FETAL MEDICINE FOUNDATION OF THE UNITED STATES OF AMERICA

March 2007

Volume 3 Issue 1

11 –13^{+6} Weeks Scan Project Newsletter

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In this issue:

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- NT, Nasal Bone, and Tricuspid Accreditation, Software Information
- Annual audit information
- CD with nasal bone and tricuspid flow lectures
- Reprints of recent publications and free book

WELCOME to the March 2007 issue of the FMF/USA newsletter. This issue's feature article is by the Fetal Medicine Foundation USA director, Dr. Jiri Sonek MD RDMS. In conjunction with Prof. Kypros Nicolaides, Dr. Sonek presented the fronto-maxillary facial angle (FMFA) as a new Down syndrome ultrasound marker at the recent International Society of Ultrasound in Obstetrics and Gynecology Conference in London and this exciting new work is outlined in Dr. Sonek's feature article. In addition, Cathy Downing, FMF-USA's Reaccreditation Coordinator has submitted an article describing the FMF-USA ID card which is now being sent to people upon successful completion of their annual audit. We have a new feature this issue which will become a regular part of future newsletters: "What's Wrong with this Picture?" - a test-your-skills image review game. As usual, upcoming courses are listed on Page 4 along with our Frequently Asked Questions (and Answers).

FRONTO-MAXILLARY FACIAL ANGLE IN SCREENING FOR TRISOMY 21

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Introduction: Langdon Down described the phenotypic features of individuals with the syndrome, which was subsequently named after him in 1866.[1] Many of these have their prenatal equivalents: "The skin is deficient in elasticity giving the appearance of being too large for the body (thickened nuchal translucency in the first trimester [2,3] and thickened nuchal fold in the second trimester)[4] ….. the nose is small" (absence of nasal bone in the first trimester and absence or hypoplasia of the nasal bone in the second trimester) [5,6,7]. Another feature, which he described, was a "flat face". Even though this can sometimes be subjectively appreciated on prenatal ultrasound, especially late in gestation, to date an objective estimation of facial flatness by prenatal ultrasound has been lacking. This is due to the complexity of the facial profile and an absence of reproducible lines or points from which topographic measurements can be taken. Attempts have been made to evaluate the degree of midface hypoplasia by measuring the maxilla [8,9]. Maxillas of fetuses with trisomy 21 have been shown to be smaller than those with normal chromosomes. However, the difference is small and has not been shown to be clinically useful. These relatively small differences also suggest that another factor may be contributing to the flat profile, such as a dorsal displacement of the maxilla. To that end, we have developed a method to evaluate the position of the maxilla relative to the forehead utilizing fronto-maxillary facial (FMF) angle measurements.

Starting in the late first trimester, the top edge of the hard palate in combination with the floor of the nasal cavity forms a relatively straight line when the fetus is viewed in the midsagittal section. Therefore, we elected to use this line as the first ray of our angle. The vertex of the angle is the anterior aspect of the maxilla at a point where this line intersects it. The second ray is drawn from the vertex up to the forehead in such a way that the inner aspect of the line is flush with the outer aspect of the bony forehead (Figure 1). The forehead was chosen because of it being an easily identifiable landmark and due to the fact that frontal bossing is not recognized as a phenotypic feature of trisomy 21. It should be stressed that in the first trimester, the metopic suture is not yet fused. At this point in gestation, an echogenic line underneath the skin representing the metopic suture, is still easily identifiable, but it is not as echogenic as bone.

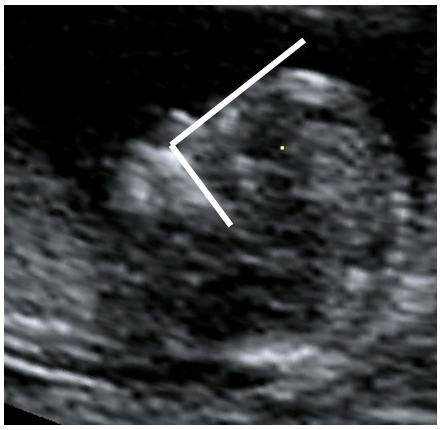
FRONTO-MAXILLARY FACIAL ANGLE IN SCREENING FOR TRISOMY 21 (cont.)

