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THE ERUPTION SEQUENCE OF PRIMARY AND PERMANENT TEETH IN A GROUP OF CHILDREN IN KAFR EL-SHEIKH GOVERNORATE, EGYPT

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ABSTRACT:
Limited numbers of studies are published from Middle Eastern countries on the eruption age of teeth. Therefore, the information utilized in the academic and clinical situation about the eruption time of teeth in Middle Eastern countries is still based on American and European standards. **Objectives:** The aim of this study was to determine the eruption dates and sequence of primary and permanent teeth and to correlate between chronological and developmental age of eruption of primary and permanent teeth in a group of Egyptian children. **Methods:** The study sample consisted of 1572 healthy Egyptian children of both sexes from Kafr El-Sheikh Governorate, Egypt. A number of 1031 children were selected from schools and 541 children were selected from Maternal and Child Welfare provided that they fulfill the criteria of selection. **Results:** The first primary tooth to erupt was the lower central incisor and its mean age of eruption was 5.4 months in boys and 4.4 months in girls. While the first permanent tooth to erupt was the lower first molar and its mean age of eruption was 5.52 years in boys and 5.33 years in

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girls.**Conclusion:** Sequence and dates of eruption of primary and permanent teeth are different in Egyptian children than that of other countries. Chronological age and developmental age are not usually coincident with each other as it is evident in some children who denoted that important individual factors play a role in teeth eruption as hereditary factors and nutrition status of children.

KEYWORDS
Eruption, Sequence, Dental developmental age.

INTRODUCTION:

Tooth eruption marks a milestone in a child's development and is synchronous with growth and development of the craniofacial complex. Eruption is a developmental process responsible for moving a tooth from its crypt position through the alveolar process into the oral cavity and to the final position of occlusion with its antagonist. The erupted tooth was defined as any tooth with any part of its crown penetrating the gingiva and visible in the oral cavity (Rao*et al.*, 2014).

The aim of the study was to determine the eruption dates and sequence of primary and permanent teeth and to correlate between chronological anddevelopmental age of eruption of primary and permanent teeth in a group of children in Kafr El-Sheikh Governorate-Egypt.

SUBJECTS AND METHODS:

The sample:

The study sample consisted of 1572 apparently healthy Egyptian children of both sexes from Kafr El-Sheikh Governorate, Egypt.1031 children were selected from schools and 541 children were selected from Maternal and Child Welfare provided that they fulfill the following criteria:

i.Children aged 5 months to 3 years old for primary teeth data.
ii.Children aged 5 to 12 years old for permanent teeth data.
iii.Children free from any apparent systemic or genetic diseases which may affect the growth; development and eruption of teeth. Any child with a history of systemic disease was excluded from the study.
iv.The dentition was free from any dental anomalies.

Collection of Data:

A questionnaire was designed byTaha and El Dokki(2011) in order to collect reliable basic information from parents; the data were collected and recorded in the subject survey sheets.

Intraoral Examination:

Intraoral examination for the children was done under daylight illumination and using disposable mirrors for retraction of the soft tissue and disposable probes.Both upper and lower jaws were examined and the state of eruption of teeth was recorded.The examination proceeded in an

orderly manner from one tooth or tooth space to the adjacent tooth or tooth space. If any part of the tooth was visible or has just penetrated the gingival tissue, the tooth was considered as emerged and recorded on the survey sheet accordingly. The children and the parents were questioned about the missing teeth, as the tooth lost by accidents or extractions was considered as erupted teeth and reported in the survey sheet.

Results:

Comparison between boys and girls regarding the age of eruption of permanent teeth:

Table (1) showsmean and standard deviation (SD) values and results of student's t-test for comparison between eruption ages of upper permanent teeth in boys and girls.There were insignificant differences between boys and girls in eruption ages for upper teeth (P> 0.05) except for upper lateral incisor, upper canine, upper first premolar and upper second molar where their mean age were 9.78, 12, 11.04 and 10.71 years respectively at which there were significant differences between both groups (P<0.05).

Table (2) shows mean and standard deviation (SD) values and results of student's t-test for comparison between ages of eruption of lower permanent teeth in boys and girls. There were insignificant differences between boys and girls groups for all lower teeth (P> 0.05) except lower lateral incisor, lower canine, lower first and second premolars, and lower second molar where their mean age were 9.28, 10.89, 10.65 and 10.92 years respectively at which there were significant differences between both groups (P<0.05).

