Onset of Dental Emergence Stages Among 4-15 Year-Old Nigerian Children: A Guide for Clinical Intervention

*Aghimien OA, **Chukwumah NM
Correspondence: Aghimien OA,
Email: osaronse@yahoo.com

* Department of Preventive Dentistry, Dental Centre, Edo Specialist Hospital, Benin City. Edo State
** Department of Preventive Dentistry. University of Benin Teaching Hospital. Benin City. Edo State

Key words: Dental emergence, Dental eruption, Dentition stage

Objective: This present study was conducted to determine the onset of the various dentition stages among a group of Nigerian children.

Materials and methods: This was a cross-sectional descriptive study. Data were collected over a fourteen-month period among clinically healthy 424 participants comprising 186 male and 238 females aged 4-15 years, and analyzed using SPSS statistics 22.0. The mean ages of onset of the various dental stages, the overall dental stages and the dental stages of each jaw were compared according to gender using unpaired t-test. Statistical significance level was set at P<0.05.

Results: The average age of the fully established deciduous dentition was 4.61 ± 0.79 years among female participants and 5.00 ± 1.16 years in males, p=0.153. Females were also observed to have attained early mixed dentition, late mixed dentition, and adolescent dentition earlier than male participants. The average age of the fully erupted first and second molars were 9.76 ±2.36 years and 13.06 ± 1.71 years respectively, with female participants observed to have attained each of the stages earlier than male participants, P>0.05.

Conclusion: The results show that female participants attained early mixed dentition, late mixed dentition, and adolescent dentition earlier than males. However, males had early attainment of the intermediate mixed dentition. The average age of the fully erupted first and second permanent molars also occurred earlier among the females. Therefore, individualized staging of the dentition stage is needed to guide the appropriate timing of treatment intervention.

INTRODUCTION

Thorough assessment of the developmental stages of an individual, whether via physiological development, skeletal development, or dental development and eruption, is invaluable in the diagnosis, treatment planning, and prognosticating treatment outcome in children, especially those at risk of growth disruption. Dental development involves the entire process of tooth formation beginning during the 5th week of intra-uterine life to the complete closure of the root apex of the third molar.[1] It has been adjudged to be the least developmental indicator affected by environmental factor,[2] making it one of the sole best physiological predictors of chronological age.[3] Dental eruption is, however, the entire dynamic process of the migration of the tooth from its earliest intra-osseous position up until it makes full functional occlusal contact. This should be distinguished from dental emergence, which is a specific phase in the entire process of dental eruption categorized as the gingival emergence of the dental hard structure.[4,5] Nonetheless, the terms have been used interchangeably in the literature.[6,7]

Many researchers have enumerated several

factors that could affect the timing of dental emergence.[8-10] These factors include genetic influences,[8] racial variations,[9] sexual dimorphism,[10] and several environmental factors like nutritional status, fluoride content, and socioeconomic status. For example, it has been reported that obese children have early dental eruption when compared with children within the normal body mass percentile.[11] Also, taller and heavier children were observed to have slightly advanced dental eruption compared to those with stunted linear development.[12]

Dental emergence has been of interest to both clinicians and anthropologists. For clinicians, it aids in clinical distinction between delayed and advanced dental eruption process,[13] and between individuals in early and advanced dental stages,[14] thereby determining the timing of clinical intervention and the possible treatment outcome. While it is difficult to ascertain the exact time of gingival emergence, the group of teeth present in the oral cavity at the time of presentation, could provide guidance to determine the timing of treatment especially orthodontic intervention in maxillary deficiency and mandibular excess. As a result, dental stages are used to describe deciduous (erupting/complete), mixed (early/intermediate/late), adolescent, and adult dentition, i.e. by using the dental emergence stages. [15,16]

Understanding the timing of the onset of the various stages of normal dentition would enable the clinician recognize, diagnose, and effectively manage any abnormality detected[15,16] during development. The timing of intervention would depend on whether the patient is within early, average, or late dental eruption stage, which, therefore, ensures individualized patient care. Although orthodontic treatment could involve targeted management of an isolated malocclusion, majority of the times consideration for care could be based on the set of teeth present in the oral cavity (dentition stage) before commencing comprehensive orthodontic care. In 2003, Schopf[17] observed that in order to prevent the development of pronounced malocclusion in the permanent dentition stage, it is ideal to advocate for early treatment in the deciduous and early mixed dentition stage, hence, the need to properly categorize patients into the right dental stages.

