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Original Article

Neonatology Section

Radiological Appearance of Molars: Do They Consistently Identify Babies of 33-36 Weeks Gestation?

AKATOLI SEMA, RAJEEV SETHI, V.K. BHATIA, JACOB PULIYEL

ABSTRACT

Background: Gestational age is calculated from the date of the last menstrual period (LMP) may not be accurate when the cycle is irregular. In a previous study on small sample of European babies, the appearance of the cusps of the deciduous molar teeth on radiographs was found to be useful for determining the gestational age. The accuracy of this method was not affected by intra-uterine malnutrition. We did this prospective study on a large sample of newborns in India to validate the findings.

Materials and Methods: Chest radiographs taken within the first 3 days of life – when they included the mandible – were studied against gestational age. Dates as per LMP, confirmed by either ultrasound examination during pregnancy or by Ballard's scoring after birth, were the standard against which tooth age was validated.

Results: The area under the receiver operating characteristic (ROC) curve for the 1st molar was 0.933 (95% CI: 0.900 to 0.966) and that for the 2nd molar was 0.952 (95% CI: 0.920 to 0.983). Accuracy was only marginally affected by intrauterine malnutrition.

Conclusion: Tooth age may be used to estimate gestational age. Like the findings of ophthalmic examination at birth, tooth age is only marginally affected by intrauterine malnutrition.

Key Words: Ballard's score, Antenatal ultrasound age, Bone age, Tooth age, Small for gestational age

INTRODUCTION

Neonatal mortality and morbidity varies according to the gestational age [1,2]. Accurate estimation of gestational age is important for correct management of the infant [3]. Several methods for estimating gestational age are available [4]. Most often, gestational age is calculated from the date of the last menstrual period (LMP) [5]. When there is uncertainty about this on account of an irregular cycle [6,7], antenatal ultrasound [8], bone age [9], and clinical examination of the infant for physical and neurological maturity [10] are used. These too have their drawbacks. Antenatal ultrasound measurements are biased when fetal growth is hampered [11]. Bone ossification is also affected by various factors such as fetal malnutrition and intra-uterine hypothyroidism [12,13]. Post-natal clinical examination by Ballard's scoring system has been found to give the best estimate of gestational age [14]. Ballard's scoring is however difficult to perform in sick preterm infants and in small-for-gestational-age (SGA) infants, as the general appearance is often indistinguishable from that of true prematures [15]. Ophthalmic examination also yields clues regarding the true gestational age in SGA babies [16,17]. Nevertheless, estimating gestational age in sick preterm infants, especially those who are SGA, is a challenge.

In 1972, Kuhns *et al*., [18] studied the calcification crowns of the 1st and 2nd deciduous molars. Fifty-two newborn infants were evaluated. No 1st molar appeared before 33–34 weeks of gestation and no 2nd deciduous molar was radiographically visualized before 36–37 weeks; they were invariably found after that age. Accuracy of aging by this method was unaffected by intra-uterine growth retardation. However, the sample size in that study was small.

A large number of Indian babies are born SGA [19,20]. We undertook this prospective study to evaluate the usefulness of this method for estimating gestational age in this population with a large incidence of SGA babies.

MATERIALS AND METHODS

All newborn babies admitted in the neonatal nursery were eligible for inclusion in the study. Data was collected between 1st November 2006 and 31st December 2007. The LMP of the mother and antenatal ultrasound findings were noted. Gestational age assessment by the new Ballard's scoring system is done routinely within 48 hours of birth in the nursery. Babies on ventilator and sick neonates are not subjected to this assessment. A baby was included in the study if he or she had a chest radiograph done within 72 hours of life and if the radiograph showed the mandible. No infant underwent radiographic examination solely for the purpose of this study. *A priori*, a family history of hypodontia was an exclusion criterion. Written informed consent was taken from the parents for gestational age assessment by the various methods. The study was approved by the hospital research board.

At the time of discharge, all radiographs of the child were assessed by one of the authors (RS) for calcification cusps of the 1st and 2nd molar teeth. This author was blind to the gestational age of the baby. A distinct line of calcification involving the cusps of a molar was looked for in the radiographs [Tables/Figs-1, 2, and 3].

