

PATTERNS AND TIME OF PERMANENT TEETH ERUPTION IN THE GOMBE STATE CHILDREN AND ADOLESCENCES

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ABSTRACT

The study aims to determine the time, sequence, gender differences, and pattern of permanent teeth eruption in Gombe State children and Adolescents. The total number of 300 individuals with an equal number of males (n=150) and females (n=150) with ages ranges from 5-14 years from Government day Secondary and Primary School Lijji were randomly selected for this research. The data was collected with the subject sited on a chair under sunlight. The oral examination was carried out using a mouth mirror, hand gloves, and a blunt probe. The teeth were cleaned of food debris with cotton wool for proper visibility. The status of the eruption of each permanent tooth was recorded even if a small part of the crown is visible clinically penetrating the oral mucous membrane. It is regarded as erupted and recorded accordingly, except for third molars. The obtained data were subjected to Student - t-test to obtain differences in the pattern of permanent teeth eruption using SPSS version 20.0 software (IBM Corporation, USA). The result shows that in the five years age group, none of the permanent teeth had erupted in both males and females. In the age group of 14 years, all the permanent teeth except the third molars had erupted, among which the maxillary teeth erupted earlier in males than females; likewise the mandible teeth erupted earlier in males than in females.

Keywords: Pattern, Time, Eruption, Permanent, Teeth

INTRODUCTION

Tooth eruption is the process by which developing teeth emerge through the soft tissues of the jaws and the overlying mucosa to enter the oral cavity, contact the teeth of the opposing arch, and function in mastication (Avery *et al.*, 2002; Verma *et al.*, 2017). The term “eruption” is derived from the Latin word “eruptio,” which means output with momentum (Neto and Falcão, 2014; Verma *et al.*, 2017). It is a continuous process that ends only with the loss of a tooth. The eruption of deciduous teeth, their exfoliation followed by eruption of permanent dentition is an orderly, sequential, and age-specific event and is considered as

an important milestone during a child’s development (Peedikayil, 2011; Verma *et al.*, 2017). The evolution of the human race has seen many changes in living habits, food habits, and oral hygiene habits for thousands of years, which may have influenced the eruption of teeth as well (Lakshmappa *et al.*, 2011; Verma *et al.*, 2017). Tooth eruption recognized as an aspect of human growth and development could be influenced by several factors that can be both physiological and pathological like growth, caries, malnutrition, genetics, etc. (Soliman *et al.*, 2012; Verma *et al.*, 2017).

Primary teeth have shown wide variations in their eruption pattern and time between

different populations, ethnic and racial groups (Lavelle, 1975; Magnusson, 1982; Hitchcock *et al.*, 1984; Ramirez *et al.*, 1994; Gunashekhar and John, 2010). Other suggested factors that affect the eruption time may include gestational period, diseases, nutritional status, and growth (Galili *et al.*, 1969; Infante, 1973; Seow, 1997; Gunashekhar and John, 2010). Eruption timing of permanent dentition may be influenced by various factors like genetic factors, hormonal factors, geographical, climatic, racial, gender and ethnic differences, economic status, body constitution, nutrition, fluoride, season of birth, temporal variations, and growth parameters together with rare general pathological conditions, such as endocrine pathology, irradiation, and developmental syndromes that exert an influence on eruption patterns (Moslemi, 2004; Chaitanya *et al.*, 2018).

Estimation of eruption schedule can be a very valuable asset in diagnosis and treatment planning during developmental years (Gupta *et al.*, 2007; Verma *et al.*, 2017). Significant deviations from accepted norms of eruption time are often observed in clinical practice (Gupta *et al.*, 2007; Verma *et al.*, 2017). The premature eruption has been noted, but delayed tooth eruption is the most commonly encountered deviation from normal eruption time (Gupta *et al.*, 2007; Verma *et al.*, 2017).