Several Nigerian studies[7] have focused on the timing and sequence of eruption of the individual primary and permanent teeth while giving little attention to the dentition stages. The aim of this study was to determine the periods of onset of the dental stages using specified group of teeth as described by Bjork et al[15] and compare findings from this current study with results from other climes. In order to ascertain the timing of the dentition stage as reported in this study, it was compared to the eruption time of specific teeth in Nigerian children to determine which dentition stage corresponds with a particular eruption timing of specific teeth.

MATERIALS AND METHODS

This study utilized a cross-sectional design, comprising children who attended the orthodontic and paedodontic clinics over a fourteen-month period (June 2022 to August 2023). All the participants were clinically healthy, with no history of orthodontic treatment, and aged between 4 to 15 years. Children attending the clinic with obvious developmental anomaly like cleft lip and palate were excluded from the study. The authors obtained ethical approval from the Ethics and Research Committee of the Hospital Management Agency, and assent was also gotten from the study participants.

Data Collection: The information obtained from the participants and/or their parents/guardians included chronological age and gender.

Assessment of dental emergence: The authors conducted visual assessment of the dental emergence on the study participants while they were seated on a dental chair. For adequate visibility, each participant rinsed the oral cavity with water for 30 seconds, and, thereafter, the gingival tissue was cleaned with a sterile gauze. The oral cavity was then examined by the investigator (AO) using a mouth mirror and periodontal probe to identify emerging teeth. The dental development of the participants, which in this study is the dental emergence staging, was based on the gingival emergence/visibility of a set of teeth in the oral cavity, corresponding to the dental stages (DS).

Description of assessment tool (Appendix A): The dental emergence staging was assessed using the method described by Bjork et al.[15]

I. If any part of a tooth is visible in the oral cavity, it is said to have emerged. When a tooth reaches the occlusal level, it is said to be completely erupted.

II. The individual is in DS 02, DS 2, or DS 4 even if not all the teeth concerned are present, provided that the reason for the absence of a tooth is extraction or dentition (developmental) anomaly.
III. Recording only one of the stages implies that all the earlier stages are complete. If a new stage occurs before the previous one is complete – for example when a canine or premolar is visible before all the incisors are fully erupted – this finding will be recorded, as DS 1 and DS 3.
IV. Document the molar eruption stage in addition to the anterior dental stage, using the definitions in Appendix A.

Also, for the purpose of sex differences, evaluation of the onset of dental emergence stages in the anterior and posterior segment of the maxilla and mandible were performed separately using the adjusted criteria (Appendix B), using a specially designed form to capture initial data for participants (Appendix C).

Data analysis: The data collected from the questionnaires were coded and inputted into IBM SPSS statistics 22.0 (SPSS Inc., Chicago, Illinois, USA). Mean ages of onset of the various dental stages, overall dental stages, and the dental stages of each jaw were compared according to gender using unpaired t-test. The statistical significance level was set at $p<0.05$.

RESULTS

Over the fourteen-month period, data was collected from 424 participants comprising 186 males and 238 females (Table 1).

Table 1: Mean age of the study participants

Gender	N (%)	MEAN ± SD	SEM
Male	186 (43.9)	8.53 ± 3.00	0.22
Female	238 (56.1)	8.72 ± 3.17	0.21
TOTAL	424 (100)		

Key: SD-Standard deviation, SEM-Standard error of mean.

The results in table 2 show the average age of the dental stages of the deciduous teeth and the permanent teeth that are anterior to the molars. The results revealed that the average age of the fully established deciduous dentition was 4.78 ± 0.97 years, with females attaining fully established deciduous dentition (4.61 ± 0.79 years) earlier than males (5.00 ± 1.16 years) p=0.153. The study also revealed that female participants attained early mixed dentition, late mixed dentition, and adolescent dentition earlier than males. Out of the 424 participants, three hundred and sixty-three (363) had molar teeth available for assessment.

Table 2: Comparison of the overall onset of dental stages of teeth anterior to molars according to gender.

