dargestellt werden. Die diagnostische Genauigkeit für das Vomer als Marker für Trisomien lag bei 0,985.

Schlussfolgerung: Sollte das Vomer im ersten und frühen zweiten Trimenon nicht visualisierbar sein, so sollte eine Karyotypisierung durchgeführt werden. Die Messung des FMF-p-Winkels ist nicht hilfreich. Die Untersuchung mit einer hochauflösenden Sonde (L12 – 5 MHz) ermöglicht die erleichterte Darstellung des Vomers.

Abstract

Purpose: The aim of this study was to measure the two frontomaxillo-facial (FMF) angles: the FMF-vomer (FMF-v) and the FMF-palate (FMF-p), and to visualize the vomer in the 1st and early 2nd trimester, in order to ascertain whether they can be used as markers for trisomy 21 and trisomy 13.

Materials and Methods: A2D ultrasound scan was performed in the 340 normal and 12 abnormal pregnancies, using the linear, convex and endovaginal probes.

Results: We visualized the FMF angles within 1 to 5 minutes in 253 (72 %) of cases by using the linear probe. FMF-v angle was significantly smaller that the FMF-p angle (79.8° vs. 89.7°, 71.5° vs. 84.5° for the two trimesters, respectively), and that the value of both angles decreased in the second trimester. There was not one single case of trisomy in which vomer could be identified in the 1st and early 2nd trimester. The FMF-p angle failed to present difference between normal cases and the ones with trisomy (89.5°). There was not one single case of trisomy (21 or 13) in which vomer or FMF-v could be identified in the first or early second trimester. The diagnostic accuracy of vomer as a marker for trisomy was 0.985.

Conclusion: If the vomer cannot be visualized in the 1st and early 2nd trimester, it is important to check the karyotype, and it is not necessary to measure the FMF-p angle. The high resolution probe (L 12 – 5 Mhz) enables easier assessment of the vomer.

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Introduction

Screening for fetal trisomy has included the detection of nuchal translucency thickness (NT) in conjunction with maternal free beta-hCG and pregnancy-associated plasma protein A (PAPP-A). Unfortunately, this approach has faced an increase in false-positive rates in the first trimester – 16% at age 38 years, 58% at age 45 [1, 2]. Therefore, fetal sonography requires other ultrasound markers, such as nasal bone absence, ductus venosus reversed flow or frontomaxillary facial (FMF) angle. Furthermore, fetal echocardiographic genetic sonography may also be an alternative option for these patients because of its high sensitivity (91%) and lower false-positive rate (14%) [3]. On the other hand, both FMF angle and fetal echocardiography as a component of genetic sonogram may be difficult to apply as a primary screening tool for trisomy 21. Unfortunately, the FMF angle will therefore only be useful for differentiating between chromosomally normal fetuses and abnormal fetuses if its measurements are as precise and reproducible as NT measurement, because the mean delta FMF angle among Down syndrome fetuses was found to be very small [4, 5].

The FMF angle, according to Plasencia et al. [6], is defined by a line along the upper surface of the maxilla and a line that traverses the anterior aspect of the maxilla extending to the external, leading surface of the frontal bone. These authors pointed out that if the difference in FMF angle between trisomy 21 and normal fetuses is confirmed as significant, it is likely that these measurements will be incorporated into first-trimester sonographic screening for trisomy 21. In current ultrasound semiology, the maxillary bone is described as a single rectangular structure, if viewed in the mid-sagittal plane of the fetal face at 11 to 13^{+6} weeks [6]. It was noted that in this particular region in the second and third trimester, at least two separate echogenic structures can be identified, the inferior one representing the palate and the superior one being the vomer [7].

The vomer is a thin perpendicular bone that forms the posterior and inferior portion of the nasal septum. It extends from the midline to the sphenoid, ethmoid, both palatine bones, and both maxillary bones (**Fig. 1, 2**). The vomer develops from the two lateral buds, approaching each other from the 8^{th} week of gestation (WG), and uniting at the midline at approximately the 12^{th} WG [8].

