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The Impact of Facial Index on the Time of Permanent Teeth Eruption

Hasam Fawzi Mnajid*, Alhan Ahmed Qasim

Department of Pedodontic and Preventive Dentistry, University of Baghdad, College of Dentistry, Iraq

ABSTRACT

Background: Facial Index (FI) is the ratio of morphological Facial Height (FH) and maximum Facial Width (FW) and can be calculated according to the formula: FI=FH/FW × 100. The values of Facial Index (FI) were used to determine the incidence of certain facial types according to Martin-Saller's scale.

Aim of the study: This study was conducted to determine the impact of facial index on the timing of permanent teeth eruption among children.

Materials and methods: The study population which was studied in the department of college of dentistry university of Baghdad reached (445) children.

An electronic vernia will be used for messing the facial height from nasion to gnathion and then spreading caliper will be used for measuring facial width between the most lateral points of zygomatic arch on both sides. The dental examination will be conducted using disposables mirrors and probe with adequate light to determine the erupted permanent teeth.

Results: The sample size 445 child 198 of them were boys and 247 were girls the time of permanent tooth eruption were normal for 152 children, delayed for 233 children and early for 60 child. The face types according to facial index were hyperereuryprospic 147 children, euryprospic 162, mesoprosopic 106, leptoprospoic 30, hyperleptoprosoipc 0. There were a relation between different face types and time of permanents teeth eruption.

Conclusion: Broad face shapes have a normal or accelerated teeth eruption more than narrow face shape.

Key words: Teeth eruption, Permanent teeth, Anthropometry, Facial morphology, Facial index

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Corresponding author: Dr. Hasam Fawzi Mnajid
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INTRODUCTION

Tooth eruption is defined as the movement of the tooth from its site of development in the alveolar bone to the occlusal plane in the oral cavity [1]. There are five stages to the tooth eruption process, which is complex and strictly regulated. Pre-eruptive movement, intra osseous stage and mucosal pentration, preocclusal and postocclusal stage [2]. The timing of tooth eruption is influenced by various factors: Physiological factors (hereditary, constitution, geographical factors, sex and race) pathological systemic factors (various diseases *i.e.* endocrine disease, cerebral palsy, severs in toxification, sever renal diseases, genetic disorders) pathological local factors (local eruption obstacles, hypodontia, lack of space) [3-6]. Craniofacial anthropometry is an important part of anthropology and medicine is used for determination of the morphological characteristics of the head and face. Face shape depend on many factors, such as gender, race and ethnicity, climate, socio economic, nutritional and genetic factors [7]. Determination of facial parameters using facial index which has been used to describe the various facial types in anthropometry. It is the ratio of the morphological facial height to the bi-zygomatic width (facial breadth) multiplied by 100 [8]. According to Martin-sallers scale, facial phenotypes are classified into: Hyperleptoprosopic, leptoprosopic, mesoprosopic, euryprosopic and hypereuryprosopic [9]. There were many factors affecting the time of permanent teeth eruption and face shape may be one of them for that reason this study is was conducted.

MATERIALS AND METHODS

This study was authorized by the scientific committee at the department of pediatric and prevention Dentistry College of dentistry university of Baghdad as well as the central ethical committee in the same college before beginning in this *vivo* study.

Sample: Using G power 3.1.9.7 (program written by Franz-Faul, Universitatit Kiel, Germany) with power of study=90%, alpha error of probability=0.05, effect size of F calculated is 0.20 (low), with 4 groups (facial index), with all these condition the sample size is 360 subjects,

adding 10% as an error rate thus sample size is 396 subjects thus 445 subjects is enough and more calculated than G power. Gathered randomly from department of preventive dentistry in college of dentistry/university of Baghdad [10-14]. Effect size F are: Small=0.1, medium=0.25, large=0.4.

Dental examination: The children attendants were informed about the study design, its benefits and privacy of the data collected. Consent form was given to each children attendant and consent was taken.

A child included in the examination if he regarded as Iraqi as determined by the race of his parents, any child with systemic diseases was excluded. Children were examined in the college clinics, they were seated in a dental chair with the use of adequate light in the examination while the examiner standing in front of the chair according to (WHO,1997) and the records were written in the case sheet.

Accurate birthday was available from the children attendant and sometimes births supported by birth certificates.

If the exact date of child's birth was not available or he has any orthodontic appliance, the child not included in the examination.