DS	Clinical Description	N (%)	MEAN ± SD	SEM	MD	P VALUE
DS02	Deciduous fully erupted				0.40	0.153
	Male	22 (5.2)	5.00 ± 1.16	0.25		
	Female	29 (6.8)	4.61 ± 0.79	0.15		
		51 (12.0)	4.78 ± 0.97	0.14		
DS1	Early mixed dentition				0.16	0.567
	Male	60 (14.2)	6.66 ± 1.70	0.22		
	Female	68 (16.0)	6.57 ± 1.55	0.17		
		128 (30.2)	6.50 ± 1.40	0.14		
DS2	Intermediate mixed dentition				-0.20	0.467
	Male	37 (8.7)	8.10 ± 1.19	1.19		
	Female	51 (12.1)	8.30 ± 1.31	1.31		
		88 (20.8)	8.22 ± 0.13	1.26		
DS3	Late mixed dentition				0.45	0.216
	Male	36 (8.5)	10.63 ± 1.46	0.24		
	Female	27 (6.4)	10.19 ± 1.36	0.26		
		63 (14.9)	10.45 ± 1.41	0.18		
DS4	Adolescent dentition				0.18	0.615
	Male	31 (7.3)	12.91 ± 1.25	0.23		
	Female	63 (14.9)	12.73 ± 1.77	0.22		
		94 (22.2)	12.79 ± 1.61	0.17		
TOTAL		424 (100)				

KEY: DS; Dental Stage; SD: standard deviation; SEM: standard error of mean; MD: mean difference

Also, this study showed that the mean age of the onset of eruption of the first permanent molars was earlier in females (6.77 ± 1.52 years) than in males (6.88 ± 1.64 years), p=0.702. The average age of the fully erupted first and second permanent molars were 9.76 ± 2.36 years and 13.06 ± 1.71 years respectively, with female participants observed to have attained each of the stages earlier than male participants, $p > 0.05$, (Table 3).

Table 3: Comparison of the overall onset of dental stages of permanent molars according to gender.

DS	N (%)	MEAN ± SD	SEM	MD	P VALUE
First molars erupting				0.11	0.702
Male	52 (14.3)	6.88 ± 1.64	0.23		
Female	61 (16.8)	6.77 ± 1.52	0.19		
	113 (31.1)	6.82 ± 1.57	0.15		
First molar fully erupted				0.05	0.202
Male	89 (24.5)	9.79 ± 2.29	0.24		
Female	115 (31.7)	9.74 ± 2.43	0.23		
	204 (56.2)	9.76 ± 2.36	0.17		
Second molar fully erupted				0.45	0.408
Male	15 (4.1)	13.37 ± 0.81	0.21		
Female	30 (8.3)	12.91 ± 2.01	0.37		
	45 (12.4)	13.06 ± 1.71	0.26		
Third molar fully erupted				0.45	0.408
Male	-	-	-		
Female	1 (0.3)	14.07 ± 0.00	0.37		
Total	363 (100)		-		

KEY: DS; Dental Stage; SD: standard deviation; SEM: standard error of mean; MD: mean difference

Table 4: Comparison of the mandibular deciduous and the permanent dentitions anterior to the molars according to sex

DS	Clinical Description	N (%)	MEAN±SD	SEM	MD	P VALUE
DS02	Deciduous fully erupted				0.40	0.153
	Male	22 (5.2)	5.00 ± 1.16	0.25		
	Female	29 (6.8)	4.61 ± 0.79	0.15		
		51 (12.0)	4.78 ± 0.97	0.14		
DS1	Early mixed dentition				0.33	0.178
	Male	48 (11.3)	6.33 ± 1.41	0.20		
	Female	48 (11.3)	6.00 ± 0.94	0.14		
		96 (22.6)	6.16 ± 1.20	0.12		
DS2	Intermediate mixed dentition				-0.09	0.772
	Male	45 (10.6)	7.87 ± 1.80	0.27		
	Female	64 (15.1)	7.96 ± 1.26	0.16		
		109 (25.7)	7.95 ± 1.57	0.15		
DS3	Late mixed dentition				0.57	0.115
	Male	34 (8.0)	10.38 ± 1.60	0.28		
	Female	30 (7.1)	9.81 ± 1.18	0.22		
		64 (15.1)	10.11 ± 1.44	0.18		
DS4	Adolescent dentition				-.012	0.720
	Male	37 (8.7)	12.58 ± 1.40	0.23		
	Female	67 (15.8)	12.70 ± 1.76	0.21		
		104 (24.5)	12.63 ± 1.65	0.16		
TOTAL		424 (100)				

KEY: DS; Dental Stage; SD: standard deviation; SEM: standard error of mean; MD: mean difference

Furthermore, the onset of the erupting first permanent molars to the stage of fully erupted first and second permanent molars were earlier in female participants when compared to the male participants, as shown in Table 5.