With consideration to the above, we decided to distinguish two different angles in the previously singular FMF entity. The vomer lies above the hard palate and is seen on ultrasound scan as a triangular hyperechogenic structure. Using its upper border, a first frontomaxillary facial angle, the so-called FMF-vomer (FMF-v) can be obtained. On the other hand, the hard palate's upper plane delineates yet another angle, the FMF-palate (FMF-p). In one of our previous retrospective analyses, we observed several cases in which the vomer was absent on ultrasound scan images of fetuses with trisomy 21 and 13 in the 1^{st} and/or early 2^{nd} trimester, i.e. at 10^{+1}–14^{+0} WG and 14^{+1}–16^{+1} WG, respectively. Regarding the significant effect of the vomer on the morphometry of the FMF angle, we conducted a prospective 2D ultrasound study in order to measure the FMF-v and the FMF-p angles, and to assess the visualization of the vomer in the 1^{st} and early 2^{nd} trimester. Consequently, we wished to evaluate whether these entities can serve as a marker for suspicion of trisomy and indication for further invasive diagnostic procedures – chorionic villus sampling (CVS) or amniocentesis.

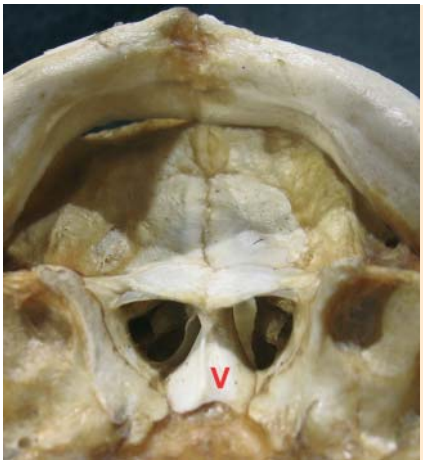

Fig. 1 Skull of the newborn, viewed from below. Vomer (v) fully developed.

Abb. 1 Schädel eines Neugeborenen, Ansicht von unten. Vomer (v) vollständig entwickelt.

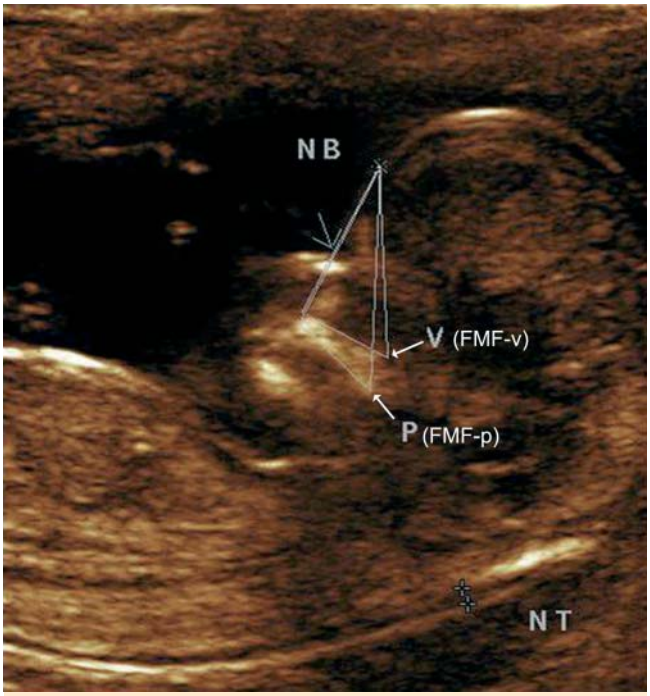

Fig. 2 Euploid fetus in the 1st trimester. Vomer is present. Captions: NB – nasal bone, NT – nuchal translucency, V – vomer, P – palate. The arm of the upper triangle follows the outline of the vomer, and the arm of the lower triangle follows the lower border of the palate. The upper surface of the palate is merged with the vomer, and is therefore not distinguishable.

Abb. 2 Euploider Fetus im ersten Trimenon. Das Vomer ist angelegt. Abkürzungen: NB – Nasenknochen, NT – Nackentransparenz, V – Vomer, P – Palatum. Die Basis des oberen Dreiecks verläuft entlang der Grenzen des Vomers, die Basis des unteren Dreiecks verläuft entlang der unteren Grenze des Palatums. Die Oberfläche des Palatums ist mit dem Vomer verschmolzen und daher nicht differenzierbar.

