Ultrasound Obstet. Gynecol. 5 (1995) 304–307

Ultrasound evaluation of the length of the fetal nasal bones throughout gestation

F. Guis, Y. Ville, Y. Vincent, S. Doumerc, J. C. Pons and R. Frydman

Unité de Médecine foetale et de Diagnostic Antenatal, Hôpital Antoine Béclère, Clamart, France

Key words: ULTRASOUND, NASAL BONES, FETUS

ABSTRACT

Subtle facial abnormalities, including smallness of the nose, are common findings in trisomy 21 and numerous other genetic conditions. The aim of this study was to construct a normal range for the length of the fetal nasal bones with gestation in a Caucasian population. Ultrasound measurements were performed on a strictly mid-sagittal profile in 376 normal singleton fetuses at 14–34 (mean 24) weeks' gestation. It was found that the length of the nasal bones increased from 4 mm at 14 weeks to 12 mm at 35 weeks' gestation, and that there was a linear relationship between the length of these bones and biparietal diameter and femur length. We conclude that the length of nasal bones can easily be measured in fetuses at 14–34 weeks' gestation and that such measurements might prove useful in the evaluation of pregnancies at high risk for associated fetal abnormalities.

INTRODUCTION

Smallness of the nose, often attributed to hypoplasia, is a common finding at postnatal examination of fetuses or neonates with trisomy 21, but also with more than 40 other genetic conditions[1]. Although the prenatal diagnosis of a flat profile has been made, its diagnosis is a subjective one, and no objective measurements of the fetal nose have been reported. We aimed to demonstrate that the fetal nose can be accurately measured by ultrasound. This cross-sectional study establishes a reference range with gestation for the length of the fetal nasal bones and evaluates its relationship with biparietal diameter and femur length in 376 normal singleton pregnancies.

MATERIALS AND METHODS

A normal range for the length of the nasal bones was established from cross-sectional data on 376 consecutive singleton pregnancies scanned at 14–35 weeks' gestation as part of routine prenatal examination. Inclusion criteria were (1) known last menstrual period and cycle length of 26–30 days; (2) no fetal abnormalities or pregnancy complications; (3) live birth after 37 completed weeks' gestation; and (4) birth weight above the 10th and below the 90th centile for gestation. In each case, fetal measurements were taken by any of five experienced ultrasonographers using a curvilinear 3.5- or 5.0-MHz transducer (Toshiba 270, Toshiba, Japan). Measurements of the nasal bones were obtained from a strictly median sagittal plane of the fetal head that imaged the fetal profile characterized by the nasal bones' synostosis, fetal lips, and aligned maxilla and mandible. An anechoic cartilagenous area between the midline of the frontal bone and the nasal bones can be recognized and identifies the nasal bridge. The hyperechogenic nasal bones'