Table 5: Comparison of the mandibular permanent molars according to sex

DS	N (%)	MEAN±SD	SEM	MD	P VALUE
First molars erupting				0.11	0.719
Male	49 (13.5)	6.87 ± 1.64	0.23		
Female	60 (16.5)	6.76 ± 1.53	0.20		
	109 (30.0)	6.81 ± 1.57	0.15		
First molar fully erupted				0.11	0.742
Male	92 (25.3)	9.80 ± 2.32	0.24		
Female	115 (31.7)	9.69 ± 2.42	0.23		
	207 (57.0)	9.74 ± 2.37	0.17		
Second molar fully erupted				0.45	0.406
Male	15 (4.1)	13.37 ± 0.82	0.21		
Female	31 (8.6)	12.92 ± 1.98	0.36		
	46 (12.6)	13.07 ± 1.69	0.25		
Third molar fully erupted					
Male	-	-	-		
Female	1 (0.3)	14.07 ± 0.00	-		
TOTAL	363 (100)				

KEY: DS; Dental Stage; SD: standard deviation; SEM: standard error of mean; MD: mean difference.

In the maxillary dentition, female participants attained fully established deciduous dentition with an average age of 5.04 ± 0.90 years compared to the male participants (5.28 ± 1.02years). Also, the average ages of onset of the early mixed (6.96 ± 1.01 years) and late mixed (10.21 ± 1.45years) and adolescent dentitions (12.69 ± 1.79 years) were earlier among female participants recruited for the study. However, this study shows that the maxillary dentition anterior to the molars in the intermediate dentition (7.93 ± 1.77) was earlier in male participants. The results also indicated that gender difference in the onset of the maxillary dentition stages anterior to the molar teeth were not statistically significant (Table 6).

Table 6: Comparison of the maxillary deciduous and the permanent dentition anterior to the molars according to sex

DS	Clinical Description	N (%)	MEAN±SD	SEM	MD	P VALUE
DS02	Deciduous fully erupted				0.24	0.213
	Male	44 (10.4)	5.28 ± 1.02	0.15		
	Female	55 (13.0)	5.04 ± 0.90	0.12		
		99 (23.4)	5.15 ± 0.96	0.10		
DS1	Early mixed dentition				0.33	0.304
	Male	38 (9.0)	7.29 ± 1.78	0.29		
	Female	41 (9.7)	6.96 ± 1.01	0.16		
		79 (18.6)	7.12 ± 1.43	0.16		
DS2	Intermediate mixed dentition				-0.34	0.319
	Male	33 (7.8)	7.93 ± 1.77	0.31		
	Female	49 (11.6)	8.73 ± 1.33	0.19		
		82 (19.4)	8.13 ± 1.52	0.17		
DS3	Late mixed dentition				0.03	0.946
	Male	38 (9.0)	10.24± 1.45	0.24		
	Female	29 (6.0)	10.21 ± 1.45	0.27		
		67 (15.8)	10.23 ± 1.44	0.18		
DS4	Adolescent dentition				0.23	0.515
	Male	33 (7.8)	12.92 ± 1.24	0.22		
	Female	64 (15.1)	12.69 ± 1.79	0.22		
		97 (22.9)	12.77 ± 1.62	0.16		
TOTAL						

KEY: DS; Dental Stage; SD: standard deviation; SEM: standard error of mean; MD: mean difference.

Considering the maxillary molar dentitions, the mean age of the onset of an erupting first permanent molars was earlier among male participants (6.92 ± 1.68 years) when compared to female participants. However, female participants in this study attained the full state of the erupted first molars (9.72 ± 2.45 years) earlier than male participants (9.76 ± 2.34 years), p=0.916. The same preponderance was observed, with the second molars attaining its fully erupted state in female participants (12.76 ± 2.16 years) when compared to male participants (13.37 ± 0.82 years). The differences observed in the mean ages of the onset of the dental stage of the maxillary molars in relation to gender were not statistically significant (Table 7).