Patients and Methods

In the period from March 2007 to September 2009, we routinely measured the FMF-v and FMF-p angles and looked for the presence of the vomer in the 1^{st} and early 2^{nd} trimester of 352

singleton pregnancies of patients from the same demographic background. The indications for ultrasound exam were maternal age, apparent anxiety and doubt, previous pathological pregnancies, positive biochemical screening, increased NT and/or absence of the nasal bones in the fetus. We used Philips HDI 5000, Sono CT and Xres, with the following broadband probes and their associated software: linear-L 12 – 5 MHz (L), convex-C 5 – 2 MHz (C) and endovaginal-V 8 – 4 MHz (V). The position of a fetal head (i.e., its distance from the ultrasound probe) determined the type of probe: if the distance was up to 6 cm, the L-probe gave more accurate view of the confirmed landmarks, particularly of the FMF-v and FMF-p angles. If the distance was more than 6 cm, V and C-probes were used. The examination of all fetuses was designed in the following sequence: first with L-probes, and then with C and V-probes. As for the duration of the scan, the measuring of the FMF angles took between 1 and 5 minutes. A 2D scan of the fetal head was acquired in the exact mid-sagittal plane of the fetal face defined by the profile presence of the tip of the nose anteriorly, translucent mid-brain in the middle and the nuchal membrane posteriorly, according to the previously reported methodology [6]. For the FMF-p angle, the first line (limb) was drawn along the superior plane of the palate and the second line from the upper anterior corner of the maxilla extending to the external surface of the forehead. For measurement of the FMF-v angle, the first line was drawn along the superior plane of the vomer and the second was the same as in FMF-p (**Fig. 3**).

The absence of the vomer was defined by the appearance of a "thin" maxilla, with a discernable upper and lower border of the palate. In comparison to the palate, the vomer presents with a lower echogenicity in the transverse plane. The mediosagittal section reveals the vomer's upper plane as sharp and less echogenic than the upper plane of the palate. Therefore, the vomer can be differentiated from the adjacent part of the maxilla as a triangular "superstructure" above the palate, rambling from it cranially towards the posterior end of the hard palate. The space between the two echogenic lines (upper borders of the vomer and the palate) has substantially reduced echogenicity, which can be visualized by high resolution linear probes. However, when the vomer is absent, there is no ascending upper border, which leaves the echogenic upper plane of the palate unchanged. On the contrary, in that case the maxilla has an altered, "thin" appearance.

Patients in whom ultrasonography revealed significant marker deviation (absence of the vomer, isolated or in conjunction with: increased NT, absence of nasal bones, ductus venosus reversed flow, and tricuspid valve regurgitation) were referred for genetic tests. If the tests proved positive for trisomy 21 or 13, the patients did not undergo ultrasonography check-up in the second trimester. In the 1st trimester the assessment of fetal size was based on the crown-rump length. The average gestational age was 12^{+6} gestational weeks.

All pregnancies underwent complete clinical follow-up, including delivery and detailed clinical exam of the neonates, in order to confirm their genetic status.

Results

In total, there were 352 fetuses in our study including 340 chromosomally normal fetuses and 12 fetuses with an abnormal karyotype (**Table 1**). Eight fetuses had trisomy 21 diagnosed by CVS at 11 to 13^{+6} weeks of gestation and two had trisomy 21 diagnosed in the early 2nd trimester (15^{+6} weeks) by amniocentesis. In another two fetuses, trisomy 13 was diagnosed by CVS in the 1st trimester ($10 – 12^{+6}$ weeks).

Positive NT (upper limit 3 mm) was found in three cases of trisomy 21 and in both cases of trisomy 13. Also, there were 15 false-positive NT findings in euploids, which were confirmed by CVS. In 14 fetuses in the first trimester, NT could not be measured for technical reasons, but genetic testing revealed no aneuploid cases among them. The serology screening (free beta–hCG and PAPP-A, risk over 1 : 250) was positive in 3 cases, one accordant with the NT finding, and the other two in cases with vomeral absences. Nasal bone absence in the first trimester was observed in: one fetus with trisomy