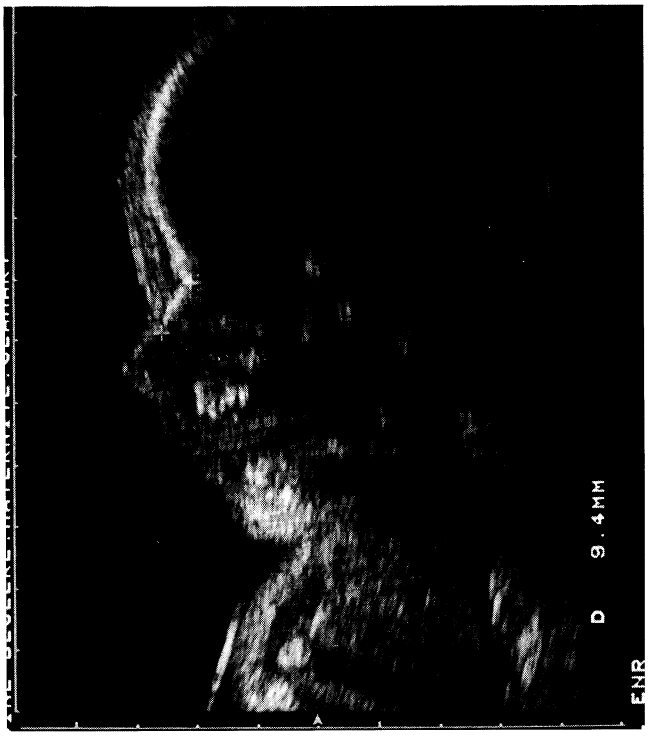

Figure 1 Ultrasound demonstration and measurement of length of nasal bones on a strictly medial sagittal plane

Correspondence: Dr Y. Ville, Unité de Médecine foetale et de Diagnostic Antenatal, Svce de Gynecologie-Obstétrique, Hôpital Antoine Béclère, 157 rue de la porte de Trivaux, 92141, Clamart, France

Received 20–10–94
Revised 23–2–95
Accepted 20–3–95

synostosis can therefore accurately be measured (Figure 1). After identification of the appropriate plane, three independent measurements of the length of the nasal bones were obtained and averaged to obtain the final measurement used in the calculations. Measurements of biparietal diameter, femur length and transverse abdominal diameter were taken in the standard planes.

Statistical analysis

Statistical analysis was performed on a Statview II SE statistical software package. The length of the nasal bones was analyzed as the dependent variable paired with gestational age, biparietal diameter and femur length as the independent variables. Polynomial least squares regression analysis was performed and the equation selected was of the lowest order for which all coefficients of the equation were significantly different from zero as computed by the full to reduced F test. The 95% prediction limits were also calculated for each model. Intraobserver variation was calculated on all measurements and interobserver variation was calculated on the first 74 measurements as the mean of ((X1 – X2)/Xm), where X1 and X2 were measurements of the lengths of nasal bones by each observer and Xm was the mean of X1 and X2.

RESULTS

Our population was of Caucasian origin, since women from Afrocaribbean or oriental origin were not included. Each patient contributed only one set of measurements and delivered after 37 completed weeks. Mean birth weight was 3237 g (range 2480–4460 g). The increase of the length of the nasal bones (NBL) throughout gestation is given by the equation NBL (mm) = $-0.11\ (GA)^2 + 0.93\ (GA) - 7.104$ ($R^2 = 0.681$, SE = 1.304, $p = 10^{-4}$), and is shown in Figure 2. Table 1 gives the mean and standard deviation of the length of the nasal bones at different gestations. Inter- and intraobserver variations were 6.2% and 10.7%, respectively.

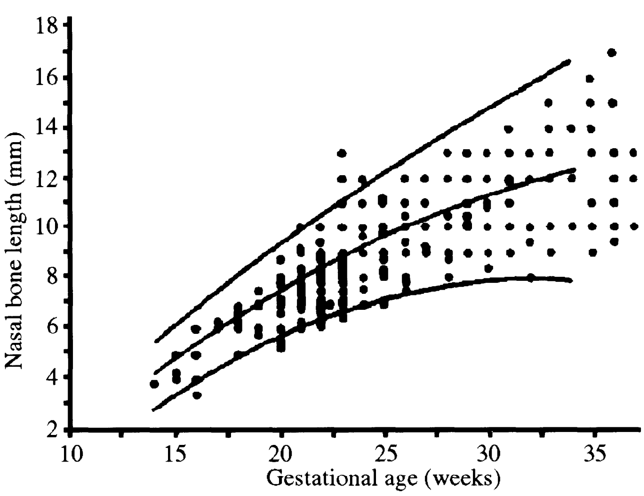

Figure 2 Distribution of length of nasal bones with gestation (mean, 5th and 95th centiles)

Table 1 Mean, standard deviation (SD), mean + 2 SD and mean – 2 SD for length of the nasal bones (mm) throughout gestation