There is limited information on the timing and sequence of permanent teeth eruption in the Nigerian population; as such, the information on the time of permanent teeth eruption used in clinical and academic situations in Nigeria is based on other populations, meanwhile individual and environmental factors vary from one geographic location to another, which might affect the timing of tooth eruption and due to

the large variability observed in previous studies, it is preferable not to adopt references from other countries as our standard as Nigerians differ from them racially, culturally and environmentally. The study aims to determine the time, sequence, gender differences, and pattern of permanent teeth eruption in Gombe State children and Adolescents that will provide information about the average time of permanent teeth eruption, which is vital in the planning of diagnostic, preventive and therapeutic measures in dental treatment planning, particularly in orthodontics. The provided information can also be used in age estimation by forensic dentistry.

MATERIALS AND METHODS

Sampling

The total number of 300 children and adolescents from Lijji Primary and Secondary School with ages ranges from 5 – 14 years, which comprises of an equal number of males ($n = 150$) and females ($n = 150$) were randomly selected for this research after been informed about the research.

Procedure of Data Collection

Initially, the basic information, which includes: Age, Gender, Address, and Date of birth, were recorded. The subject was allowed to sit on a chair under sunlight and open their mouth; the dental examination was carried out using a mouth mirror, hand gloves, and a blunt probe. The teeth were cleaned of food debris with cotton wool for proper visibility.

The teeth examination for permanent teeth commenced from the right maxillary quadrant followed by the left maxillary quadrant, right mandibular quadrant, and

then left mandibular quadrant. The teeth were identified according to the two-digit system of the Federation Dentaire Internationale (FDI) (Hayes and Mantel, 1958; Gates, 1966; Kutesa *et al.*, 2013). The status of the eruption of each permanent tooth was recorded. Even if a small part of the crown is visible clinically penetrating the oral mucous membrane, it is regarded as erupted and recorded accordingly, except third molars. (Hayes and Mantel, 1958; Gates, 1966; Kutesa *et al.*, 2013).

Data Analysis

The mean age of individual permanent teeth was calculated using probit transformation. For each tooth, the percentages of subjects in whom the tooth was present at a specific age level were determined and transformed into probit values for each age group. Standard deviations (SD) were calculated separately for males and females for maxillary and mandibular teeth. Student's t-test was used for comparing the two means, using SPSS software version 20.0. The confidence interval of 95% ($P \leq 0.05$) was considered statistically significant.

RESULTS

The study population consisted of 300 subjects with ages ranges from 5 – 14 years, which are from Lijji primary and secondary schools Gombe. Among the subjects, 150 boys constituting 50 % and 150 girls constituting 50 % of the total sample of 300 children and adolescences. Table 1 shows the distribution of the sample according to age, gender and the percentage of each gender according to age group.

Table 1: Distribution of the study population

Age	Males	Males %	Female	Female %
5	3	1	2	1
6	15	5	15	5
7	22	7	20	7
8	18	6	14	5
9	17	6	13	4
10	12	4	11	4
11	22	7	21	7
12	18	6	18	6
13	9	3	16	5
14	15	5	20	7
Total	150	50	150	50

Table 2 shows the number and percentage of the permanent maxillary teeth eruption at different age in males, in which there was 0.0 % eruption at the age of 5 years at all levels, in 6 years only the first molar indicated 5.8 % eruption. There was 10.7 % eruption at the level of the first molar tooth which is the least erupted tooth at the age of 14 years and 50.0 % at the second molar which is the highest erupted tooth at the age of 14 years.

Table 3 shows the number and percentage of the permanent maxillary teeth eruption at different age in females, in which at the age of 5 years there was 0.0 % eruption at all the teeth level. Still, at the age of 6 years there was 0.9 % eruption in the central incisor and 5.7 % eruption at the first molar, at the age of 14 years there was least eruption (13.0 %) at incisor and the highest eruption (43.9 %) at the second molar level.