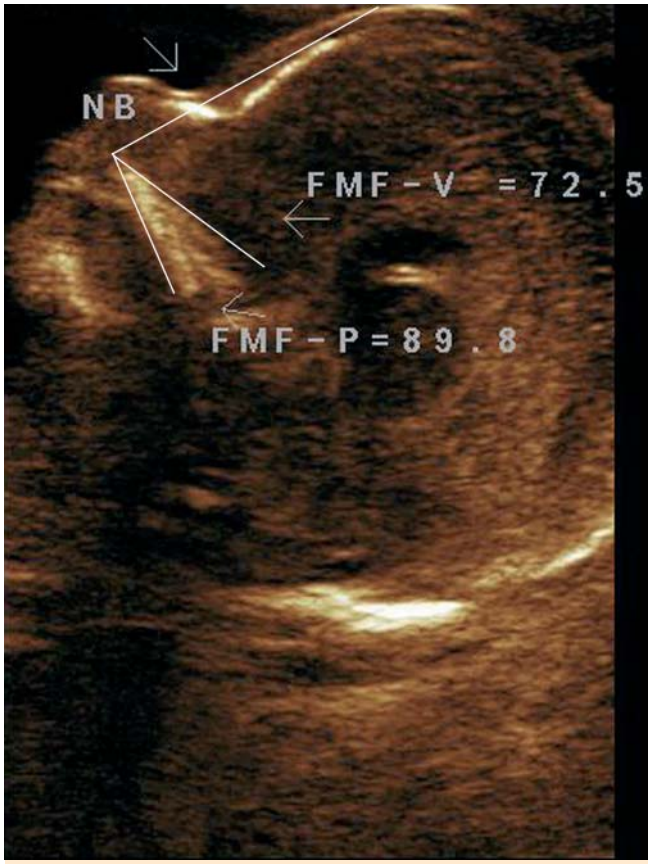

Fig. 3 Values of FMF-p and FMF-v angles measured in the early 2nd trimester (16 WG) by means of linear probe. Definition of the angle arms given in the text, white lines omitted for clarity. The lower contour of the palate clearly visible, the upper contour merged with the vomer. Caption: NB – nasal bone.

Abb. 3 Mit Linearsonde ermittelte FMF-p und FMF-v Winkel im frühen zweiten Trimenon (16. SSW). Definition der Winkel bildenden Schenkel wie im Text, zur besseren Übersicht wurden weiße Linien weg gelassen. Der untere Rand des Palatums ist deutlich erkennbar, der obere Rand ist mit dem Vomer verschmolzen. Abkürzung: NB – Nasenknochen.

Table 1 Trisomy cases revealed by ultrasound screening.

diagnosis	trisomy 21	trisomy 13
1st trimester	8	2
2nd trimester	2	0

21, both cases with trisomy 13 and in one euploid fetus. Ductus venosus reversed flow was found in three cases: two with trisomy 13 and one with trisomy 21, the latter was consistent with the NT finding. Tricuspid valve regurgitation was found in two trisomy 13 cases, both with hypoplasia of the left heart.

Table 2 Efficiency of L, V and C probes in visualizing the FMF angles in the 1st and 2nd trimester of pregnancy.

probes	1st trimester	early 2nd trimester
L probe	253/352 (72%)	92/342 (27%)
V probe	81/352 (23%)	10/342 (3%)
C probe	0/352 (0%)	226/342 (66%)

Table 3 FMF-v and FMF-p angles in the 1st and 2nd trimester of pregnancy.

	FMF-v angle (mean ± SD; min-max)	FMF-p angle (mean ± SD; min-max)
first trimester		
normal (324) *GAR* [1] 10^{+1} – 13^{+6}	79.8° ± 4.0° (65.7°–90.4°)	89.7° ± 4.9° (70.2°–105.6°)
trisomy 21 and 13 (10) GAR 11^{+3} – 13^{+6}	not measured	89.5° ± 9.1° (72.7°–103.5°)
early second trimester		
normal (326) GAR 14^{+1} – 16^{+1}	71.5° ± 3.8° (64.3°–88.2°)	84.5° ± 2.9° (76.5°–92.6°)
trisomy 21 (2) GA 15^{+3} and 15^{+5}	not measured	82.5° and 89.2°

[1] GAR – gestational age range (WG).