Gestation (weeks)	*Mean*	*Standard deviation*	*Mean – 2 SD*	*Mean + 2 SD*
14	4.183	0.431	3.321	5.045
16	5.213	1.062	3.089	7.337
18	6.308	0.654	5.000	7.616
20	7.621	0.953	5.715	9.527
22	8.239	1.102	6.035	10.443
24	9.362	1.300	6.762	11.962
26	9.744	1.277	7.190	12.298
28	10.721	1.459	7.803	13.639
30	11.348	1.513	8.322	14.374
32	11.580	1.795	7.990	15.170
34	12.285	2.372	7.541	17.029

The distributions of biparietal diameters and femur lengths of the 376 patients are shown in Figure 3. There was a linear relationship between length of the nasal bones, abdominal diameter (AD) (NBL = 0.122 (AD) + 1.62; $R^2 = 0.669$; SE = 1.286; $p = 10^{-4}$) and biparietal diameter (BPD) (NBL = 0.136 (BPD) + 0.773; $R^2 = 0.683$; SE = 1.265; $p = 10^{-4}$) and femur length (FL) (NBL = 0.153 (FL) + 2.146; $R^2 = 0.693$; SE = 1.244; $p = 10^{-4}$) measurements throughout gestation. Regressions between length of the nasal bones and the other measurements are shown in Figure 4.

DISCUSSION

The results demonstrate an increase in the length of the nasal bones throughout gestation that parallels other parameters of fetal growth, with a linear relationship between length of the nasal bones, femur length, biparietal diameter and abdominal diameter. The closest correlation was obtained with femur length; however, all the relationships were very strong and similar.

Ultrasound evaluates the fetal face and neck quite efficiently from 16 weeks' gestation[2]. The observation of the fetal nose has, for the most part, been considered for the diagnosis of cleft lip[3]. Extensive and time-consuming sonographic investigation of the face is not useful in the vast majority of cases in low-risk obstetric sonography. On the other hand, since most facial anomalies detected prenatally involve the nasal or periorbital regions or the mouth, visualization of the fetal profile[4] and axial scanning through the level of the fetal orbits and frontal view of the upper lip and mouth are well standardized planes that should be offered to every pregnant woman undergoing a detailed morphology scan[5].

The mid-sagittal view of the face demonstrates the fetal profile within 2–3 min in approximately 75% of cases[4,6]. This scanning plane may visualize subtle abnormalities including abnormal nose, micrognathia, enlarged tongue, or absent nasal bridge. The profile images of the face may be especially helpful in fetuses with a positive family history of facial abnormalities or maternal ingestion of teratogens[3,7]. Abnormalities seen on a facial profile view may assist in accurate diagnosis in multiple malformation syndromes, including Down