Table 1: Comparison between boys and girls regarding age of eruption of upper permanent teeth.

Jaw	Tooth	Sex	Min. (Years)	Max. (Years)	M (Years)	±SD	P-value
Upper	1	Boys	5.94	9.29	9.16	1.46	0.6600
		Girls	5.52	10.13	9.13	1.59	
	2	Boys	6.59	10.88	9.78	1.20	0.0008*
		Girls	5.67	11.63	9.58	1.45	
	3	Boys	9.59	12.21	10.90	1.05	0.0001*
		Girls	10.68	13.29	12.00	0.89	
	4	Boys	7.23	11.96	10.34	0.99	0.0001*
		Girls	8.87	13.21	11.04	1.13	
	5	Boys	8.35	12.21	10.66	0.88	0.2320
		Girls	7.90	13.29	10.71	0.99	
	6	Boys	5.52	8.04	8.64	1.64	0.0001*
		Girls	5.33	7.13	6.23	1.78	
	7	Boys	9.92	12.21	11.21	0.65	0.0115*
		Girls	9.52	14.13	11.29	0.76	

Min: Minimum;Max: Maximum; M: Mean; SD: Standard deviation; P: Probability level; *Significant difference.

Table 2: Comparison between boys and girls regarding age of eruption of lower permanent teeth.

Jaw	Tooth	Sex	Min. (Years)	Max. (Years)	M (Years)	±SD	P-value
Lower	1	Boys	5.52	8.52	8.71	1.63	0.688
		Girls	5.33	10.19	8.74	1.72	
	2	Boys	5.94	9.69	9.28	1.43	0.0001*
		Girls	5.67	10.19	9.22	1.56	
	3	Boys	6.59	12.27	10.89	0.93	0.0001*
		Girls	7.51	13.00	10.25	0.89	
	4	Boys	8.52	12.85	10.65	0.86	0.0012*
		Girls	7.90	13.35	10.51	1.06	
	5	Boys	8.35	12.27	10.63	0.87	0.0001*
		Girls	8.91	13.35	10.92	0.87	
	6	Boys	5.14	9.10	7.12	1.69	0.305
		Girls	5.21	9.19	7.20	1.80	
	7	Boys	9.39	12.27	10.83	1.09	0.0001*
		Girls	9.69	13.35	11.10	0.69	

Min: Minimum; Max: Maximum; M: Mean; SD: Standard deviation; P: Probability level; *Significant difference.

Comparison between boys and girls regarding age of eruption of primary teeth:

Table (3) shows mean and standard deviation (SD) values and results of student's t-test for comparison between ages of eruption of upper primary teeth in boys and girls. There were insignificant differences between boys and girls groups for all upper teeth (P> 0.05) except upper canine, upper first and second molar where their mean age were 2.21, 1.98 and 2.54 years respectively at which there were significant differences between both groups (P<0.05).

Table (4) shows mean and standard deviation (SD) values and results of student's t-test for comparison between ages of eruption of lower primary teeth in boys and girls. There were insignificant differences between boys and girls groups for all teeth (P> 0.05) except lower lateral, lower canine and lower second molar where their mean age were 1.93, 2.25 and 2.43 years respectively which there were significant differences between both groups (P<0.05).

Table 3: Comparison between boys and girls regarding age of eruption of upper primary teeth.

Jaw	Tooth	Sex	Min. (Months)	Max. (Years)	M	±SD	P-value
Upper	A	Boys	8.90	1.44	1.69	0.67	1.0000
		Girls	4.40	1.86	1.69	0.69	
	B	Boys	8.90	1.86	1.77	0.66	0.3418
		Girls	9.10	1.94	1.81	0.67	
	C	Boys	9.10	2.78	2.10	0.60	0.0033*
		Girls	9.84	2.36	2.21	0.58	
	D	Boys	9.10	1.94	1.98	0.60	0.0001*
		Girls	10.44	2.11	1.82	0.62	
	E	Boys	21.00	3.03	2.39	0.56	0.0001*
		Girls	21.60	3.28	2.54	0.36	

Min: Minimum; Max: Maximum; M: Mean; SD: Standard deviation; P: Probability level;
*Significant difference.

Table 4: Comparison between boys and girls regarding age of eruption of lower primary teeth.