The criteria used:

- Only emerged permanent teeth were recorded. A tooth was defined as emerged when any part of its crown pierced the gingiva, the probe was used to be sure from crown emergence when any suspension exist [15].
- Any extracted permanent teeth were recorded as erupted [16].

Since no radio-graphical examination was made, any congenital missing tooth was recorded as non-emerged [17].

Measurement of facial height

The measurement of facial height was done by using spreading caliper and electronic vernia for double check. Children were asked to sit in a relaxed state, straight and looking forward. Face length was measured from nasion to gnathion.

Nasion: The intersection of the nasofrontal suture with the midsagittal plane. Nasion is the uppermost landmark for the measure of facial height.

Measurement of facial width

The measurement of facial width was done by using spreading caliper. Children were asked to sit in a relaxed state, straight and looking forward. Then face width was measured as bizygomatic breadth.

Bizygomatic breadth: Farthest points on zygomatic arches.

Classification of facial index

The facial index is the ratio of the maximum length of the face to its maximum width and multiplied by 100 for convenience.

After measuring facial height and facial width the following equation were used for calculating facial index

$$\text{Prosopic index (Facial index)} = \frac{\text{Face length}}{\text{Face width}} \times 100$$

Based on the facial index (%), the facial types were classified into the following according to Martin-Saller's scale [18].

- **Hyperleptoprosopic (very long face):** Facial index above 93.0%.
- **Leptoprosopic (long face):** Facial index between 88 and 92.9%.
- **Mesoprosopic (round face):** Facial index between 84 and 87.9%.
- **Euryprosopic (broad face):** Facial index between 79 and 83.9%.
- **Hypereuryprosopic (very broad face):** Facial index below 78.9%.

Statistical analysis

Data description, analysis and presentation were performed using Statistical Package for Social Science (SPSS version 22, Chicago, Illionis, USA), both descriptive analysis (frequency, percentage and charts) and inferential analysis (pearson correlation, levene test and One Way Analysis of Variance (ANOVA)) were used in this study.

Level of significance as: Not significant $P>0.05$, significant $P<0.05$.

RESULTS

The distribution of the sample according to gender for a sample size of (445), as it was found that the number of males is (198) and at a rate of (44.49%), while the number of females is (247) and at a rate of (55.51%) and distributed between ages (6-13) years, which is the age that includes the appearance of permanent teeth in children, where there from 6-9 years (159) at ratio of (35.73%), while for 10-13 years (286) at ratio of (64.27%).

Distribution of subjects by face shape

Through the study sample, the studyfound that there were (137) children with a face shape (hypereury prosopic) with a percentage of (33.03%), while the most significant percentage of those who had a face shape (EuryProsopic) and a number (162), *i.e.* a percentage

(36.4%), while those who had MesoProsopic were (106) and a percentage of (23.82%), while those who had (lepto prosopic) had several (30), or a percentage of (6.74%), while they were in the form of (hyperleptoprosopic) were the less significant with ratio of (0.0%).

Normal teeth eruption among age and facial index

The mean value of normal teeth eruption for both age groups with different face type showed in Table 1. Euryprosopic face type shows the highest percent of normal tooth eruption for upper and lower teeth in both age groups except for lower teeth from 6-9 years the highest percent were mesoprosopic face type. While the least percent of normal eruption of permanent teeth for upper and lower jaws in both age groups was leptoprosopic, the statistical difference among different groups was significant. Except for lower jaw from 6-9 years age group.

Table 1: Descriptive and statistical test of teeth eruption in normal among age and facial index.

Vars.	Age	Facial index C								F	P value
		Hypereuro		Eury		Meso		Lepto			
		Mean	SE	Mean	SE	Mean	SE	Mean	SE		
Upper normal	6-9 years	4	0.23	4.966	0.198	4.813	0.252	4.8	0.381	3.832	0.011
	10-13 years	9.204	0.329	10.327	0.263	9.838	0.401	7.8	0.952	3.539	0.015
	Total	7.469	0.308	8.407	0.273	8.321	0.367	5.8	0.476	5.707	0.001
Lower normal	6-9 years	5.245	0.213	5.69	0.16	5.938	0.254	5.1	0.307	2.568	0.056
	10-13 years	9.561	0.319	10.846	0.288	10.135	0.376	7.6	0.884	5.206	0.002
	Total	8.122	0.28	9	0.274	8.868	0.331	5.933	0.412	8.007	0
T normal	6-9 years	9.245	0.41	10.655	0.321	10.75	0.469	9.9	0.64	3.152	0.027
	10-13 years	18.765	0.635	21.173	0.537	19.973	0.771	15.4	1.833	4.47	0.004
	Total	15.592	0.579	17.407	0.538	17.189	0.692	11.733	0.871	6.944	0