The efficiency of L, V and C-probes was established by visualizing and differentiating the FMF-p and FMF-v angles (**Table 2**). The C-probe could not accurately distinguish the FMF-v and FMF-p angles in the 1st trimester based on the comparison of picture quality between the probes. The FMF angles could not be exactly measured in 18 (5.1%) fetuses in the first semester, and in 14 (4.1%) in the second semester. Of those 18 cases in the first trimester, 2 were diagnosed as trisomy 21 in the early second trimester. Finally, there were only 5 cases in which the FMF angles were not visualized in either of the two trimesters, caused by malposition of the fetal head, loss in image resolution and extensive movement of the fetus. All other ultrasound and biochemical markers were negative for trisomy in those patients, which was also clinically confirmed upon delivery.

The FMF-v and FMF-p angles in our overall patient sample are summarized in **Table 3**. In the 1st trimester, in eight fetuses with trisomy 21 and in two fetuses with trisomy 13, the FMF-v angle could not be measured since the vomer could not be visualized (**Fig. 4, 5**). The same occurred in two fetuses with trisomy 21 in the early 2nd trimester (15 and 15^{+6} WG, respectively).

In 335 fetuses with a normal karyotype, we were able to visualize the vomer in either of the two trimesters. There were no cases of trisomy (21 or 13) in which the vomer could be identified in the first or early second trimester. The statistical analysis concerning the vomer as a diagnostic marker for trisomy yielded the following results: specificity = 0.985, sensitivity = 1.000, negative predictive value = 1.000, positive predictive value = 0.706, and accuracy = 0.985, positive likelihood ratio = 0.667, negative likelihood ratio 0.000.

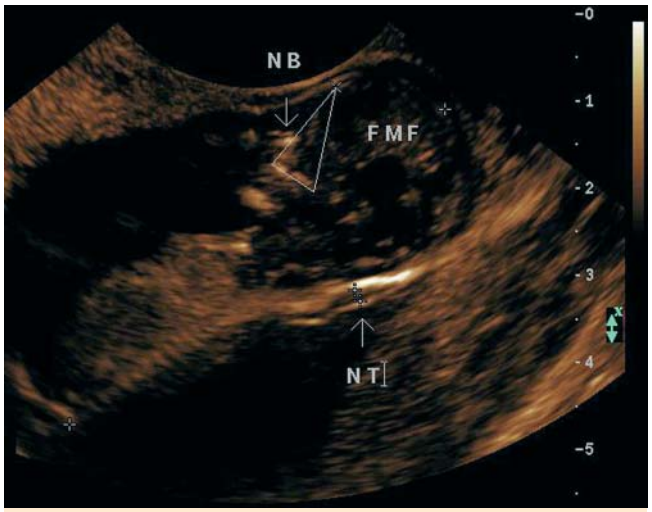

Fig. 4 First trimester – trisomy 21. Vaginal probe reveals (thin maxilla). Lower FMF angle arm tracing the inferior contour of the palate. The upper border of the palate clearly visible (vomer absent) and parallel to the inferior one. Vomer not clearly visible by means of vaginal probe in trisomy 21. Captions: NB – nasal bone, NT – nuchal translucency, FMF – frontomaxillary-facial angle.

Abb. 46 Erstes Trimenon – Trisomie 21. Untersuchung mit endovaginaler Sonde zeigt eine (dünne Maxilla). Der untere FMF-Winkel-Schenkel entspricht dem unteren Rand des Palatums. Die obere Grenze des Palatums ist eindeutig zu erkennen (Vomer fehlt) und verläuft parallel zur unteren. Das Vomer ist bei Trisomie 21 mittels transvaginaler Sonografie nicht eindeutig darzustellen. Abkürzungen: NB – Nasenknochen, NT – Nackentransparenz, V – Vomer, P – Palatum.