Jaw	Tooth	Sex	Min.(Months)	Max. (Years)	M	±SD	P-value
Lower	A	Boys	5.4	1.19	1.57	0.71	0.8238
		Girls	4.4	3.11	1.58	0.71	
	B	Boys	9.0	1.77	1.85	0.66	0.0068*
		Girls	9.0	3.11	1.93	0.66	
	C	Boys	9.0	2.61	2.15	0.60	0.0066*
		Girls	14.6	3.11	2.25	0.56	
	D	Boys	9.0	1.77	1.99	0.61	0.0676
		Girls	9.8	1.94	2.06	0.60	
	E	Boys	13.6	2.86	2.31	0.51	0.0001*
		Girls	15.96	2.86	2.43	0.37	

Min: Minimum; Max: Maximum; M: Mean; SD: Standard deviation; P: Probability level;
*Significant difference.

Sequence of eruption of permanent teeth in boys:

Fig. (1) shows the sequence of eruption of permanent teeth in boys as follow; lower first molar , upper first molar,lower central incisor, upper central incisor, lower lateral incisor , upper lateral incisor, upper first premolar, lower second molar, lower first molar, upper second premolar, lower second molar, lower canine, upper canine and upper second molar.

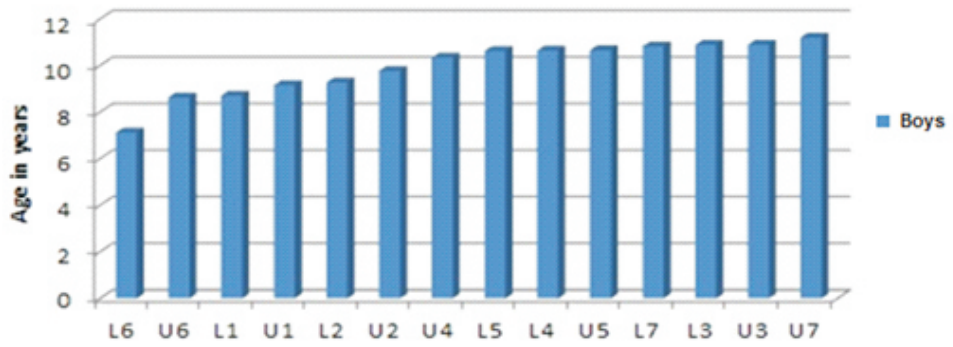

Fig. 1: Sequence of eruption of permanent teeth in boys (L: lower, U: upper).

Sequence of eruption of permanent teeth in girls:

Fig. (2) shows the sequence of eruption of permanent teeth in girls as follow; upper first molar , lower first molar ,lower central incisor, upper central incisor, lower lateral incisor ,upper lateral incisor, lower canine, lower first premolar, upper second premolar, lower second premolar, upper first

premolar, lower second molar, upper second molar and canine.

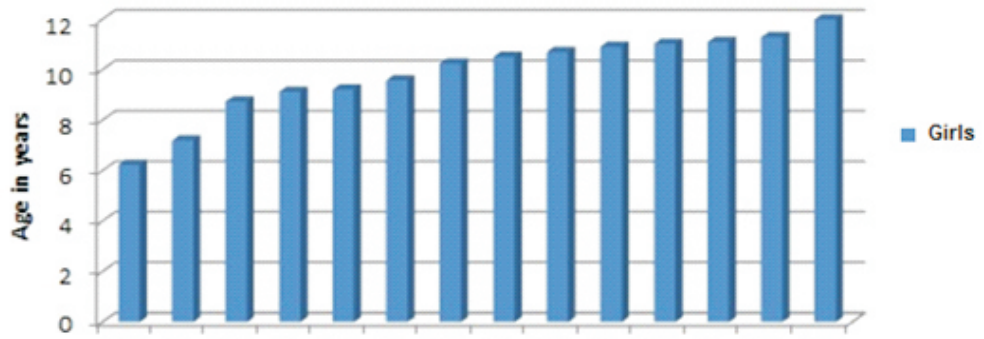

Fig. 2: Sequence of eruption of permanent teeth (L: lower, U: upper).

Sequence of eruption of primary teeth in boys:

Fig. (3) shows the sequence of eruption of primary teeth in boys as follow; lower central incisor, upper central incisor, upper lateral incisor, lower lateral incisor, upper first molar, lower first molar, upper canine, lower canine, lower second molar and upper second molar.

