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Original Article

Fetal maxillary and mandibular length in normal pregnancies from 11 weeks' to 13^{+6} weeks' gestation: A Taiwanese study

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ABSTRACT

Objectives: This study aims to establish the normal range of maxillary and mandibular lengths within the Taiwanese population at 11^{+0} weeks to 13^{+6} weeks of gestation in normal singleton pregnancy as a reference value for prenatal ultrasonographic examinations.
Materials and methods: We examined nuchal translucency in 269 normal singleton pregnancies, with the gestational age ranging from 11 weeks to 13^{+6} weeks in this study. Fetal biometric measurements, with an emphasis on maxillary and mandibular lengths, were obtained from the patients during consecutive routine prenatal ultrasonographic examinations.
Results: Maxillary and mandibular lengths were recorded successfully in 191 patients and 179 patients, respectively. The mean maternal age was 31 years (range 19–45 years), with a corresponding gestational age of 12 + 4 weeks (range, 11^{+0}–13^{+6} weeks). A first-degree correlation was found to exist between the gestational age and maxillary length ($r = 0.596$; $p < 0.0001$; $y = 1.491 \times GA - 10.523$) as well as mandibular length ($r = 0.465$; $p < 0.0001$; $y = 1.050 \times GA - 6.50$).
Conclusion: Normative data for ultrasonographic measurements of maxillary and mandibular lengths within the Taiwanese population were presented. Our data can serve as a reference value in congenital anomaly screening during prenatal examination.

Introduction

Ultrasonographic assessment of the fetal face is an essential part of a prenatal anatomical survey. The deviation in maxillary and mandibular lengths is associated with multiple congenital anomalies [1–3]. A short maxillary length may be related to a series of abnormalities, including choanal atresia, Marfan syndrome, and trisomy 21 [4]. A short mandibular length also correlates with craniofacial malformations, cleft palate, and trisomy 21 [5]. Several studies have attempted to establish the normative data of maxillary and mandibular lengths at a gestational age of 11^{+0}–13^{+6} weeks [4–7]. Nevertheless, discrepancies in facial measurements exist among different populations. The objective of our study was to define the normal range within the Taiwanese population, which may be applied during prenatal screening for congenital malformations.

Materials and methods

Patients

Normal singleton pregnancies with a gestational age ranging from 11^{+0} weeks to 13^{+6} weeks were included in this study. All patients were Taiwanese. We estimated the fetal age from the last

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menstrual period and made further confirmation by biometric measurements. Pregnancies with loss of follow-up or complications, including gestational diabetes, preterm labor, antepartum hemorrhage, congenital abnormalities, and maternal systemic disease, were excluded from the study. Hospital medical records were reviewed to assess the outcome of the pregnancy, and newborns with abnormal karyotypes or major structural abnormalities were excluded from the study. The study was approved by the Institutional Review Board at Taipei Veterans General Hospital, Taipei, Taiwan, and informed consent was obtained from all participants.

Ultrasound examination

All ultrasonographic measurements were performed using a Voluson 730 ultrasound machine (GE Healthcare, Milwaukee, WI, USA) equipped with a 4-MHz transabdominal transducer and an 8-MHz transvaginal transducer. Nuchal translucency and nasal bone measurements were performed for all the fetuses, with a focus on the fetal facial profile. We started from the mid-sagittal view, in which the bridge of the nose, nasal bone, alveolar ridge, and the tip of the mandible were presented in a straight line. The maxilla and mandible were found by tilting the transducer laterally (about 10–15°). The length of the rod-shaped maxillary bone was measured from inner to outer margins along the mid-line, taking care to exclude the condylar part (Fig. 1A). The length of the mandibular bone was measured only from the outer margin to the lower edge of the ramus (Fig. 1B). All the measurements were performed by one experienced obstetrician (C.Y.C.).

Statistical analysis

Data were collected in an Excel spreadsheet (Microsoft, Redmond, WA, USA) and analyzed using SPSS for Windows, version 15.0 (SPSS Inc., Chicago, IL, USA). Relationships between the maxillary length, mandibular length, and gestational age were evaluated by regression analysis. Pearson's correlation coefficient was used to assess the degree of correlation between variables.