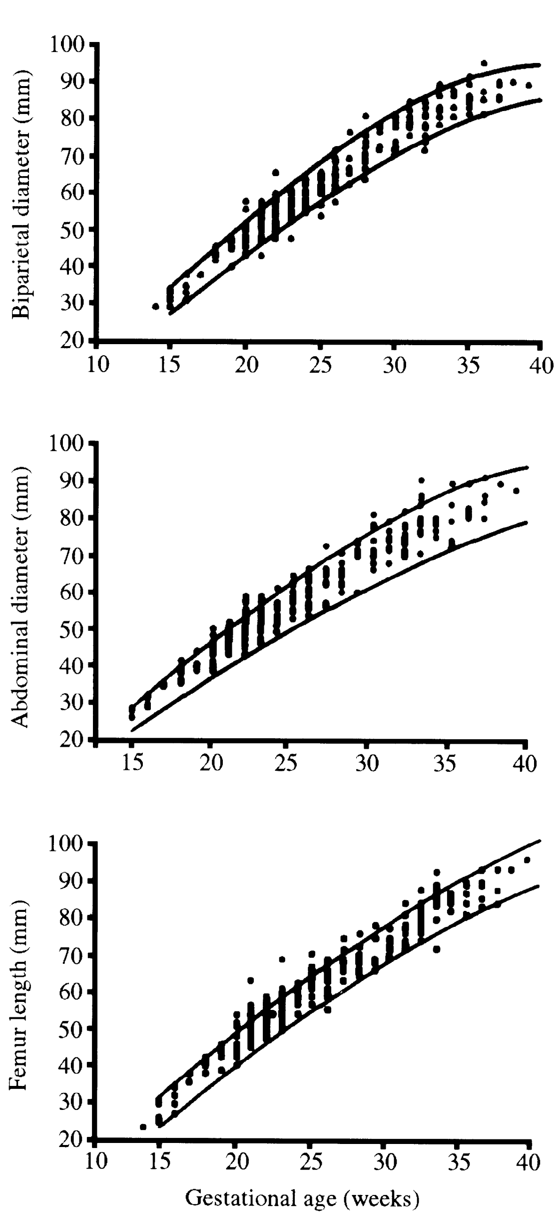

Figure 3 Distribution of biparietal and abdominal diameters and femur length with gestation (5th and 95th centiles)

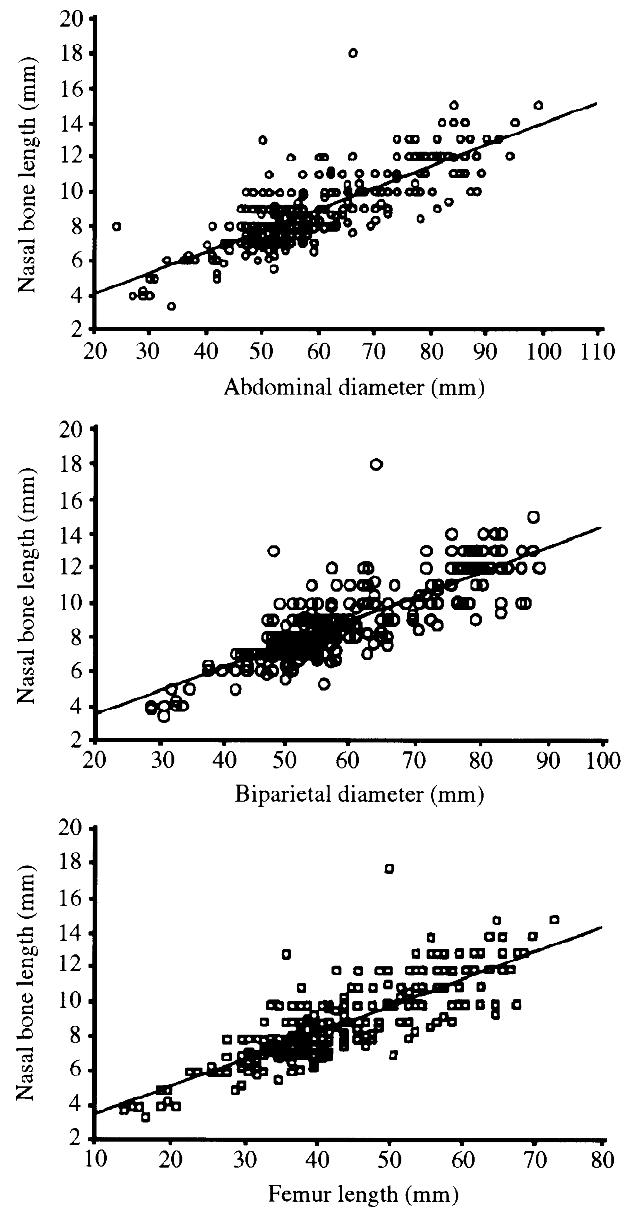

Figure 4 Regression between length of nasal bones and abdominal and biparietal diameters and femur length

syndrome, by showing additional markers such as protruding tongue and flat profile with small or hypoplastic nose. Small or hypoplastic nose has been described as a component of over 40 genetic syndromes[1] such as trisomy 21 and trisomy 18, Apert and de Lange syndromes and fetal environmental toxic effects. However, the diagnosis in these instances has been made from a subjective impression of a flat profile. While the value of impressions of the experienced sonologist should not be underestimated, it is frequently beneficial to be able to rely on objective, reproducible measurements of well-studied parameters.