To overcome any possible error in LMP due to mistaken dates and irregular cycle length, only babies whose gestational age by LMP was confirmed by at least one other method (antenatal ultrasound estimation or Ballard's scoring) were included in the study.

There were 217 babies who had a suitable radiograph of the mandible during the study period. Of these, 182 had suitable assessment of gestational age (LMP age that was confirmed by either Ballard's scoring or ultrasound age). These 182 infants were therefore

enrolled in the study. We used receiver operating characteristic (ROC) to look for the predictive ability of the appearance of 1st and 2nd molar teeth for estimation of gestational age. Infants were further grouped as being appropriate for gestational age (AGA) or SGA according to whether their weight at birth was above or below the 10th centile for age. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy in SGA and AGA babies were calculated separately using 2 × 2 tables.

RESULTS

[Table/Fig-1] shows the demographic characteristics of the study population. The gestational age ranged from 25 to 43 weeks, with the mean and median being 34 weeks. According to the study criteria, 16% were SGA.

[Table/Fig-4 and 5] show the ROC curve for the 1st and 2nd molars, respectively. The area under the curve for the 1st molar was 0.933 (95% CI: 0.900 to 0.966) and that for the 2nd molar was 0.952 (95% CI: 0.920 to 0.983). For the 1st molar, the sensitivity was 96%, specificity 76.5%, PPV 88.4%, NPV 92%, and accuracy 89.5% in AGA babies [Table/Fig-2] ; in SGA babies, the sensitivity was 86.6%, specificity 88.8%, PPV 92.8%, NPV 80%, and accuracy 87.5% [Table/Fig-3] . For the 2nd molar, the sensitivity was 96%, specificity 90.6%, PPV 87.5%, NPV 97.1%, and accuracy 92.8% in AGA babies [Table 4]; the sensitivity was 75%, specificity 100%, PPV 100%, NPV 94.7%, and accuracy 95.4% in SGA babies [Table/Fig-5] .

[Table/Fig-4] shows the mean age of appearance of the 1st and 2nd molar teeth in AGA and SGA babies. The mean age of appearance of the 1st molar was 33.7 weeks in AGA babies and 35.45 weeks in the SGA group. The mean age of appearance of the 2nd molar was not very different in the two groups (38.12 weeks in AGA and 38.2 weeks in SGA babies).

Gestation in weeks (LMP)	Male	Female
25	1	_
26	3	_
27	2	2
28	3	5
29	8	3
30	12	2
31	4	1
32	9	1
33	8	3
34	5	8
35	5	7
36	8	5
37	14	7
38	16	8
39	13	4
40	6	5
41	1	2
42	_	_
43	1	_
Total	119	63

[Table/Fig-1]: Demographic profile of the sample

1st molar	>34 weeks	<33 weeks
+	84	11
–	3	36

[Table/Fig-2]: Appearance of 1st molar tooth AGA group
Sensitivity 96.5%, specificity 76.5%, PPV 88.4%, NPV 92.3%, accuracy 89.5%.

1st molar	>34 weeks	<33 weeks
+	13	1
–	2	8

[Table/Fig-3]: Appearance of 1st molar tooth in SGA group
Sensitivity 86.6%, specificity 88.8%, PPV 92.8%, NPV 80%, accuracy 87.5%.

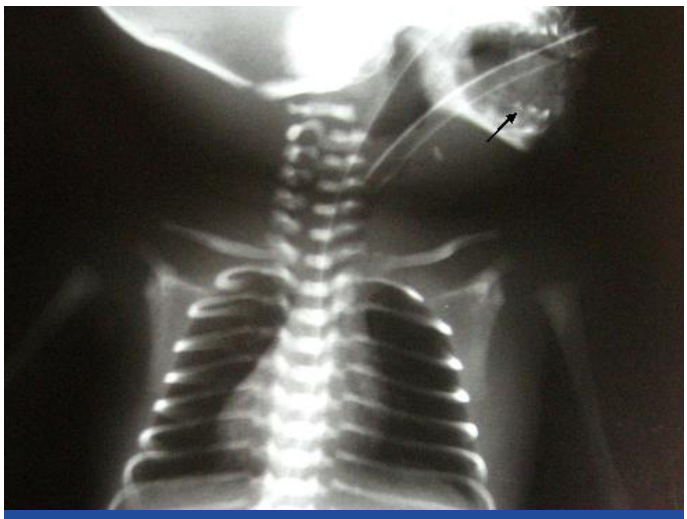
2nd molar	>37 weeks	<36 weeks
+	49	7
–	2	68

