

Fetal Nasal Bone Length Nomogram

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Abstract

Objective: To obtain the nasal bone length nomogram throughout normal gestation with known prognosis, and to compare it with some other growth measurements.

Methods: Nasal bone lengths of 540 consecutive cases ranging between 11-39 weeks of pregnancy were measured by ultrasonography prospectively. Biparietal diameter (BPD) and femur lengths (FL) were obtained in the meanwhile. Nasal bone length nomograms of the 276 term fetuses, which were born alive and without malformation were obtained according to, BPD, FL, and gestational week. The correlation between variables was assessed by regression analysis.

Results: A linear growth pattern of the nasal bone length was obtained throughout gestation. (Nasal bone length = Gestational week x 0.42 - 2.81) ($r^2 = 0.94$). A positive correlation was found between the growth of nasal bone length and the growth of other bone measurements.

Conclusion: Measurement of the nasal bone length during gestation shows a linear growth pattern according to gestational week, BPD and FL.

Keywords: Fetus, nasal bone, ultrasonography, nomogram

Fetal burun kemiği uzunluk nomogramı

Amaç: Prognozu bilinen normal gebeliklerde fetusun burun kemiği uzunluğu nomogramının elde edilmesi ve diğer büyüme ölçümleri ile karşılaştırılması.

Yöntem: Gebeliğin 11-39 haftaları arasında 540 olguda fetusun burun kemik uzunluğu prospektif olarak ultrasonografi ile ölçüldü. Eş zamanlı olarak biparietal çap (BPD) ve femur boyları (FL) elde edildi. Zamanında canlı doğum yapan, anomali saptanmayan 276 fetusun ölçümleri BPD, FL ve gebelik haftasına göre değerlendirilerek burun kemiği uzunluğu nomogramı oluşturuldu. Değişkenler arası korelasyon regresyon analizi ile araştırıldı.

Bulgular: Burun kemiği uzunluğunun intrauterin hayatta lineer tipte gelişim gösterdiği belirlendi (Burun Kemiği = Gebelik haftası x 0.42 - 2.81) ($r^2 = 0.94$). Burun kemiği büyüme eğrisinin diğer kemik ölçümleri ile de pozitif korelasyon gösterdiği gözlemlendi.

Sonuç: Normal gebeliklerde fetusun burun kemiğinin ultrasonografi ile ölçümü gebelik haftasına BPD ve FL ölçümlerine uygun olarak lineer bir artış göstermektedir.

Anahtar Sözcükler: Fetus, burun kemiği, ultrasonografi, nomogram.

Introduction

Nasal bone is a structure which can be displayed by ultrasonography after 10th gestational week and it is actually formed of two different bones.¹ If it is not examined in an appropriate plan, it may be evaluated shorter or longer than normal and even it may be supposed as it does not

exist.²⁻⁴ Quality of the device, experience of the applier, oligohydroamnios, obesity, fetus position and gestational week may affect the success of determination.^{2,5,6-8}

Measurement or only display of nasal bone is a leading method for early scanning of chromosome anomalies. It is shown that non-existence of nasal

bone in especially first trimester and non-existence or hypoplasia of nasal bone may be found with chromosome anomalies.^{5,9-13} (Figures 1 and 2). It is claimed that nasal bone length may show difference between races.^{7,14,15}



Figure 1. Normal nasal bone (17th gestational week).

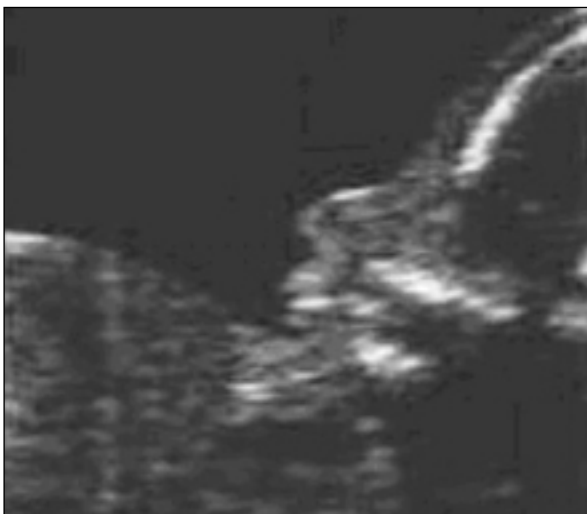


Figure 2. Nasal bone deficiency (15th gestational week).