Table 7: Comparison of the mandibular dentition anterior to the molars according to gender

DS	N (%)	MEAN±SD	SEM	MD	P VALUE
First molars erupting				-0.01	0.974
Male	46 (13.0)	6.92 ± 1.68	0.25		
Female	54 (15.2)	6.93 ± 1.51	0.21		
	100 (28.2)	6.93 ± 1.58	0.16		
First molar fully erupted				0.04	0.916
Male	93 (26.2)	9.76 ± 2.34	0.24		
Female	115 (32.4)	9.72 ± 2.45	0.23		
	208 (58.6)	9.74 ± 2.39	0.17		
Second molar fully erupted				0.61	0.299
Male	15 (4.2)	13.37 ± 0.82	0.21		
Female	31 (8.7)	12.76 ± 2.16	0.35		
	46 (12.9)	12.96 ± 1.84	0.27		
Third molar fully erupted					
Male	-				
Female	1 (0.3)	14.07 ± 0.00			
TOTAL	355 (100)				

KEY: DS; Dental Stage; SD: standard deviation; SEM: standard error of mean; MD: mean difference

DISCUSSION

As far as orthodontic treatment is concerned, optimal timing is of paramount importance. This holds true for the determination of the onset of the various dental stages which could influence the timing of intervention.[18-20] Onset of dental eruption of the primary and permanent teeth have majorly been the focus of research among the Nigerian Children.[6,7] Nonetheless, the staging of the dentition into deciduous, mixed, or permanent is yet to receive significant attention. However, studies in several Scandinavian countries like Icelandic, Denmark, and Sweden have presented the various ages of onset of the dentition stages as either falling into the deciduous, early, intermediate, and late mixed dentition stages, and permanent dentition stages.[14,16,21,22] This study reviewed the findings of the research in relation to the observations made in these other climes. Also, findings from this research were related to dental emergence of the deciduous and permanent teeth and the onset of dental eruption as reported among Nigerians.

The mean age of onset of early mixed dentition (DS1) recorded in this present study (males, 6.66 years, and females, 6.50 years), though comparable to the results among Swedish children[16] (male, 6.17 years, and females 5.91 years), appeared to be delayed. Female participants in this present study attained late mixed dentition (DS3) and adolescent dentition (DS4) stages earlier than the male participants, which corroborates observations made from earlier researches.[16, 21-23] However, period of onset of the intermediate mixed dentition (DS2) was observed to have been be earlier in male participants than female participants in our current study, which is at variance with findings by other authors[16,21-22] This difference could be accounted for by the huge difference in the number of participants. In this study, time of onset of the intermediate mixed dentition (DS2) was observed to be largely comparable to the finding among the Norwegian, Danish, Icelandic and Swedish children.[16,21-23] In 1974, Helm & Seidler[21] reported DS2 among male and female Danish children to be 8.72 years and 8.32 years respectively, while the findings of Hagg & Taranger[16] regarding Swedish children was 8.30 and 7.97 years, among males and females respectively.

The onset of late mixed dentition stage (DS3) among Icelandic children were reported to be 9.48 years and 8.94 years in males and females respectively,[22] while 9.55

years and 9.07 years was reported in Denmark among male and female children respectively,[21] and Swedish male and female children were observed to be 10.07 years and 9.21 years respectively.[16] The periods of onset of DS3 as reported by the authors[16,21,22] appear to be earlier than the observations made in this study. A cross-sectional approach was employed to obtain data for this study, so it is possible that the exact period of the establishment of the dentition may have been earlier. This could have accounted for the variations in the timing. The onset of the adolescent stage (DS4) was observed to be similar to the observations made by previous researchers.[21,22] Our study showed DS4 to be 12.91 years in males which could be likened to 12.69 years in Danish male children,[21] 12.92 years in Icelandic male children,[22] and 12.60 years in Norwegian male children.[23] In addition, the onset of DS4 in female participants in this study was 12.79 years, which is proportionate to 12.09 years in Danish female children,[21] 12.05 years in Iceland female children,[22] and 12.15 years in Norwegian male children.[23]