Table 2: Number and percentage of the maxillary permanent teeth erupted at different age in males

Age	CI	CI %	LI	LI %	C	C %	1 ST PM	1 ST PM %	2 ND PM	2 ND PM %	1 ST M	1 ST M %	2 ND M	2 ND M %
5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	8	5.8	0	0.0
7	6	5.6	2	2.2	0	0.0	0	0.0	0	0.0	20	14.4	0	0.0
8	11	10.2	5	5.6	0	0.0	0	0.0	0	0.0	18	13.0	0	0.0
9	15	13.9	9	10.1	0	0.0	0	0.0	0	0.0	17	12.2	0	0.0
10	12	11.1	11	12.4	1	2.4	4	7.1	1	2.4	12	8.6	0	0.0
11	22	20.4	21	23.6	8	19.5	15	26.8	8	19.5	22	15.8	2	7.7
12	18	16.6	17	19.1	10	24.4	14	25.0	11	26.8	18	13.0	5	19.2
13	9	8.3	9	10.1	8	19.5	8	14.3	7	17.1	9	6.5	6	23.1
14	15	13.9	15	16.9	14	34.2	15	26.8	14	34.2	15	10.7	13	50.0
Total	108	100.0	89	100.0	41	100.0	56	100.0	41	100.0	138	100.0	26	100.0

Key: CI = Central Incisor, LI = Lateral Incisor, C = Canine, 1st PM = First premolar, 2nd PM = Second Premolar, 1st M = First Molar, 2nd M = Second Molar, % = Percentage.

Table 3: Number and percentage of the permanent maxillary teeth erupted at different age in females

AGE	CI	CI %	LI	LI %	C	C %	1 ST PM	1 ST PM %	2 ND PM	2 ND PM %	1 ST M	1 ST M %	2 ND M	2 ND M %
5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0	8	5.7	0	0.0
7	6	5.6	2	2.0	0	0.0	0	0.0	0	0.0	19	13.6	0	0.0
8	9	8.4	4	4.0	0	0.0	0	0.0	0	0.0	14	10.0	0	0.0
9	12	11.2	9	9.0	0	0.0	0	0.0	0	0.0	13	9.3	0	0.0
10	11	10.3	10	10.0	1	1.7	4	5.7	1	1.8	11	7.9	0	0.0
11	21	19.6	21	21.0	8	13.8	15	21.4	9	15.8	21	15.0	3	7.3
12	18	16.8	18	18.0	14	24.1	16	22.9	14	24.6	18	12.9	8	19.5
13	16	14.9	16	16.0	15	25.9	16	22.9	15	26.3	16	11.4	12	29.3
14	14	13.0	20	20.0	19	32.8	20	28.6	19	33.3	20	14.3	18	43.9
Total	107	100.0	100	100.0	58	100.0	70	100.0	57	100.0	140	100.0	41	100.0

Key: CI = Central Incisor, LI = Lateral Incisor, C = Canine, 1st PM = First premolar, 2nd PM = Second Premolar, 1st M = First Molar, 2nd M = Second Molar, % = Percentage.

Table 4 shows the number and percentage of mandibular permanent teeth, that erupted in males at a different age, in which the five years indicated no eruption (0.0 %) at all tooth levels, the six years indicated eruption at the level of the central incisor (1.6 %), lateral incisor (0.9 %) and first molar (6.4 %), the least erupted tooth at the age of 14 years was first molar (10.7 %) and highest erupted tooth was the second molar (45.1 %) eruption.

Table 5 shows the number and percentage of mandibular permanent teeth, that erupted in females at a different age, in which the five years indicated no eruption (0.0 %) at all tooth levels, the six years indicated eruption at the level of the central incisor (1.6 %), lateral incisor (0.9 %) and first molar (6.4 %), the least erupted tooth at the age of 14 years was first molar (14.2 %) and highest erupted tooth was the first premolar (39.7 %) eruption.