Bone development curves which are one of the basic criteria of following fetus development can be applied to various bones of fetus. Biparietal diameter and femur length measurements are frequently used in daily practice. Furthermore, some other long bones are also help to distinctive diagnosis and scanning. Each bone which is able to be

evaluated by ultrasonography may be leading in this process. Knowing how bones deviated from normal length after evaluation contributes to normal-abnormal distinction. For that reason, ultrasonography appliers have to evaluate his/her society's nomograms and have to compare them with international standards from time to time.

In this work, it is aimed to evaluate fetus nasal bone length as to gestational week and standard bone evaluations by ultrasonography and to obtain reference intervals and growth nomograms for certain gestational weeks.

Methods

Nasal bone lengths of fetuses of 540 pregnant who applied consecutively in between 01.09.2002 – 31.12.2003 were examined in this work. Routine ultrasonography examination was performed to each pregnant between 11th – 39th weeks. For gestational week, last menstrual period dates were taken as a base for those who have 28-32 days of menstrual period; crown-rump length (CRL) in first trimester, biparietal diameter (BPD) in second trimester, BPD and femur length (FL) measurements in last trimester were taken as a base for those who did not know the last menstrual period date. Cases with fetal anomaly, karyotype anomalies, multiple pregnant, those delivered dead and those delivered on 37th week or before, those which had birth weight under 10th percentile and over 90th percentile were excluded from the work. Nasal bones were displayed in low brightness setting by about 45 degree angle within the area that maxilla and frontal bone limits in central line and sagittal plans in which chin and lips were displayed in face profile of fetus (Figure 1). Each measurement was done twice and their average was taken. It was paid attention to align signs with the upper and lower edges of nasal bone in measurements. Minimum enlargement interval for calibration was adjusted as to be 0.1 mm. Cases were grouped at two weeks intervals. All examinations were done 5 mHz convex probe of Toshiba SSH 140-A model ultrasonography device. SPSS program was used for statistical analyzes, length of nasal bone was taken as dependent variable, linear regression analysis was applied by using SSPS 13 program and by matching gestational week with BDP and FL. P being less than 0.05 was taken as statistical significance limit.

Results

276 pregnant were found who were appropriate for research criteria during the study. Age intervals of these pregnant were 19 – 47 and their average age was found as 30.50 ± 5.92 . Totally 14 weeks groups were obtained. Average gestational week in which examination was performed was determined as 22.38 ± 6.63 week. It was observed that case of 35th-36th gestational week was less but they did not change general average.

Nasal bone measurements within 95% confidence interval as to gestational week are shown in Table 1. A linear and positive correlation was found between gestational week and nasal bone in simple regression analysis. Descriptive coefficient of gestational week was $r^2=0.95$ in nasal bone development. Relation between them was found statistically quite significant ($p<0.001$). Regression formula between gestational week and nasal bone was defined as: Nasal bone (mm) = Gestational

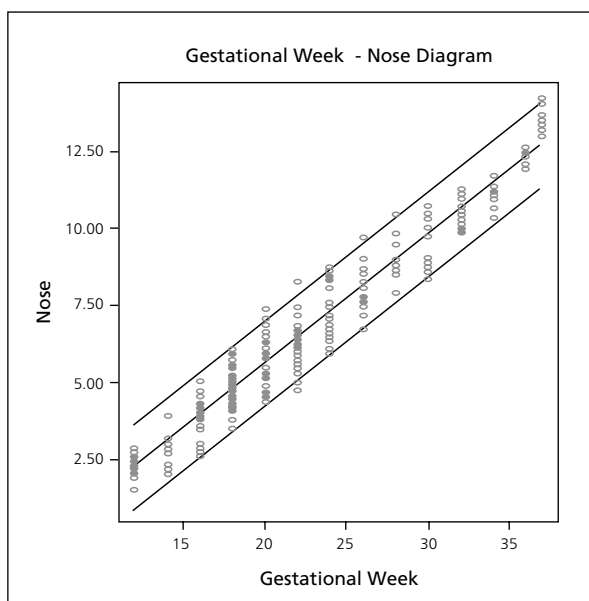


Diagram 1. Gestational week nasal bone length. Nasal Bone = (Gestational week x 0.42) – 2.81
 $r^2=0.94$; $p<0.001$