The prerequisite for this study was to determine landmarks on the fetal profile that allow consistent and reproducible measurements. Visualization of the nasal bones is most easily achieved with the fetal head in the transverse or occiput posterior position; the 'back-up' position makes measurement most difficult, but, up to 28 weeks' gestation, gentle external pressure over the fetal anterior shoulder or head makes measurement possible on any fetus. Pilu and co-workers[6] examined the accuracy of prenatal ultrasound for the detection of facial anomalies among 223 fetuses at risk of craniofacial abnormalities. The face could not be visualized in 11% of these targeted fetuses at 18–40 weeks, because of severe oligohydramnios, maternal obesity or persistently awkward fetal positioning that might be related to the fetal condition under investigation. Right and left nasal bones join by a thick synostosis that extends medially from the nasal root just below the glabella to the tip of the ossified part of the nose[8]. The synostosis appears hyperechogenic when compared to the thin distal cartilagenous extremity of the nose that is nearly echolucent (Figure 1). A strict medial profile is an essential condition for reproducible measurements, since nasal bones have a trapezoidal shape and the inner edge is shorter than the external one.

The normal range is provided for the length of the synostosis joining the inner edges of right and left nasal bones; a laterally and deviated plane would, therefore, overestimate this measure and overlook a certain degree of nasal hypoplasia.

Although this study defines normal growth of the fetal nose, abnormal growth has yet to be well studied. Furthermore, our population was mainly of Caucasian origin and equivalent measurements obtained in oriental countries, for example, may be significantly different. Until the onset of altered nasal growth is determined for various conditions, a normal nose measurement will not rule out the eventual development of hypoplasia of the nose. Furthermore, more fetuses will have to be studied to determine the usefulness of these data in differentiating the normal and abnormal fetus. We believe that, in low-risk obstetric sonography, access to the face and profile of any fetus should be obtained at 18–20 weeks, as part of the surveillance for chromosome and genetic syndromes on a routine basis[5]. It is therefore possible that these data will allow an increase in the detection rate of earlier and more subtle abnormalities of nasal growth.

REFERENCES

1. Jones, K. L. (1988). *Smith's Recognizable Patterns of Human Malformation*, 4th edn. (London: W.B. Saunders)
2. Escobar, L. F., Bixler, D. and Padilla, L. M. (1988). Fetal craniofacial morphometrics: *in utero* evaluation at 16 weeks' gestation. *Obstet. Gynecol.*, **72**, 674–9
3. Jeanty, P., Romero, R., Standach, A. and Hobbins, J. C. (1986). Facial anatomy of the fetus. *J. Ultrasound Med.*, **5**, 607–16
4. Turner, G. M. and Twining, P. (1993). Facial profile in the diagnosis of fetal abnormalities. *Clin. Radiol.*, **47**, 389–95
5. Campbell, S. (1993). The obstetric ultrasonographic examination. In Chervenak, F. A., Isaacson, J. C. and Campbell, S. (eds.) *Ultrasound in Obstetrics and Gynecology*, pp. 187–98. (Boston, Toronto, London: Little, Brown)
6. Pilu, G., Reece, A. and Romero, R. (1986). Prenatal diagnosis of craniofacial malformations with ultrasonography. *Am. J. Obstet. Gynecol.*, **155**, 45–50
7. Hegge, F. N., Prescott, G. H. and Watson, P. T. (1986). Fetal facial abnormalities identified during obstetrics sonography. *J. Ultrasound Med.*, **5**, 679–84
8. Rouvière, H. (1967). *Anatomie humaine descriptive et topographique*, 10th edn., Tome I. *Tête et cou*, pp. 321–39. (Paris: Masson Ed)