Clinical applications: The FMF angle changes with the location of the maxilla: it increases as the maxilla is displaced in the dorsal direction. In order to evaluate whether fetuses with trisomy 21 have dorsally displaced maxillas in comparison to euploid fetuses, we measured the FMF angle in 100 fetuses with trisomy 21 and 300 fetuses with normal chromosomes[10]. This was done by reviewing three dimensional volumes of the fetal head which had been obtained prior to fetal karyotyping by CVS. Since these were originally obtained for the purpose of nasal bone evaluation, they were all generated using the same technique: the fetus was facing the transducer and the face of the transducer was parallel with the longitudinal axis of the nose. The images were scrolled through in the multiplanar mode to generate a precise mid sagittal view of the fetal profile. The FMF angles were measured using the above described technique by operators who were blinded to the presence or absence of trisomy 21. The inter- and intra-observer variability was less than 5 degrees in 95 percent of the cases.

The results showed that 69% of the FMF angles in fetuses with trisomy 21 were above the 95th percentile of the normal ranges and 40% were above the upper limit of the normal range. On the other hand, only 2% of the fetuses with trisomy 21 had FMF below the 50th percentile. The FMF angle measurements appeared not to change significantly with gestational age. They were found to be independent of the nuchal translucency measurement, presence or absence of the nasal bone, and maternal serum biochemistries (free beta-hCG and PAPP-A). As such, the FMF angle meets criteria for inclusion in the first trimester combined screening protocols.

Summary: Preliminary data shows that using the FMF angle is likely to improve our ability to screen for trisomy 21 in the first trimester. Mathematical modeling suggests that their inclusion would improve combined first trimester screening detection rate to 98% with a screen positive rate of below 5%.

Still, caution needs to be used in interpreting our data. In the first trimester, 3-D ultrasound volumes were used exclusively to create the optimal image planes for FMF angle measurements. It is not yet entirely clear how this will translate into distributions based on 2D ultrasound images. Furthermore, prospective 3-D data (submitted for publication), suggest that the normal FMF angle ranges undergo a small, yet statistically significant decrease with increasing crown-rump length measurement . Therefore, gestational age-specific normal ranges need to be used to appropriately interpret FMF angle measurements. As is the case with all other first trimester markers, adherence to standardized techniques is crucial. We will keep you updated in this newsletter as the data regarding this technique are refined.

a. 

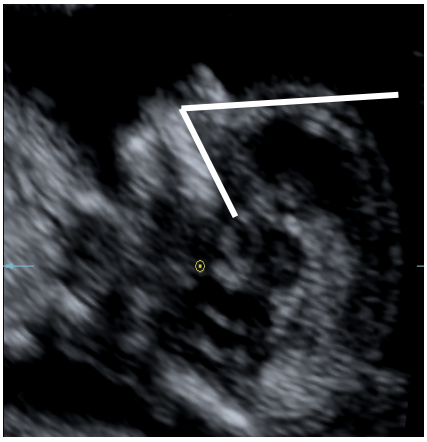
b. 

Figure 1.

(a) Increased FMF angle in a first trimester fetus with trisomy 21. (b) An acute FMF angle in a first trimester fetus with normal chromosomes.

.References

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3. Snijders RJ, Noble P, Sebire N, Souka A, Nicolaides KH. UK multicentre project on assessment of risk of trisomy 21 by maternal age and fetal nuchal-translucency thickness at 10-14 weeks of gestation. Fetal Medicine Foundation First Trimester Screening Group. Lancet 1998;352:343-6.

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5. Sonek J, Nicolaides K. Prenatal ultrasound diagnosis of nasal bone abnormalities in three fetuses with Down syndrome. Am J Obstet Gynecol 2002; 186:139-41

6. Cicero S, Curcio P, Papageorghiou A, Sonek J, Nicolaides KH. Absence of nasal bone in fetuses with trisomy 21 at 11-14 weeks of gestation: an observational study. Lancet 2001;358:1665-7.

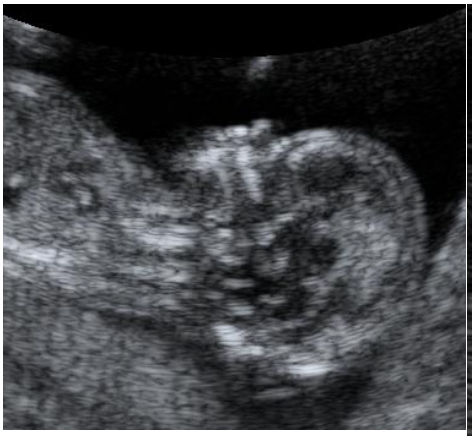
7. Sonek J, Cicero S, Neiger R, Nicolaides K. Nasal bone assessment in prenatal screening for trisomy 21. Am J Obstet Gynecol 2006;195:1219-30.