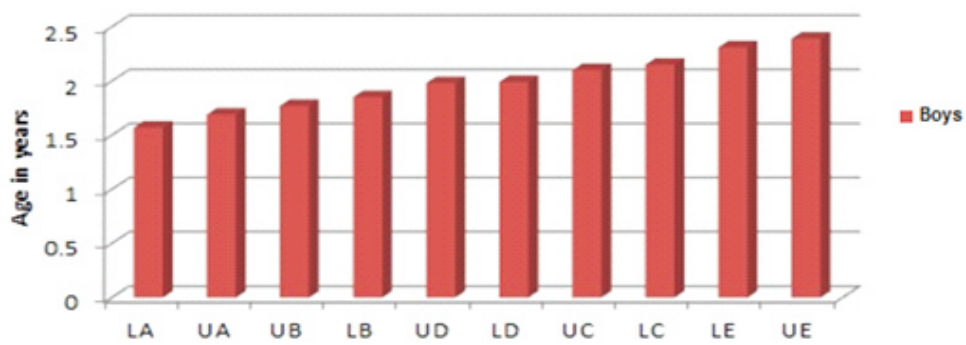

Fig. 3:Sequence of eruption of primary teeth in boys (L: lower, U: upper).

Sequence of eruption of primary teeth in girls:

Fig. (4) show the sequence of eruption of primary teeth in girls as follow; lower central incisor, upper central incisor, upper lateral incisor, upper first molar, lower lateral incisor, lower first molar, upper canine, lower canine, lower second molar and upper second molar.

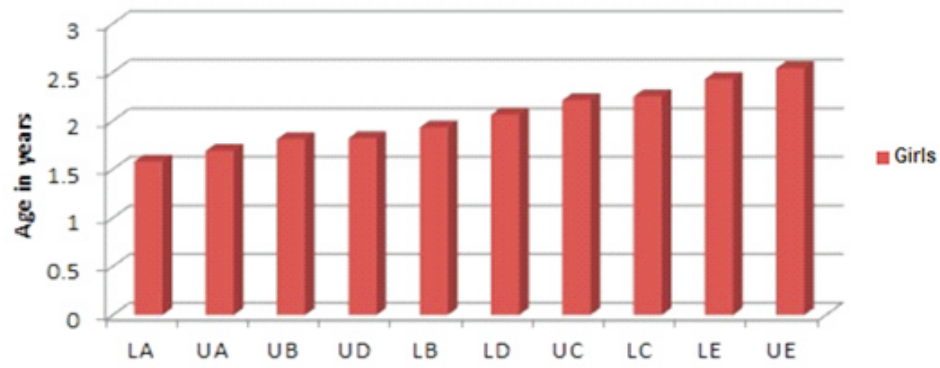

Fig. 4:Sequence of eruption of primary teeth in girls (L: lower, U: upper).

Correlation between chronological and developmental age:

1.Permanent Teeth:

Correlation between developmental age and chronological age was performed using Pearson`s correlation test. It was revealed that there was weak positive correlation for upper central, upper lateral, upper first and second bicuspid. On the contrary, there was weak negative correlation for upper canine, upper first and second molar, while there was strong positive correlation for lower first and second bicuspid in addition to weak positive correlation for lower first molar. On the contrary, there was strong negative correlation for lower central, lower lateral, lower canine and lower second molar, as listed in Table (5).

Table 5: Correlation between developmental and chronological age for upper and lower permanent teeth.

Tooth	Upper Permanent				r	r^2	Percentage
	Developmental age		Chronological age				
	M (Years)	±SD	M	±SD			
1	5.730	1.525	7.5	1.525	0.443*	0.196	19.60
2	6.130	1.325	8.5	1.325	0.053*	0.002	0.20
3	10.135	0.970	11.5	0.970	-0.033**	0.001	0.10
4	8.050	1.060	10.5	1.060	0.013*	0.00016	0.016
5	8.125	0.935	11.0	0.935	0.175*	0.03	3.00
6	5.425	1.710	6.5	1.710	-0.244**	0.059	5.90
7	9.720	0.705	12.5	0.705	-0.008**	0.000064	0.0064
Lower Permanent							
1	5.425	1.675	6.5	1.675	-0.47****	0.2209	22.09
2	5.805	1.495	7.5	1.495	-0.535****	0.286	28.60
3	7.050	0.910	9.5	0.910	-0.845****	0.714	71.40
4	8.210	0.960	11.0	0.960	0.512***	0.262	26.20
5	8.630	0.870	11.5	0.870	0.733***	0.537	53.70
6	5.175	1.745	6.5	1.745	0.015*	0.000225	0.0225
7	9.540	0.890	12.0	0.890	-0.764****	0.538	53.80