Results

A total of 269 women with normal singleton pregnancy between 11 weeks' and 13^{+6} weeks' gestation were examined in this study. All the measurements were completed during examinations and also reviewed by the obstetrician (C.Y.C.) from Taipei Veterans General Hospital Picture Archiving and Communication System. Poor-quality images were excluded. Birth records of all fetuses were reviewed. No small (or large) for gestational age or neonatal anomalies were identified. After review by the obstetrician (C.Y.C.), the maxillary length and mandibular length were analyzed in 191 participants and 179 participants, respectively. The mean maternal age was 31 years (range, 19–45 years), and the corresponding gestational age was 12^{+4} (range, 11^{+0}–13^{+6}) weeks. The characteristics of the patients and birth data are shown in Table 1.

Table 1
Maternal and fetal characteristics.

Number of patients	269
Maternal characteristics	
Age (y)	31.32 ± 4.09
Gestational age at study (wk)	12.68 ± 0.68
Fetal characteristics	
Fetal body weight (g)	3133.51 ± 376.37
Fetal body length (cm)	47.69 ± 2.44
Apgar score (1 min/5 min)	8/9
Fetal sex	
Male (%)	56.52
Female (%)	43.38

A linear correlation exists between gestational age and maxillary length, as well as between mandibular lengths. A first-degree correlation was discovered [maxilla: $r = 0.596$; $p < 0.0001$; $y = 1.491 \times GA - 10.523$ (Fig. 2); mandible: $r = 0.465$; $p < 0.0001$; $y = 1.050 \times GA - 6.50$ (Fig. 3)].

Discussion

Facial malformation has been associated with congenital anomalies, and the maxilla and mandible are both important facial bones. Dagklis et al [2] Cicero et al [3] have demonstrated that trisomy 21 fetuses have a shorter maxillary length during 11–14 weeks of gestation, possibly due to an alteration in genes expressing the extracellular matrix formation. Prenatal detection of maxillary and mandibular hypoplasia may aid an early diagnosis of congenital anomalies. In the past, ultrasonographic detection of hypoplasia of maxilla or mandible was performed after 14 weeks' gestation. Targeted ultrasonographic assessment at 20 weeks' gestation would be suggested for fetuses with suspected facial abnormalities. Recent advances in ultrasonographic techniques make it possible to measure both at an early gestational age. In addition, screening of Down's syndrome using ultrasonographic measurement of nuchal translucency and nasal bone length during $11–13^{+6}$ weeks' gestation has become prevalent [2,5,7]. Thus, early detection of maxillary or mandibular hypoplasia may be accomplished. The paired maxilla ossification starts from the 40th day [8].

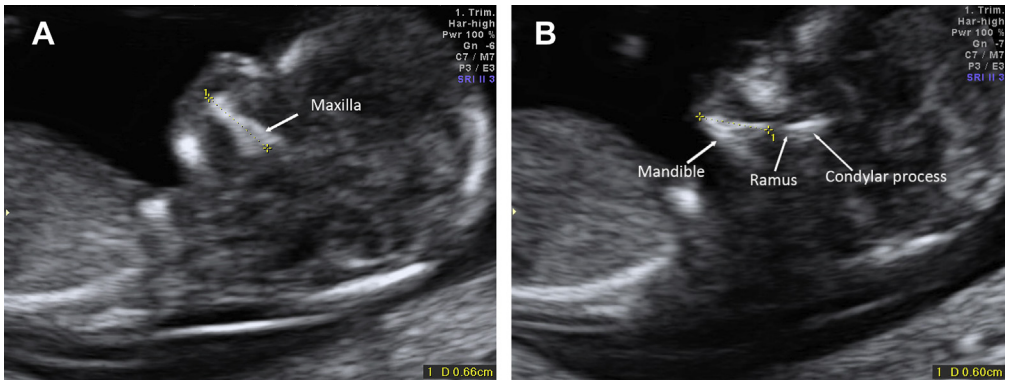

Fig. 1. Measurement along the (A) mid-line of maxilla and (B) mandible of a 12-week fetus at nuchal translucency screening. The maxillary and mandibular lengths exclude the ramus and condylar part.