The usefulness of “Volume NT” in measuring the fetal nasal bone in the first trimester

T. Ghi, MD, M. Nanni, MD, G. Cucchi, MD

Department of Obstetrics and Gynecology, University of Bologna, Italy

"3D ultrasound supported by “Volume NT” software represents an easy and reproducible method to measure the fetal nasal bone in the first trimester "

Introduction

The absence or hypoplasia of fetal nasal bones (NB) at ultrasound from 16 weeks of gestation onward has been consistently associated with a higher risk of trisomy 21. Furthermore, it has been estimated that at 11 to 13 + 6 weeks, the sonographic assessment of fetal NB (mostly in terms of presence vs. absence) can increase the detection rate of the first trimester screening test for aneuploidies from 91% to 93%\(^1\). However, in comparison with the second trimester, an accurate measurement of fetal NB at 11 to 13 + 6 weeks is more difficult to achieve. Normal reference values for fetal NB length at 11 to 13 + 6 weeks of pregnancy have been established using 2D ultrasound among different ethnic groups\(^2-7\). The reproducibility of these data has been found to be inadequate by some authors\(^8-9\) and to vary in accordance with the sonographer experience. The use of 3D ultrasound may allow a more accurate measurement of fetal NB by aligning the volume dataset on the mid-sagittal plane of the fetal profile.

The aim of this study was to investigate the feasibility and reproducibility of 3D ultrasound in measuring the NB in the first trimester and to assess the usefulness of the volume nuchal translucency (NT) software, Volume NT, in improving the accuracy of these measurements.

Methods

A group of singleton viable pregnancies attending the 11 to 13 + 6 weeks aneuploidy screening at the University of Bologna were prospectively selected. For each patient, fetal NB was measured first by 2D ultrasound. Subsequently, a 3D ultrasound of the fetal head was acquired, and fetal NB was measured by two operators blinded to each other’s findings by offline analysis using the volume nuchal translucency software.

Ultrasound examinations were carried out transabdominally using an Accuvix A30 (Samsung Medison Co, Ltd, Seoul, Korea) equipped with a multifrequency 3D probe. For volume acquisition, a slow ultrasound sweep with a narrow angle (50°) was performed while the fetus appeared still, facing the transducer and in a neutral position, using the sagittal plane as the starting plane.
Volume acquisition was repeated for technical unsatisfactory due to fetal movements. At offline analysis, volume was adjusted by automatic manipulation of the three orthogonal planes with the aim of obtaining a true mid-sagittal view of the fetal face on the A plane. No manual adjustment was made. A specific software uploaded on the machine and commonly employed to achieve automatic measurements of NT was used to obtain the mid-sagittal plane of the fetal face for correct measurement of NB. Volume NT is able to provide the true mid-sagittal plane after manual tracking of the fetal diencephalon. Image resolution of the reconstructed planes was improved by the activation of high-definition volume imaging algorithm.

The NB was then measured manually at the level of the synostosis, pointing the caliper from edge to edge on the NB (Figure 1).

The correlation between 2D and 3D ultrasounds and the intra and inter-reproducibility of fetal NB measurement at 3D ultrasound were assessed. To assess intra-observer reproducibility, each NB measurement was performed offline three times by each investigator. Statistical analysis was performed with SPSS for Windows 15.0 software package (Chicago, IL, USA). A mean value between the three measurements assessed by each operator was used to assess 3D and 2D–3D inter-observer reproducibility.

Results

Overall, 161 Caucasian women were included in the study (Table 1). A qualitatively acceptable volume was obtained for each fetus with a mean additional time for the ultrasound examination of 40 s ± 5 SD. Two or more volume acquisitions were necessary respectively in 13 and 15 cases. Offline measurement of NB was technically feasible in all cases within a short period (2 min ± 1.3 SD). At 3D ultrasound, NB measurement showed an excellent intra-observer and inter-observer agreement. The agreement between 2D and 3D measurements was moderate. Larger NB measurements were obtained at 3D ultrasound compared with 2D ultrasound, the greatest differences being observed when NB length was below 1.6 mm (Table 2, 3 and Figure 2, 3). A reference chart of NB length at 11 to 13 weeks was constructed using the values obtained at 3D ultrasound (Figure 4).