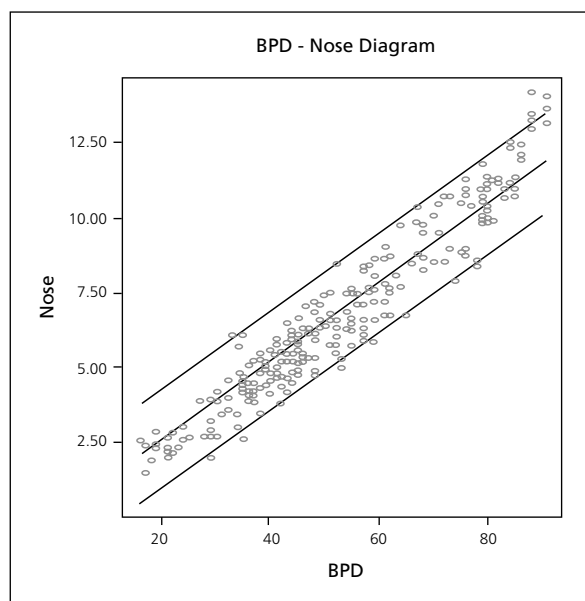


Diagram 2. Biparietal diameter nasal bone length. Nasal Bone = (BPD x 0.15) – 0.97
 $r^2= 0.92$; $p<0.001$

Table 1. Length nomogram of nasal bone as to gestational weeks.

Week	n	Average	Standard deviation	Standard fault	%95 Confidence Interval			
					Down	Up	Minimum	Maximum
11-12	12	2.29	0.39	0.10	2.06	2.52	1.50	2.85
13-14	10	2.86	0.67	0.21	2.39	3.34	2.00	3.95
15-16	21	3.81	0.70	0.15	3.49	4.13	2.60	5.05
17-18	48	4.82	0.66	0.09	4.64	5.01	3.50	6.10
19-20	44	5.62	0.76	0.11	5.39	5.85	4.35	7.40
21-22	35	6.39	0.76	0.13	6.12	6.65	4.75	8.30
23-24	26	7.27	0.86	0.17	6.92	7.61	5.95	8.75
25-26	14	8.03	0.78	0.21	7.58	8.48	6.75	9.75
27-28	9	9.16	0.77	0.26	8.56	9.75	7.95	10.50
29-30	11	9.46	0.89	0.26	8.88	10.05	8.40	10.80
31-32	16	10.50	0.50	0.13	10.23	10.77	9.90	11.30
33-34	15	11.06	0.34	0.09	10.87	11.25	10.40	11.80
35-36	6	12.29	0.24	0.99	12.04	12.55	12.00	12.60
37-38	9	13.48	0.44	0.15	13.14	13.82	13.00	14.25

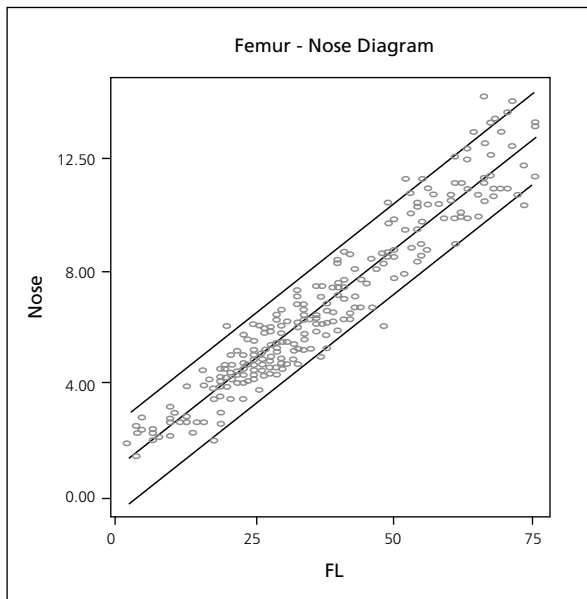


Diagram 3. Femur length – nasal bone length. Nasal Bone = $(FL \times 0.16) + 0.94$ $r^2 = 0.92$; $p < 0.001$

week $\times 0.42 - 2.81$ (Diagram 1). $r^2 = 0.94$; ($p < 0.001$).

Nasal bone length measurements were researched by BPD and FL which are other criteria showing growth of fetus and it was observed that both two criteria were in a positive relation with nasal bone and growth was linear type (Diagram 2, 3). Related formulas: Nasal Bone = $(BPD \times 0.15) - 0.97$; $r^2 = 0.92$; $p < 0.001$. Nasal Bone = $(FL \times 0.16) + 0.94$; $r^2 = 0.92$; $p < 0.001$. It was interpreted that the best descriptive variable for growth of nasal bone as mm was gestational week (growth of fetus).