Table 4: Number and percentage of the permanent mandibular teeth erupted at different age in males

AGE	CI	CI %	LI	LI %	C	C %	1 ST PM	1 ST PM %	2 ND PM	2 ND PM %	1 ST M	1 ST M %	2 ND M	2 ND M %
5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	2	1.6	1	0.9	0	0.0	0	0.0	0	0.0	9	6.4	0	0.0
7	12	9.8	5	4.7	0	0.0	0	0.0	0	0.0	20	14.3	0	0.0
8	15	12.3	10	9.4	0	0.0	0	0.0	0	0.0	18	12.9	0	0.0
9	17	13.9	14	13.3	0	0.0	1	1.9	0	0.0	17	12.1	0	0.0
10	12	9.8	12	11.3	2	4.4	4	7.5	2	4.8	12	8.6	0	0.0
11	22	18.0	22	20.8	9	20.0	13	24.6	8	19.0	22	15.7	3	9.7
12	18	14.8	18	16.9	12	26.7	13	24.6	10	23.8	18	12.9	7	22.6
13	9	7.4	9	8.5	8	17.7	8	15.1	7	16.7	9	6.4	7	22.6
14	15	12.3	15	14.2	15	33.3	15	28.3	14	33.3	15	10.7	14	45.1
Total	122	100.0	106	100.0	45	100.0	53	100.0	42	100.0	140	100.0	31	100.0

Key: CI = Central Incisor, LI = Lateral Incisor, C = Canine, 1st PM = First premolar, 2nd PM = Second Premolar, 1st M = First Molar, 2nd M = Second Molar, % = Percentage.

Table 5: Number and percentage of the permanent mandibular teeth erupted at different age in females

AGE	CI	CI %	LI	LI %	C	C %	1 ST PM	1 ST PM %	2 ND PM	2 ND PM %	1 ST M	1 ST M %	2 ND M	2 ND M %
5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	2	1.6	1	0.9	0	0.0	0	0.0	0	0.0	9	6.4	0	0.0
7	11	8.9	4	3.7	0	0.0	0	0.0	0	0.0	19	13.5	0	0.0
8	12	9.7	7	6.4	0	0.0	0	0.0	0	0.0	14	9.9	0	0.0
9	13	10.5	11	10.0	0	0.0	0	0.0	0	0.0	13	9.2	0	0.0
10	11	8.9	11	10.0	2	3.1	3	4.7	1	1.8	11	7.8	1	2.1
11	21	16.9	21	19.3	12	18.8	13	20.3	9	15.8	21	14.9	5	10.4
12	18	14.5	18	16.5	15	23.4	16	25.0	14	24.6	18	12.8	10	20.8
13	16	12.9	16	14.7	16	25.0	13	20.3	14	24.6	16	11.3	14	29.2
14	20	16.1	20	18.5	19	29.7	19	39.7	19	33.2	20	14.2	18	37.5
Total	124	100.0	109	100.0	64	100.0	64	100.0	57	100.0	141	100.0	48	100.0

Key: CI = Central Incisor, LI = Lateral Incisor, C = Canine, 1st PM = First premolar, 2nd PM = Second Premolar, 1st M = First Molar, 2nd M = Second Molar, % = Percentage.

Table 6 shows the mean ages comparison for maxillary teeth eruption between males and females, in which the mean age and standard deviation for the maxillary teeth eruption were 7.7 ± 1.2 years for the central incisor, 8.67 ± 1.2 years for lateral incisor, 11.68 ± 1.2 years for canine, 10.78 ± 1.3 years for the first premolar, 11.5 ± 1.31 years for the second premolar, 5.4 ± 1.18 years for the first molar, and 12.64 ± 1.138 years for the second molar in the males and

7.46 ± 1.2 years for central incisor, 8.54 ± 1.1 years for lateral incisor, 11.2 ± 1.17 years for canine, 10.5 ± 1.3 years for the first premolar, 11.21 ± 1.19 years for the second molar, 5.4 ± 1.07 years for first molar and 12.3 ± 1.02 years for the second molar in females. This shows that the mean age in males is significantly greater than females in central incisor, lateral incisor, first premolar and first molar, with the P-value less than 0.05.