The mean age of onset of the molars recorded in this study showed that females were also earlier in all the stages, which corroborates with results reported in previous studies.[16,21,22] This study revealed that the first molar emerged (M0) and got to full occlusal contact (that is fully erupted, M1) quite earlier among the Swedish population (M0: males 6.17 years, and females 5.91 years; M1: males 8.30 years, and 7.97 years for females)[16] when compared to this current study. However, our research revealed that the mean ages of onset of the fully erupted second molar M2; (males 13.37 years, and 12.91 years in females) was quite comparable to findings reported among the Danish children (M2: males 13.37 years, and 12.82 years in females),[21] Icelandic children (M2: males 13.23 years, and 12.40 years females),[22] and the Swedish children (M2: males 12.20 years, and 12.68 years for females).[16]

The periods of onset of the dental stages were compared to dental eruption as reported in the literature. The intermediate mixed dentition (DS2) is described as the period when all the incisors are said to have emerged.[15] In this study, the average age of DS2 for both males and females was 7.92 years. According to a study conducted among Nigerian children, the maxillary lateral incisor teeth were the last to emerge in that series and were noted to have occurred at 7.87 years.[7] Therefore, the mean stage of onset of the intermediate dentition from this study is closely related to the period of the eruption of the maxillary lateral incisors. In the same vein, a study conducted among Ghanaian children[24] showed that the maxillary lateral incisors were also the last teeth to erupt among the incisors, at 7.7 years. This suggests that Ghanaian children attain the intermediate mixed dentition slightly earlier than Nigerian children. Also, the mean age of onset of the adolescent dentition stage (DS4) corresponds to when all the canines and premolars have emerged, noted at 12.79 years in this study. In 2014, Oziegbe et al documented that the maxillary second premolars were the last teeth to emerge in that series, which occurred at 10.91 years.[7] Therefore, findings from our own research suggests that that the mean age of the adolescent dentition stage occurred about 2 years after the emergence of the maxillary second premolars. Bruce et al also observed that among Ghanaian children, the maxillary and mandibular second premolars emerged about the same period at 10.80 years.[24]

It is therefore important to determine a patient's dentition stage for the purpose of appropriate timing of clinical intervention.[20] The early mixed dentition stage has been adjudged to have a strong correlation with the pre-pubertal stage while the late mixed dentition and early permanent dentition are good indicators of the pubertal growth spurt.[25] In 2017, Fareen et al reported that the use of protraction facemask for the treatment of maxillary deficiency produced better treatment outcomes when instituted during the late mixed dentition stage than in the early mixed dentition stage.[18] These authors'[18] finding is, however, at variance with the observations made by some researchers[19,20] who noted that early mixed dentition is more suitable for overall treatment outcome when managing class III skeletal discrepancy with reverse pull facemask therapy. Meanwhile, encouraging the use of chin cup appliance during the deciduous dentition or early mixed dentition for management of mandibular excess is a good practice.

These varying observations made by researchers,[18-20] therefore suggest that categorizing a patient into the early or late

mixed dentition stage should not merely be by recording the chronological age, but it should be by appropriate determination of the dentition stage. This is because factors like genetic influence, sexual dimorphism, nutritional and socio-economic, could interfere with the dental emergence process.[8-11]

This research should therefore serve as a guide to clinicians regarding the timing of intervention for different clinical cases among Nigerian children.

CONCLUSION

This study revealed that the average age of the fully established deciduous dentition was 4.78 ± 0.97 years and occurred earlier among the females, p=0.153. Female participants attained early mixed dentition, late mixed dentition, and adolescent dentition earlier than males. On the other hand, male participants attained the intermediate mixed dentition earlier than the females. The average age of the fully erupted first and second permanent molars was 9.764 ± 2.364 years and 13.064 ± 1.712 years respectively, which also tend to have occurred earlier among the females, p > 0.05.