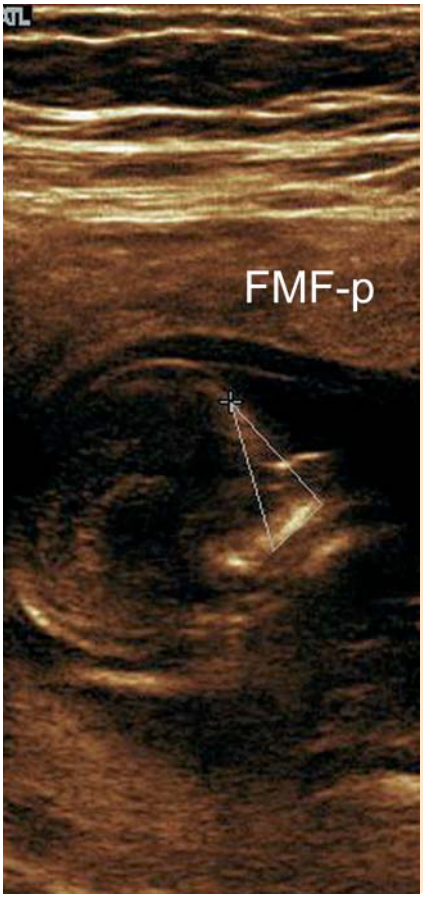

Fig. 5 Early second trimester trisomy 21. The FMF angle arm deliberately traced along the inferior palate to elucidate the absence of the vomer. Caption: FMF-p – frontomaxillary facial angle – palatum.

Abb. 5 Frühes zweites Trimenon bei Trisomie 21. Der untere FMF-Winkel-Schenkel wurde bewusst entlang des inferioren Palatums gelegt, um das Fehlen des Vomers zu verdeutlichen. Abkürzungen: FMF-p – frontomaxillofazialer Winkel – Palatum.

Subgroups	t-test	p
FMF-v (normal, 1st trimester) vs. FMF-p (normal, 1st trimester)	28.15	< 0.01
FMF-p (normal, 1st trimester) vs. FMF-p (trisomy, 1st trimester)	0.15	NS
FMF-v (normal, 1st trimester) vs. FMF-v (normal, 2nd trimester)	26.67	< 0.01
FMF-p (normal, 1st trimester) vs. FMF-p (normal, 2nd trimester)	16.37	< 0.01
FMF-v (normal, 2nd trimester) vs. FMF-p (normal, 2nd trimester)	48.75	< 0.01

[1] NS – not significant.

Table 4 FMF angle comparison for different subgroups.[1]

The subgroups from **Table 3** were mutually compared using the Student's t-test (**Table 4**). The subgroup trisomy 21 from the 2nd trimester was not included because of the small sample (2 cases). It is obvious that the FMF-v angle is significantly smaller than the FMF-p angle, and that the size of both angles decreases in the second trimester. On the other hand, the FMF-p angle failed to present a difference between normal cases and the ones with trisomy.

Discussion

The frontomaxillary facial (FMF) angle is a recently described sonographic entity for predicting trisomies. The FMF angle in association with NT thickness and maternal serum free beta-hCG and PAPP-A could improve the detection rate for Down syndrome to more than 90% for a 5% false-positive rate [2]. Further, fetal echocardiographic genetic sonography, when used as an adjunct to first and/or second-trimester screening for trisomy 21 may increase the detection rate to as high as 99% [3]. According to our findings, the diagnostic accuracy of FMF angle and vomer presence was significantly above the other ultrasound markers and/or serology, which gave us incentive to check these entities closely.

Numerous studies suggested that this measurement is likely to be a useful marker in first-trimester screening for trisomy 21 [2, 4, 6, 7, 9, 10], defining the FMF angle between two lines, one along the upper surface of the maxilla and the second that traverses the anterior aspect of the maxilla extending to the external, leading surface of the frontal bone [6].

It was noted by Molina et al. [7] that at least two separate echogenic structures could be identified in this particular region, the inferior one representing the palate and the superior one being the vomer, but the role of the vomer was not properly distinguished. These authors based their FMF angle on the palate-vomer complex for ultrasound scans in the first trimester, but switched to the palate for the second semester, which adds to the confusion. According to this study, the mean value of the FMF angle in trisomy 21 is only 4 degrees larger than in euploids, but this was proven in only 62% of the trisomy cases. Further, it was underlined that after the 18 WG the echogenicity of the nasal bones obscures the palato-vomeral complex, precluding the measurement of the FMF angle.

We distinguished two different angles in the previously singular FMF entity, FMF-v and FMF-p. The benefit of the linear probe was in distinguishing the palate from the overlying vomeral bone. In our experience the upper border of the vomer has a slightly convex shape and is less echogenic than the palate. These facts are of key importance for a precise measurement of FMF-p and FMF-v angles (**Fig. 2, 3**). According to our personal experience, the extensive expertise in the evaluation of NT gives an ultrasonographer sufficient capacity for detecting the absence or presence of vomer.