<table>
<thead>
<tr>
<th>N=161</th>
<th>Mean and SD</th>
</tr>
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<tbody>
<tr>
<td>maternal age</td>
<td>31.28 ± 4.47(range 20-39 years)</td>
</tr>
<tr>
<td>Body mass index</td>
<td>24 ± 3.2 (range 22-28 Kg/m2)</td>
</tr>
<tr>
<td>Gestational age</td>
<td>86 ± 2 (range 77-97 days)</td>
</tr>
<tr>
<td>Crown rump length</td>
<td>59.3 ± 9.5 (range 55-84 mm)</td>
</tr>
<tr>
<td>Nuchal translucency</td>
<td>1.4 ± 0.4 (range 0.8-2.6 mm)</td>
</tr>
</tbody>
</table>

Table 1. Demographic details of the patients

| Operator 1 | 2D measurement | 1.8 ± 0.3 |
| 1st 3D measurement | 2.00 ± 0.45 |
| 2nd 3D measurement | 2.00 ± 0.43 |
| 3rd 3D measurement | 2.00 ± 0.41 |
| Operator 2 | 1st 3D measurement | 2.05 ± 0.43 |
| 2nd 3D measurement | 2.07 ± 0.45 |
| 3rd 3D measurement | 2.11 ± 0.43 |

Table 2. 2D-3D nasal bone length
Table 3. Intra-observer and inter-observer reproducibility of NBL with 3D ultrasound and correlation between 2D-3D ultrasound

<table>
<thead>
<tr>
<th>Measurements (n)</th>
<th>ICC and/or rc</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-observer operator 1 3D</td>
<td>161</td>
<td>0.98 (ICC)</td>
</tr>
<tr>
<td>Intra-observer operator 2 3D</td>
<td>161</td>
<td>0.921 (ICC)</td>
</tr>
<tr>
<td>Inter-observer 3D</td>
<td>161</td>
<td>0.92 (rc)</td>
</tr>
<tr>
<td>Correlation 2D-3D</td>
<td>161</td>
<td>0.77 (rc)</td>
</tr>
</tbody>
</table>

**Note**

ICC: Intraclass Correlation Coefficient; ICC<0.65: weak agreement, ICC=0.65-0.79: moderate agreement, ICC=0.8-0.9: good agreement, ICC>0.9: excellent agreement. 95% CI: confidence interval of ICC

rc: Lin’s Concordance Correlation Coefficient; rc<0.65: weak agreement, rc=0.65-0.79: moderate agreement, rc=0.8-0.9: good agreement, rc>0.9: excellent agreement. 95% CI: confidence interval of rc

**Conclusion**

Our study shows that in a population of chromosomally normal fetuses, the NB length can be confidently measured in the first trimester of gestation using 3D ultrasound. An excellent intra-observer and inter-observer agreement was obtained by Volume NT, a dedicated software for dataset offline analysis, which was originally introduced to yield more accurate measurements of NT.

Normal reference values for fetal NB length in the second trimester of pregnancy have been previously established using 2D\(^{10-16}\) and 3D ultrasound\(^{17-19}\). These studies have consistently proven that fetuses with a small but visible NB have in fact an increased risk of trisomy 21. To date, in the first trimester, only the absence of NB has been consistently demonstrated to increase the risk of trisomy 21, whereas the clinical implications of NB hypoplasia have not been fully elucidated. However, in comparison with the second trimester, an accurate measurement of fetal NB at 11 to 14 weeks is more difficult to achieve.
Reference charts of NB length are available for different ethnic groups also in the first trimester. NB has been measured mostly by 2D ultrasound at the 11 to 14 weeks scan, but the results on the reproducibility of these measurements are conflicting.

On the other hand, a reliable reference chart for fetal NB length at 11 to 14 weeks scan is mandatory to assess if the sonographic demonstration of a small NB in the first trimester would increase the risk of trisomy 21. In comparison with manual manipulation, in this study, the use of a dedicated software, Volume NT, to align the volume of the fetal head on a mid-sagittal plane may have permitted more accurate and reproducible measurements of the fetal NB in the first trimester.

**Clinical Applications**

3D ultrasound supported by the volume nuchal translucency software, Volume NT, may provide reliable measurements of the fetal NB in the first trimester. This algorithm despite having been implemented for offline measurement of NT has been successfully used to achieve a quick and reliable mid-sagittal view of the fetal face where the NB length could be easily identified and measured.

At the light of our findings, a larger prospective study on unselected cases is warranted to assess if small NB automatically measured by 3D ultrasound may contribute to refine the risk of trisomy 21 at 11 to 13 + 6 weeks of gestation.

**Supported Systems**

(1) RS80A  
(2) WS80A  
(3) Accuvix A30

**References**

(8) Bekker MN, Twisk JWR, Van Gught M. J Ultrasound Med 2004; 23:1613-18  