Table 6: Comparison of the mean age of the maxillary teeth eruption between males and females

Tooth	Boys	Girls	T - Value	P - Value
CI	7.7 ± 1.2	7.46 ± 1.2	- 5.071	0.000
LI	8.67 ± 1.2	8.54 ± 1.1	-3.703	0.000
C	11.68 ± 1.2	11.2 ± 1.1	-0.488	0.626
1 ST PM	10.78 ± 1.3	10.5 ± 1.3	-3.047	0.002
2 ND PM	11.5 ± 1.31	11.21 ± 1.19	-4.585	0.113
1 ST M	5.4 ± 1.18	5.4 ± 1.07	-5.469	0.000
2 ND M	12.64 ± 1.138	12.3 ± 1.02	1.380	0.168

Key: CI = Central Incisor, LI = Lateral Incisor, C = Canine, 1st PM = First premolar, 2nd PM = Second Premolar, 1st M = First Molar, 2nd M = Second Molar, % = Percentage.

Table 7 shows the mean age comparison for mandibular teeth eruption between males and females, in which the mean age and standard deviation for the mandibular teeth eruption were 6.8 ± 0.92 years central incisor, 7.9 ± 1.02 years for lateral incisor, 11.4 ± 1.3 years for canine, 10.9 ± 1.41 years for first premolar, 11.3 ± 1.32 years for second premolar, 5.14 ± 1.24 years for first molar and 12.2 ± 1.17 years for second molar in males and 6.9 ± 0.92 years for

central incisor, 7.9 ± 1.07 years for lateral incisor, 10.5 ± 1.3 years for canine, 11.21 ± 1.19 years for first premolar, 11.5 ± 1.32 years for second premolar, 5.18 ± 1.24 years for first molar and 11.9 ± 1.17 years for second molar in females. This shows that the mean age is significantly greater in male than in females with P-value less than 0.05 in central incisor, lateral incisor, first premolar and first molar teeth.

Table 7: Comparison of the mean age of the mandibular teeth eruption between males and females

Tooth	Boys	Girls	T - Value	P - Value
CI	6.8 ± 0.92	6.9 ± 0.92	-5.687	0.000
LI	7.9 ± 1.02	7.9 ± 1.07	-5.755	0.000
C	11.4 ± 1.3	10.8 ± 1.3	-0.286	0.775
1 ST PM	10.9 ± 1.41	10.6 ± 1.41	-3.463	0.001
2 ND PM	11.3 ± 1.32	11.5 ± 1.32	-1.388	0.181
1 ST M	5.14 ± 1.24	5.18 ± 1.24	-5.560	0.000
2 ND M	12.2 ± 1.17	11.9 ± 1.17	1.443	0.149

Key: CI = Central Incisor, LI = Lateral Incisor, C = Canine, 1st PM = First premolar, 2nd PM = Second Premolar, 1st M = First Molar, 2nd M = Second Molar, % = Percentage.

Table 8 shows the comparison of the mean age of eruption between maxillary and mandibular teeth in males, which shows that the maxillary central and lateral incisor are significantly greater than the mandibular central and lateral incisor and no significant difference between the maxillary canine, first premolar, second premolar, first molar and second molar with that of the mandible. This shows the mean age is significantly greater

in maxillary teeth than mandibular teeth in males, with P- value less than 0.05 in the central incisor, lateral incisor and canine.

Table 9 shows the comparison of the mean age of eruption between maxillary and mandibular teeth in females, in which the maxillary central incisor, lateral incisor and canine shows the significant difference with that of the mandible and no significant

difference between the maxillary first premolar, second premolar, first molar and second molar with that of the mandible. This show that the mean age of maxillary teeth is significantly greater than mandibular teeth in females, with P-value less than 0.05 in central incisor, lateral incisor, canine and second molar.

Table 8: Comparison of the mean age of eruption between maxillary and mandibular teeth in males.

Teeth	Maxilla	Mandible	T – Test
CI	7.73 ± 1.2	6.8 ± 0.92	0.000
LI	8.7 ± 1.2	7.9 ± 1.02	0.000
C	11.68 ± 1.2	11.4 ± 1.3	0.027
1 ST PM	10.78 ± 1,3	10.9 ± 1.41	0.505
2 ND PM	11.5 ± 1,31	11.3 ± 1.32	0.745
1 ST M	5.4 ± 1.18	5.14 ± 1.24	0.647
2 ND M	12.64 ± 1.138	12.2 ± 1.17	0.164

Key: CI = Central Incisor, LI = Lateral Incisor, C = Canine, 1st PM = First premolar, 2nd PM = Second Premolar, 1st M = First Molar, 2nd M = Second Molar, % = Percentage.