The potential relationship between the nasal bone and the vomer is also of clinical interest. The intramembranous ossification of the nasal bone begins in the third month, while the ossification of the vomer occurs somewhat earlier, from two centers in the eighth week. On this basis, it would only be reasonable to presume that their embryogenesis as well as their presence/absence are somewhat independent. The quantitative and qualitative expression of morphological disorders in aneuploids is variable and often without satisfactory rationale. For example, in the population of fetuses with AVSD, cardiac anatomy is less distorted in fetuses with trisomy 21 than in euploids, which is difficult to explain [11]. However, there is a correlation between the absence of the vomer and the length of nasal bones. The precise measurement of the length of nasal bones depends on the experience of the sonographer [12], while the insight of vomer relates to the resolution of the applied transducer.

As the vomer grows during the 1st trimester until the end of the 16th week of gestation (early 2nd trimester), the FMF-v angle decreases by 8 degrees on average according to our findings. The FMF-p angle has the same tendency, but to a lesser extent. The latter is probably caused by the increase of the palatine convexity, and adds to the impairment of the FMF-v angle, as the vomer is reposed on the hard palate. This normal decrease in FMF angle has also been shown by other studies in which the values of the FMF angle were very similar when using 2D and 3D techniques [2, 4].

Evaluating the frontomaxillary facial angle in chromosomally normal fetuses at 11^{+0} to 13^{+6} weeks, Borenstein et al. [2] reported that the FMF angle decreases as the fetal CRL increases. Furthermore, the same authors found that in cases with trisomy 13 the FMF angle increases only with associated holoprosencephaly [13]. We diagnosed the absence of the vomer in two fetuses with trisomy 13 which, contrary to this data, was not associated with holoprosencephaly.

Molina et al. [7] have shown that in fetuses with trisomy 21 the FMF angle (which they did not differentiate into –v and –p) ranged from 75.4° to 104° (mean 88.7°). This value is identical to our results for the FMF-p angle for both normal fetuses and fetuses with trisomy 21, with regard to the same trimester. On the other hand, the size of the FMF-v angle in our study was very similar to the FMF angle for normal fetuses (range 66.6°–89.5°, mean 78.1°). Sonek et al. [9] conducted a 3D ultrasound study on FMF angle in 400 fetuses, 25% of which had trisomy 21. The size of the FMF angle exceeded 85° in 69% of aneuploid fetuses and in only 5% of euploid fetuses. Nevertheless, in our study the FMF-p angle in fetuses with trisomy 21 in the 2nd trimester resembled the results of the FMF angle (mean 88.5°) presented by Plasencia et al. [6].

If our observation corresponds to an absent or underdeveloped vomer, it would also be ideal that this hypothesis is confirmed by pathological examination. Alternatively, in vitro studies

could be performed to confirm that the imaged entity conforms to the vomer.

It is worth mentioning that in the study by Borenstein et al. [2] the measurement is reproducible and the results obtained by 3D and 2D ultrasound are similar. In their study, 111 of 500 cases (22.2%) were not included as it was not possible to obtain the precise mid-sagittal plane of the fetal face with 3D within the allotted 15-minute time period [4]. It has been postulated that although 2D grayscale detailed examination remains the conventional approach for anatomical surveys, 3D sonography may help diagnose fetal anomalies earlier and with greater confidence [14]. On the other hand, in our 2D study, in the first trimester the absence of the vomer could be diagnosed by the linear probe and V-probe in 1 – 5 minutes, with a failure rate of only about 5%. Furthermore, the C-probe could not distinguish the palatum from the vomer. However, at present there is one published study regarding the time required for training in the measurement of the FMF angle [5].

In numerous references [2, 6, 9, 13] there is a perplexity in differentiating the two appearances of the maxilla: rectangular (vomer present) and "thin" (vomer absent), by means of standard probes. Furthermore, the FMF angle cannot be assessed on a subjective basis, as it is only 3 – 11 degrees larger in euploid cases than in trisomy cases [4].