[Table/Fig-4]: Appearance of 2nd molar tooth AGA group
Sensitivity 96%, specificity 90.6%, PPV 87.5%, NPV 97.1%, accuracy 92.8%.

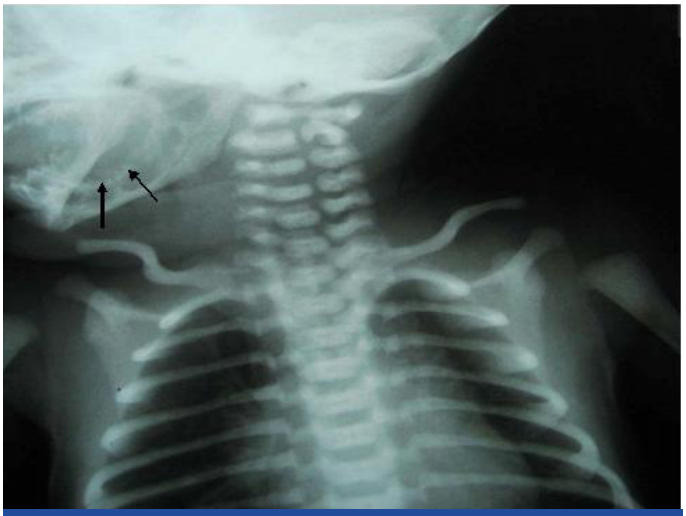
1st molar	>37 weeks	<36 weeks
+	3	0
–	1	18

[Table/Fig-5]: Appearance of 2nd molar tooth in SFD group
Sensitivity 75%, specificity 100%, PPV 100%, NPV 94.7%, accuracy 95.4%.

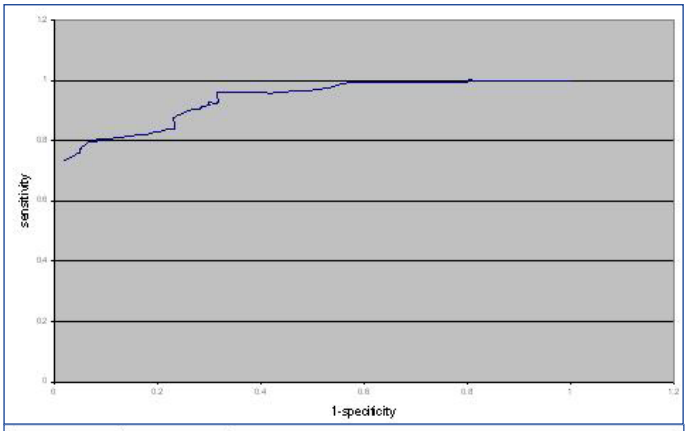
[Table/Fig-6]: Mandible before appearance of the deciduous molar teeth