Table 9: Comparison of the mean age of eruption between maxillary and mandibular teeth in females.

Teeth	Maxilla	Mandible	T – Test
CI	7.46 ± 1.2	6.9 ± 0.92	0.000
LI	8.54 ± 1.1	7.9 ± 1.07	0.000
C	11.2 ± 1.1	10.8 ± 1.3	0.001
1 ST PM	10.5 ± 1.3	10.6 ± 1.41	0.156
2 ND PM	11.21 ± 1.19	11.6 ± 1.41	0.485
1 ST M	5.4 ± 1.07	5.18 ± 1.24	0.660
2 ND M	12.3 ± 1.02	11.9 ± 1.17	0.036

Key: CI = Central Incisor, LI = Lateral Incisor, C = Canine, 1st PM = First premolar, 2nd PM = Second Premolar, 1st M = First Molar, 2nd M = Second Molar, % = Percentage.

DISCUSSION

The eruption of maxillary teeth was compared with mandibular teeth in both

males and females. The central incisor, lateral incisor, canine, second premolar, first molar and second molar erupted earlier in mandible. The first premolar erupted earlier in the maxilla. In females, the central incisor, lateral incisor, canine, first molar and second molar erupted earlier in mandible. The first premolar and second premolar erupted earlier in the maxilla. The timing of the eruption of permanent teeth has been studied among different ethnic groups and within the same ethnic groups by several researchers. A variation in the sequence of tooth emergence in both dentitions adds to the difficulties in establishing the dental age. Tooth eruption time must be based upon a mean with a wide latitude of variation for individual cases as suggested by Steggerda and Hill, 1996: Mahima and Balaji- Rao, 1997.

In this study, the early eruption of both maxillary and mandibular first molar was observed in both sexes and find out that in the five years age group none of the permanent tooth had erupted in both males and females. In the age group of 14 years, all the permanent teeth except the third molars had erupted. Hagg and Taranger, 1985 support this finding; Lakshmappa *et al.*, 2011, also stated that that premature loss of deciduous molars due to high caries risk is generally expected to cause accelerated emergence of the permanent successors and other teeth in the posterior segment. It was observed in this study that maxillary teeth erupted earlier in males than females, which is statistically significant in almost all the teeth except in maxillary canine, second premolar and second molar. Likewise, the mandible teeth erupted earlier in males than in females. It was also evident from the present study that premolars erupted earlier in males than in females. This was in concurrence with the study of Bogaerts

(Leroy *et al.*, 2003; Lakshmappa *et al.*, 2011).

There was no difference between the timing of calcification at the early stages between males and females. However, in males, there was early completion of the root formation and the apical closure, which may lead to an accelerated eruption. This may occur because of advancement in physical development as reported by Hoffding *et al.*, (1984), Lakshmappa *et al.*, (2011). The present study shows the overall early eruption of the permanent teeth in males than in females and the findings agrees with the results of Magnusson, (1976); Sarava, (1978); Hoffding *et al.*, (1984) and Lakshmappa *et al.*, (2011). It is also clearly shown in the present study that the maxillary teeth erupted earlier than their mandibular counterparts with minor discrepancies. This is in agreement with research findings of (Lee *et al.*, 1965; Hoffding *et al.*, 1984; Lakshmappa *et al.*, 2011).

CONCLUSION

The mean ages of eruption obtained in the present study are strikingly comparable with those of the other investigators in different populations across the world. Environmental, geographical, racial factors and secular trends may not have a major role to play in influencing the eruption of the teeth. Since the current study involved a small sample of children, the data reported could be used as standards when assessing permanent tooth eruption for a specific area of Gombe.

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