We were usually able to discriminate the palate from the vomer in the 1st trimester using the L-probe, while the other authors have accomplished this in the 2nd trimester using the convex probe [7]. The position of a fetal head (i.e., its distance from the probe) determined the type of probes in our study: if the distance was up to 6 cm, the L-probe provided a more accurate view of confirmed landmarks, especially of the FMF-v and FMF-p angles. If the distance was more than 6 cm, V and C-probes were used.

In the second trimester C, L and V-probes could usually visualize the vomer and it could not be assessed in only 4% of the cases. The precision of the high-resolution probes including the linear probe of 12 – 5 MHz enables identification of all ultrasound markers for trisomy 21 in the 1st trimester of pregnancy 10 – 13^{+6} weeks [10]. The linear probe in the mid-sagittal plane, however, shows only one nasal bone. The frontal bone was not visible in the 1st trimester because there is a normal gap between the frontal bones [15]. Even if two nasal bones as well as the frontal bone and maxillary bone without the zygomatic are visible, the measurements of the FMF-v angle are reliable and it is a big advantage of the L-probe as they are not visible with the C-probe in the 1st trimester of pregnancy. It has been accentuated that expertise and an adequate learning curve play a significant role in performing this procedure [16].

Finally, it has been noted that hypoplasia of the middle third of the face, if present, can be visible in fetuses with trisomy 21 at 11^{+0} to 13^{+6} weeks of gestation [17], or 6 – 7 months after birth, but there is no precise data on this item in the midterm of pregnancy [7]. On the other hand, the necessity for establishing a reliable early ultrasound marker is beyond doubt [15], and we find our study to a great leap in that direction. Since we definitely established a link between the sonographic absence of the vomer and trisomy 21 and 13, this finding represents a sonographic marker for a chromosomal abnormality in the first trimester which requires further invasive prenatal diagnostic procedures – CVS or amniocentesis.

Although the number of aneuploid cases in our sample was relatively small, its incidence in the risk population exceeds the usual levels for trisomy 21. This occurrence can be explained by our indications for ultrasound exam. Nevertheless, the criterion of the absence of the vomer as a marker for aneuploidy has proven to have high sensitivity in our study.

Our suggestion might also prove to be useful, i.e, if the vomer is clearly visualized, there is no reason to evaluate the FMF angle, thus avoiding problems with its precise measurement. Furthermore, omission of this measurement significantly reduces the duration of the exam, particularly since the vomer can be visualized in the same mediosagittal plane with NT. This approach gains time for testing other ultrasound markers, such as NT, nasal bone absence, ductus venosus reversed flow and tricuspid valve regurgitation, consequently increasing the detection rate of trisomy 21 [3]. However, the observation in our study is of limited usefulness since the presence of the vomer after 16 weeks cannot distinguish aneuploid fetuses. On the other hand, since there were only 2 cases of Down syndrome in the second trimester in this series, there is insufficient data to make such a suggestion. Finally, it should be underlined that ultrasound markers for early detection of trisomy have a most significant and incomparable impact on pregnancy.

Conclusion

Owing to its higher resolution, the linear probe can detect the absence of the vomer, exhibited by the modification of the shape of the maxilla, from rectangular to thin (with palate but without vomer). We think that it is critical to gain adequate training and experience with this procedure. Nevertheless, this alteration of the maxillary appearance can also be detected by means of a lower-resolution transabdominal convex probe (in cases of a distance exceeding 6 cm), or with a vaginal probe. It is our belief that in those cases it is not necessary to measure the FMF angle, but to proceed to genetic tests (CVS), regardless of the presence/absence of other ultrasound markers. On the other hand, if it is not feasible for any reason to accurately detect the absence of the vomer, i.e., the modification of the shape of the maxilla, the FMF angle measurement becomes mandatory.

Moreover, in the early 2nd trimester (16^{th} WG), the detection of vomer absence does not require the quantification of the FMF angle, as in those cases this angle is certainly increased. In such circumstances, the genetic amniocentesis is indicated. It should be underlined that the presence of the vomer after the 16^{th} week of gestation does not exclude aneuploidy.

Abbreviations in the text

FMF, frontomaxillo-facial
–p, palate
–v, vomer
WG, week of gestation
L, linear
C, convex
V, endovaginal
CVS, chorionic villus sampling

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