[Table/Fig-7]: Mandible with 1st deciduous molar tooth

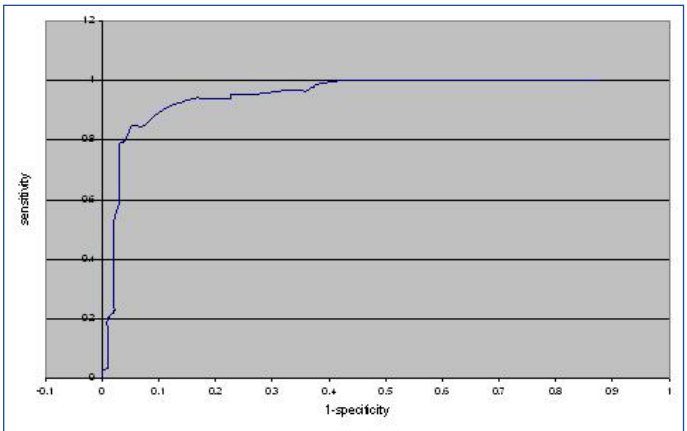


[Table/Fig-8]: Mandible with 1st and 2nd deciduous molar teeth



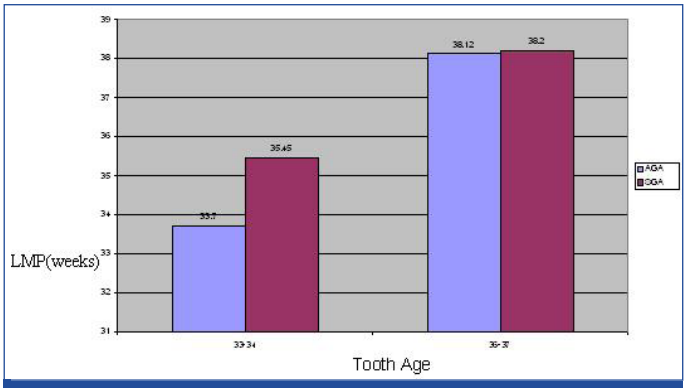
Area	Std.error[a]	Asymptotic Sig.[b]	Asymptotic 95% confidence interval	
			Lower bound	Upper bound
0.933	0.017	0.000	0.900	0.966

[Table/Fig-9]: ROC for 1st molar



Area	Std.error[a]	Asymptotic Sig.[b]	Asymptotic 95% confidence interval	
			Lower bound	Upper bound
0.952	0.016	0.000	0.920	0.983

[Table/Fig-10]: ROC for 2nd molar



[Table/Fig-11]: Tooth age compared with age as per LMP in AGA and SGA group

DISCUSSION

We found that age at appearance of the deciduous molars on radiographs was useful for assessment of gestational age. The area under the ROC curve of 0.933 and 0.952 for the 1st and 2nd molars, respectively, suggests that this method has excellent discriminative ability in age assessment. Our findings using ROC curves confirms the findings of Kuhns *et al.,* [18] This is arguably the largest study of gestational age assessment using tooth age. We used dates as per LMP, confirmed by another method (ultrasound estimation of gestational age or Ballard's scoring), as the gold standard against which tooth age was compared.

Kuhns *et al.,* [18] had studied only European Caucasian infants with gestational age of 26–42 weeks. Our data shows that their findings also hold for Asian children. The study cohort of Kuhns *et al.* included 11 SGA babies; 10 of them had normal tooth mineralization and they had concluded that tooth age was not affected by being SGA. Our sample contained 29 SGA babies. Statistical analysis was done by comparing the SGA babies to AGA babies using 2 × 2 tables. The accuracy was only marginally different (±2 weeks) in the two groups.

Kuhns *et al.* found tha tooth mineralization was consistent with gestational age in trisomy 21, retarded in trisomy 13-15, and accelerated by 5 weeks in trisomy 18. Our cohort did not include any babies with chromosomal aberrations.

In a case of superfetation, where one of the twins was 32 weeks and the other 36 weeks at birth, we found that tooth age estimation, along with the Ballard's score and ophthalmic examination, helped to corroborate the gestational age disparity that was first noticed during antenatal intra-uterine ultrasound examination [21].

To the best of our knowledge, there are no other large studies with which we can compare our findings. It would appear that tooth age is a reliable method for the estimation of gestational age in infants between 33 and 37 weeks of gestation.

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AUTHOR(S):
1. Dr. Akatoli Sema
2. Dr. Rajeev Sethi
3. Dr. V.K. Bhatia
4. Dr. Jacob Puliyel

PARTICULARS OF CONTRIBUTORS:
1. Department of Pediatrics, St Stephens Hospital, Delhi, India.
2. Department of Radiology, St Stephens Hospital, Delhi, India.
3. Indian Agricultural Statistical Research Institute, Pusa Institute, Delhi, India.
4. Department of Pediatrics, St Stephens Hospital, Delhi, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Jacob Puliyel
St Stephens Hospital, Tis Hazari, Delhi, India - 110054.
E-mail: puliyel@gmail.com

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