When the mandible and maxillary arches were considered separately, the onset of the early mixed, late mixed, and adolescent dental stages were earlier in the females in the dentition anterior to the permanent molars in both arches, p > 0.05. In the mandibular arch, the onset of the erupting first permanent molars to the stage of fully erupted first and second permanent molars were also earlier among female participants. On the other hand, in the maxilla, the mean age of the onset of an erupting first permanent molars was earlier among male participants. But in the maxilla, female participants slightly attained the fully erupted state of the first permanent molars (9.72 ± 2.45 years) earlier than male participants (9.76 ± 2.34 years), p=0.916, and fully erupted state of the second permanent molars (females; 12.76 ± 2.16 years) earlier than male participants (13.37 ± 0.82 years). However, the differences observed in the mean ages of the onset of the dental stage of the maxillary molars in relation to gender were not statistically significant.

Study limitation: This study was a descriptive, cross-sectional research and the dentitions of the participants were assessed based on what was evident at the time of data collection. It is difficult to categorically state when the dental stage may have begun because the exact time of dental emergence may have been missed. Consequently, in order to ascertain what has been termed as dental emergence, only the set of teeth that were present in the mouth were evaluated. This may have resulted in the over-estimation of the time of the actual onset of a particular dental stage recorded in this present study.

RECOMMENDATION

The authors therefore suggest that a longitudinal survey should be conducted to determine the exact period of onset of a particular dental emergence stage.

Conflict of interest

The authors declare no conflict of interest.

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Authors' contributions:

Osaronse Anthony AGHIMIEN was responsible for the conceptualization, design of the study, data acquisition, critical review of intellectual content, and final approval for the article to be published. Nneka Maureen CHUKWUMAH was involved in design of the study, data collection, and critical review of intellectual content, and final approval for the article to be published.

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Appendix A: BJORK ET AL CRITERIA FOR DENTAL EMERGENCE STAGING (DES)

DES	DESCRIPTION	STAGE OF DENTITION	
	GRADING FOR PRIMARY TEETH, PERMANENT ANTERIOR TEETH AND PREMOLARS		
DS01	Deciduous teeth erupting	Deciduous dentition erupting	
DS02	Deciduous teeth fully erupted	Deciduous dentition complete	
DS1	Permanent incisors erupting	Early mixed dentition	1-7 incisors
DS2	Permanent incisors fully erupted	Intermediate mixed dentition	All incisors
DS3	Permanent canine or premolar erupting	Late mixed dentition	1-11 canines and/or premolars
DS4	Permanent canine or premolar fully erupted	Adolescent dentition	All canines and premolars
	GRADING FOR MOLARS		
M0	First permanent molar erupting	First molar not fully erupted	1-3 first molars
M1	First permanent molar fully erupted	First molar fully erupted	All first molars
M2	Second permanent molar fully erupted	Second molar fully erupted	All second molars
M3	Third permanent molar fully erupted	Third molar fully erupted	All third molars

Appendix B: ADJUSTED BJORK ET AL CRITERIA FOR DENTAL EMERGENCE STAGING (DES) FOR EACH JAW.

DES	DESCRIPTION	STAGE OF DENTITION	
	GRADING PERMANENT ANTERIOR TEETH AND PREMOLARS		
DS1	Permanent incisors erupting	Early mixed dentition	1-3 incisors
DS2	Permanent incisors fully erupted	Intermediate mixed dentition	All incisors
DS3	Permanent canine or premolar erupting	Late mixed dentition	1-5 canines and/or premolars
DS4	Permanent canine or premolar fully erupted	Adolescent dentition	All canines and premolars
	GRADING FOR MOLARS		
M0	First permanent molar erupting	Left or right first molar not fully erupted	Left or right first molars
M1	First permanent molar fully erupted	Left and right first molars molar fully erupted	Left and right first molars
M2	Second permanent molar fully erupted	Left and right second molars molar fully erupted	Left and right second molars molar.
M3	Third permanent molar fully erupted	Left and right third molars molar fully erupted	Left and right third molars molar.

Appendix C: Entry form for participants

S/N	**PARTICIPANT NAME**	**CA (mths)**	**GEN**	WT (kg)	HT (m)	DES **UA**	**LA**	**ADS**
1.								
2.								

KEY-CA- chronological age in months; **GEN**- gender; **WT** (kg)- weight in kilogram; **HT** (m)- Height in meters; **DES**-Dental Emergence Staging; **UA**-Upper arch; **LA**-Lower arch. **ADS**-Overall Dental Stage.