8. Cicero S, Curcio P, Rembouskos G, Sonek JD, Nicolaides KH. Maxillary length at 11-14 weeks of gestation in fetuses with trisomy 21. Ultrasound Obstet Gynecol 2004;24:19-22.

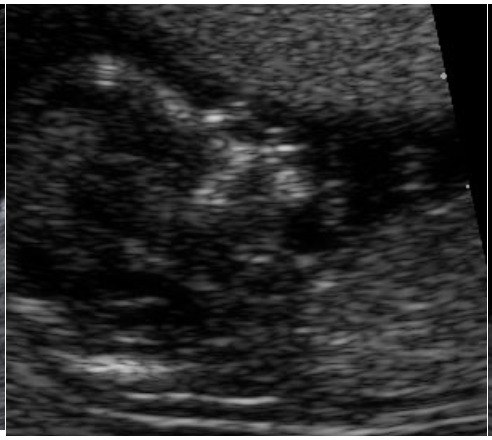
9. Dagklis T, Borenstein M, Peralta CFA, Faro C, Nicolaides KH. Three-dimensional evaluation of mid-facial hypoplasia in fetuses with trisomy 21 at 11-13^{+6} weeks. Ultrasound Obstet Gynecol 2006;28:261-5.

10. Sonek J, Borenstein M, Dagklis T, Persico N, Nicolaides K. Fronto maxillary facial angle in fetuses with trisomy 21 at 11-13^{+6} weeks. Am J Obstet Gynecol. In press.

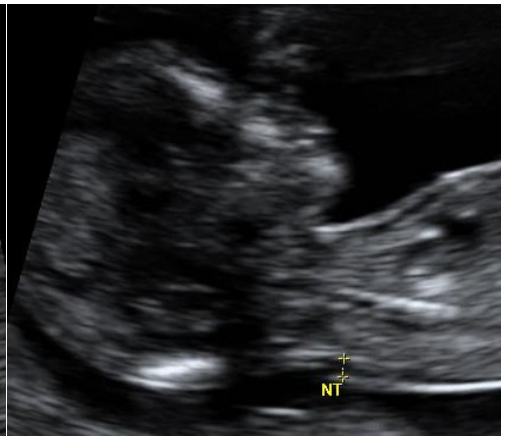
WHAT'S WRONG WITH THIS PICTURE? Test your skills as an image-reviewer. In each of the images below, decide if the image meets all criteria and, if not, choose all criteria that are *not* satisfied. (Answers at bottom of page 4)



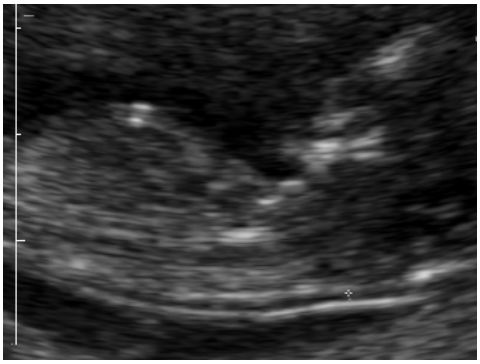
1. Nasal Bone Image
   a) Sound beam 90^0 to nasal bone
   b) Nasal bone more echogenic than skin
   c) Mid-sagittal plane
   d) Head and thorax fill the image
   e) All criteria are satisfied



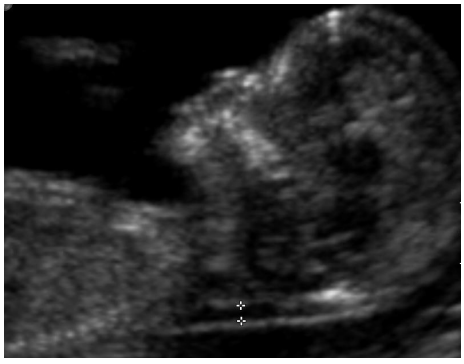
2. Nasal Bone Image
   a) Sound beam 90^0 to nasal bone
   b) Nasal bone more echogenic than skin
   c) Mid-sagittal plane
   d) Head and thorax fill the image
   e) All criteria are satisfied