M: Mean; SD: Standard deviation; r: Pearson`s Correlation Coefficient, r 2: Coefficient of Determination.
*weak positive correlation; **weak negative correlation; ***strong positive correlation; ****strong negative correlation

2.Primary Teeth:

Correlation between developmental age and chronological age was performed using Pearson`s correlation test. It was revealed that there was weak positive correlation for upper canine. On the contrary, there was weak negative correlation for upper central, upper lateral and upper first and second molar. While there was strong positive correlation for lower central and lower second molar. On the contrary, there was strong negative correlation for lower lateral in addition to weak negative correlation for lower canine and lower first molar, as listed in Table (6).

Table 6: Correlation between developmental and chronological age for upper and lower primary teeth.

Tooth	Upper Primary				r	r^2	Percentage
	Developmental age		Chronological age				
	M(Months)	±SD	M	±SD			
A	6.65	0.680	7.5	0.680	-0.241**	0.058	5.80
B	9.00	0.665	9.0	0.665	-0.112**	0.0125	1.25
C	9.47	0.590	18.0	0.590	0.318*	0.101	10.10
D	9.77	0.610	14.0	0.610	-0.278**	0.077	7.70
E	21.30	0.460	24.0	0.460	-0.24**	0.0576	5.76
Lower Primary							
A	4.90	0.710	6.0	0.710	0.646***	0.417	41.70
B	9.00	0.660	7.0	0.660	-0.539****	0.2905	29.05
C	11.8	0.580	16.0	0.580	-0.028**	0.000784	0.0784
D	9.40	0.605	12.0	0.605	-0.241****	0.058	5.80
E	14.78	0.440	20.0	0.440	0.595***	0.0205	2.05

M: Mean; SD: Standard deviation; r: Pearson`s Correlation Coefficient, r 2: Coefficient of Determination
*weak positive correlation; **weak negative correlation; ***strong positive correlation; ****strong negative correlation.

DISCUSSION

Adequate knowledge of the timing of tooth emergence is of considerable importance in diagnostic, preventive and therapeutic measures also in child dental health planning e.g. extraction of deciduous tooth and to ascertain when to initiate orthodontic treatment (Wedlet al., 2005).In this study it was found that the first primary tooth to erupt was the lower central incisor and its mean age of eruption was 5.4 months in boys and 4.4 months in girls. This result goes with El-Batranet al. (2002),Solimanet al.(2009) and Raoet al.(2014) who found that the lower central incisor was the first primary tooth erupted in the oral cavity. While the first permanent tooth to erupt was the lower first molar and its mean age of eruption was 5.52 years in boys and 5.33 years in girls.This result goes with

Singh(2005), Shaweesh(2012) and Dahiyaet al. (2013). On the contrary Helm and Seidler(1974) found that the first molar in each jaw and the mandibular central incisor showed similar emergence time. While Almonaitieneet al. (2012) found that the earliest permanent teeth to emerge just before the 5 years of age were lower central incisor for girls and mandibular first molar for boys.The variations in eruption among different countries and populations may be due to difference in geographic location, nutrition and environmental factors, which may cause difference in the development of permanent dentition (Almonaitieneet al., 2010).

The results of eruption of primary teeth showed no statistical significant difference between mean ages of eruption of primary teeth for boys and girls except for lower lateral, upper and lower primary canines and second molar which there were statistical significant differences where boys preceded girls, these findings coincide with Solimanet al.(2009) and Gunashekhar and Tenny(2010).These findings might be due to accelerated growth in boys during the first trimester of pregnancy; this finding was supported by Oziegbeet al.(2008).The results of eruption of permanent teeth showed no statistical significant difference between mean ages of eruption of permanent teeth for boys and girls except for upper and lower lateral incisor, lower canine, lower first premolar, upper first molar and lower second molar at which there were statistical significant differences where girls preceded boys. The same results were observed by Greer and Loo (2003).This earlier eruption was explained to be a sign of earlier maturation of girls when compared to boys; this is coinciding with the study done by Abou El-Yazeed et al. (2008).