It was observed that nasal bone length was changed about 2.29-3.81 mm in 11th-16th weeks, 4.82-6.39 mm in 17th-22nd weeks, 7.27-9.16 mm in 23rd-28th weeks, 9.46-11.06 mm in 29th-34th weeks and 12.29-13.48 mm in 35th-39th weeks.

Discussion

Ossification points in nose become to being formed in two sides of gristly focus in middle line beginning from 10th gestational week. While vomer bones first appear in U shape, they become V shape by getting unite in next weeks.¹ It was showed that this space may be determined as if it does not exist by mistake (about 20%) in the examinations done in that period.¹⁶

It should be observed in ultrasonographic examinations that nasal bones are formed of two bones uniting in the middle and lying to the front as echogenic structures. While bones do not pass upper – lower limits of orbitas in second trimester, they seem as two thin lines in the middle. The examination should be carried in neutral position of fetus and about 45-degree angle. Bones may not be displayed or may be measured less than their normal length in examinations under the angle of 45 degree or above 135.^{4,17} This fault can be fixed by three dimensional ultrasonography.³ Also position of fetus affects closely displaying.^{7,8} Nasal bones may not be displayed in early period (11th-14th weeks) examinations about 0.5-1%.^{6,9} This rate is higher in black race.⁹

CRL was reported as 42 mm in the earliest fetus size measurement that nasal bone might be seen in examinations done after about 10 weeks.¹ It was claimed that these bones might be measured as from 0.8 mm in 10th gestational week.¹⁸ The lowest measurement value in our study was 1.5 mm in 11th gestational week.

Nasal bones shows a linear growth characteristic in parallel to growth of other bones in body.² Obido et al reported that nasal bone development showed a linear increase tendency in 11th-20th gestational week.¹⁹ The development is linear in second and third trimesters.² Guis et al found a linear increase about 4-12 mm in the length of nasal bone in their ultrasonographic measurements done in 11th-35th gestational weeks.² Bunduki et al found nasal bone length in between 5.9 and 8.0 mm in 16th-24th gestational weeks in their study performed on 1600 cases.⁷ Sonek et al measured nasal bone in between 1.3-14.7 mm within 11th and 40 gestational weeks.⁵ In our work, our diagnoses were changing between 2.2 – 11.0 mm in 11th-34th weeks, 3.8-7.2 mm in 16th-24th weeks, 2.2-13.4 mm 11th-38th weeks and growth tendency was in linear style as in other works. Existence of nasal bone is important especially in the first trimester scanning studies.²⁰ Existence and non-existence of bone are paid attention in spite of measurement. As it is known that ossification is late in fetuses with chromosome anomaly, it is claimed that cases with hypoplasia should be evaluated again and so wrong test positivity may decrease.²¹ Nasal bone

length within 11th-14th gestational weeks showed change between 2.3 and 3.1 mm in series of Sonek et al.⁵ Our findings showed similarly changes about 2.2-2.8 mm.

Ossification in nasal bones of fetuses with trisomy is delayed.^{4,6} It was reported that nasal bone did not being observed within 11-14 weeks at 52% rate and at 43% rate within 14th-25th weeks in fetuses with trisomy 21 in a work in which ultrasonography and radiological examination were compared; they also reported that radiological examination is a golden standard for making determination.¹¹

Cicero et al found nasal bone hypoplasia (<2.5 mm) at 61.8% rate in fetuses with trisomy 21 and they at 1.2% rate in normal fetuses in their series of 1046 cases they examined in between 15th-22nd gestational weeks.¹⁰ They calculated that nasal bone hypoplasia increased trisomy 21 risk 50 times. It is interesting that this diagnosis is isolated in 14% of fetuses with trisomy 21. Hypoplasia rate was given as 0.5% for white race and as 8.8% for black race in the same study. We can not give any statistical rate due to the fact that chromosome anomaly cases are less in our work but we keep collecting data and we guess that we will be able to give results with many cases in the next series.

Consequently, while existence or non-existence of nasal bone are attached importance in first trimester examinations, obtaining bone length and determining nasal bone hypoplasia gain importance. Thus, determining nasal bone nomograms becomes important. It is possible to express 2.5 mm bone length limit value which is used in second trimester now by standard variables in near future. The pioneer series we inspected showed that nasal bone had a linear increase related with gestational week during gestation and they might be stated by formula. After this series we want to transfer broader series, it will be easier to compare deviations from normal in our society.

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