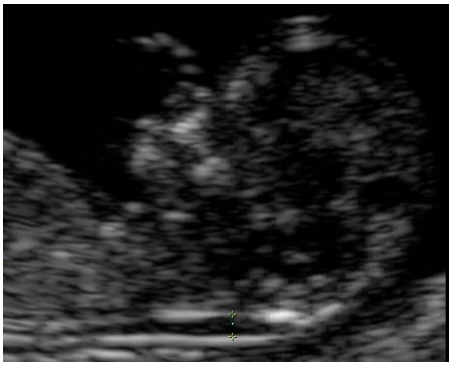
3. NT Measurement Image
   a) Head and thorax fill the image
   b) Calipers border NT fluid space
   c) Mid-sagittal plane
   d) Whole NT region is seen
   e) Widest lucency is measured
   f) NT lines are thin and sharp
   g) Neutral head and neck position
   h) All criteria are satisfied



4. NT Measurement Image
   a) Head and thorax fill the image
   b) Calipers border NT fluid space
   c) Mid-sagittal plane
   d) Whole NT region is seen
   e) Widest lucency is measured
   f) NT lines are thin and sharp
   g) Neutral head and neck position
   h) All criteria are satisfied



5. NT Measurement Image
   a) Head and thorax fill the image
   b) Calipers border NT fluid space
   c) Mid-sagittal plane
   d) Whole NT region is seen
   e) Widest lucency is measured
   f) NT lines are thin and sharp
   g) Neutral head and neck position
   h) All criteria are satisfied



6. NT Measurement Image
   a) Head and thorax fill the image
   b) Calipers border NT fluid space
   c) Mid-sagittal plane
   d) Whole NT region is seen
   e) Widest lucency is measured
   f) NT lines are thin and sharp
   g) Neutral head and neck position
   h) All criteria are satisfied

NEW!! FMF USA Identification Cards

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Maintenance of current accreditation is an integral part of ongoing quality NT measurements as well as a prerequisite for nasal bone and/or tricuspid flow accreditation(s). This service is provided free of charge. Quality assessment and assurance are accomplished via annual auditing. Effective January 2007, the Fetal Medicine Foundation USA will issue FMF ID cards with each successful audit. A successful audit means that your data was in the expected range (40-60% above the median)* and your images were of high quality. The FMF ID card will include your name, FMF ID number, certifications, expiration date and audit instructions for future reference. This card may be copied and sent to labs as well as insurance companies for verification of status.

*some exceptions may apply

Upcoming Fetal Medicine Foundation United States Courses

Face-to-Face Courses

** Saturday April 21, 2007— Chicago, IL (7.5 CMEs)

** Saturday August 4, 2007— Seattle, WA (7.5 CMEs)

**Contact Melissa Machtolff (MMachtolff@genecare.com) or Carrie Spradley (CSpradley @genecare.com)
Website: www.genecare.com/35/id/Conferences 1-800-277-4363

Online course:

***FMF USA 11-13+6 Week Scan Theory and Practical NT/NB/TF Internet Course

(complete theory course covering nuchal translucency, nasal bone, and tricuspid flow theory, techniques and accreditation/ ongoing quality assurance processes) (4.0 CMEs)

***FMF USA Nasal Bone and Tricuspid Flow Theory and Practical Internet Course

(new short course just covering nasal bone and tricuspid flow theory, techniques and accreditation / ongoing quality assurance processes—see box below this for explanation) (4.0 CMEs)

Website: http://www.mfmedicine.com/CourseList.aspx E-mail: John.Lai@mfmedicine.com

Frequently asked question:

Question: Recently I have heard that the NT screening window should begin when the fetus measures 38mm. I thought the Fetal Medicine Foundation protocol said to begin NT screening at CRL >=45mm. What is the difference?

Answer: When the Fetal Medicine Foundation originally developed the first trimester screening protocols in the mid 1990's, the range of gestational age extended to 10^{+3} weeks' gestation (38mm CRL). This lower limit was subsequently increased to 11 weeks (45mm CRL) due to several reasons. These included the realization that a number of fetal anatomic structures can be evaluated with much greater precision at or beyond 11 weeks' gestation: cranium, fetal kidneys and bladder, spine, extremities, and the fetal heart. The presence of physiologic mid-gut herniation prior to 11 weeks' gestation makes it difficult to rule out an omphalocele at that time. Furthermore, the newer ultrasound markers such as the nasal bone, tricuspid flow, ductus venosus flow, and the fronto-maxillary angles are designed to be used at or beyond 11 weeks' gestation. There is no loss of detection rate by waiting until 11 weeks to do your NT screen. Yet there is much to be gained by waiting until this gestational age.

Answers to "What's Wrong with this Picture": 1) a,b,d 2) e 3) b,d,e 4) b,c,e 5) b 6) h