The results of this study showed that the sequence of eruption of primary incisors in boys start with the eruption of lower central incisor, upper central incisor, upper lateral incisor and lower lateral incisors. These results were quite similar to the study done by El-Batranet al.(2002), Solimanet al.(2009) and Baralet al.(2014).Regarding the primary canines and molars, their sequence of eruption in males started by upper first molar followed by lower first molar, followed by upper canine then lower canine and finally lower second molar followed by upper second molar. This finding goes with the study done by Singh(2005).While in girls, the sequence of primary teeth started with lower central incisor, upper central incisor, upper lateral incisor, and upper first molar. These results were quite similar to the study done by El-Batranet al.(2002) and Solimanet al.(2009), followed by lower lateral incisor, lower first molar, upper canine, lower canine, lower second molar followed by upper second molar.The sequence of eruption of permanent teeth in boys started with lower first molar, upper first molar, lower central incisor, upper central incisors, lower lateral incisors and upper lateral incisor. These results go with Singh(2005) andShaweesh(2012).Regarding the eruption of the canines, premolars and second permanent molar, their sequence of eruption started by upper first premolar, lower second premolar, lower first premolar, upper second premolar, lower second molar, lower canine, upper canine and upper second molar these findings coincide with the findings of Wedlet al.(2004) and Shaweesh (2012).While in girls, the sequence of permanent teeth started with upper first molar, lower first molar, lower central incisor, upper central incisor, lower lateral incisor, upper lateral incisor, lower canine, lower first premolar, upper second premolar, lower second premolar, upper first premolar, lower second molar, upper second molar and upper canine.

Correlation between developmental and chronological age of primary teeth relying on McDonald et al.(2011)standards of eruption that showed a strong positive correlation for primary lower central incisor and second molar with percentage 41.7% and 2.05% respectively, which indicates that developmental and chronological ages coincide with each other's. Upper canine showed weak

positive correlation with percentage 10.1% indicating a slight approximation between developmental and chronological ages. Upper central incisor, lateral incisor, first molar, second molar and lower canine showed weak negative correlation between developmental and chronological ages with percentage 5.8%, 1.25%, 7.7% and 5.76% respectively. While lower lateral incisor and first molar showed strong negative correlation between developmental and chronological ages in some children with percentage of 29.05% and 5.8% respectively. These findings may be due to hereditary and growth factors. Correlation between developmental and chronological age of permanent teeth relying on McDonald et al., (2011) standards of eruption showed a strong positive correlation for permanent lower first and second premolar with percentage 26.2% and 53.7% respectively, which indicates that developmental and chronological ages coincide with each other's. Upper central incisor, lateral incisor, first premolar, second premolar and lower first molar showed weak positive correlation in some children with percentage 19.6%, 0.2%, 0.016%, 3% and 0.0225% indicating a slight approximation between developmental and chronological ages. Upper canine, first molar and second molar showed weak negative correlation between developmental and chronological ages with percentage 0.1%, 5.9% and 0.0064% respectively. While lower central incisor, lateral incisor, canine and second molar showed strong negative correlation between developmental and chronological ages in some children with percentage 22.09%, 28.6%, 71.4% and 53.8% respectively.These findings may be due to early extraction of primary teeth which enhance eruption of permanent teeth, inadequate diet and hereditary factors which may play a great role in eruption.

CONCLUSIONS:

- Sequence and dates of eruption of primary and permanent teeth are different in Egyptian children than that of other countries.
- Boys preceded girls in primary teeth eruption in certain teeth; lower lateral incisor, upper and lower canines and second molar. While girls preceded boys in permanent teeth eruption in certain teeth; upper and lower lateral incisor, lower canine, lower first premolar, upper first molar and lower second molar.
- Chronological age and developmental age are not usually coincident with each other's as it is evident in some children who denoted that important individual factors play a role in teeth eruption as hereditary factors and nutrition status of children.

RECOMMENDATIONS:

- A longitudinal study should be done to expand the research in sequence and dates of eruption of primary and permanent teeth on all Egyptian governorates to develop baseline data for all Egyptian children.
- Researchers and clinicians should rely on Egyptian data when taking decisions during diagnosis and treatment plan strategies.

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