Table 2 showed the significant relation between hypereuryprosopic and euryprosopic in upper and lower normal teeth eruption for both age groups except for lower jaw from 6-9 years age group. And also show significant relation between euryprosopic and leptoprosopic face type in lower jaw age group 10-13 years.

Table 2: Multiple pairwise comparisons of teeth eruption in normal among facial index by age using Hochberg GT2.

Dependent variable	Age	(I) Facial index C	(J) Facial index C	MD	P value
Upper normal	6-9 years	Hypereuro	Eury	-0.966	0.00957
			Meso	-0.813	0.12601
			Lepto	-0.8	0.27856
		Eury	Meso	0.153	0.99822
			Lepto	0.166	0.9989
		Meso	Lepto	0.013	1
	10-13 years	Hypereuro	Eury	-1.123	0.04102
			Meso	-0.634	0.70673
			Lepto	1.404	0.68022
		Eury	Meso	0.489	0.88189
			Lepto	2.527	0.08382
		Meso	Lepto	2.038	0.27438
Lower normal	10-13 years	Hypereuro	Eury	-1.285	0.02009
			Meso	-0.574	0.78708

			Lepto	1.961	0.29429
		Eury	Meso	0.711	0.56747
			Lepto	3.246	0.00993
		Meso	Lepto	2.535	0.08884
Total normal	6-9 years	Hypereuro	Eury	-1.41	0.04317
			Meso	-1.505	0.08298
			Lepto	-0.655	0.92785
		Eury	Meso	-0.095	1
			Lepto	0.755	0.85551
		Meso	Lepto	0.85	0.84153
	10-13 years	Hypereuro	Eury	-2.408	0.03126
			Meso	-1.208	0.73277
			Lepto	3.365	0.45522
		Eury	Meso	1.2	0.72714
			Lepto	5.773	0.0265
		Meso	Lepto	4.573	0.14823

Delayed teeth eruption among different facial types by age

The mean value of delayed teeth eruption for both age groups with different face type showed in Table 3. Hypereuryprosopic shows the highest percent of delayed permanent teeth eruption in upper jaw for both age group while leptoprosopic shows the highest percent of delayed eruption in lower jaw for both age group. For total delayed teeth in upper and lower jaw shows the highest percent for hypereuryprosopic and the least percent of delayed tooth eruption were euryprospoic face type. The statistical difference among different groups was significant. Except for lower jaw from 6-9 years age group and upper jaw from 10-13 years age group.

Table 3: Descriptive and statistical test of teeth eruption in delay among facial index by age.

Vars.	Age	Facial index								F	P value
		Hyper euro		Eury		Meso		Lepto			
		Mean	SE	Mean	SE	Mean	SE	Mean	SE		
Upper delay	6-9 years	0.694	0.131	0.138	0.052	0.438	0.148	0.3	0.147	5.496	0.001
	10-13 years	1.163	0.153	0.731	0.105	0.838	0.149	0.4	0.267	2.53	0.057
	Total	1.007	0.112	0.519	0.073	0.717	0.114	0.333	0.13	5.972	0.001
Lower delay	6-9 years	0.367	0.104	0.259	0.112	0.25	0.1	0.4	0.184	0.342	0.795
	10-13 years	1.776	0.123	0.923	0.107	1.541	0.142	2.2	0.359	11.002	0
	Total	1.306	0.104	0.685	0.083	1.151	0.118	1	0.23	7.645	0
T delay	6-9 years	1.061	0.185	0.397	0.145	0.688	0.203	0.7	0.206	2.919	0.036
	10-13 years	2.939	0.256	1.654	0.193	2.378	0.251	2.6	0.6	5.708	0.001
	Total	2.313	0.195	1.204	0.142	1.868	0.2	1.333	0.289	8.004	0

Table 4 showed significant relation between hypereuryprosopic and euryprosopic in upper and lower delayed teeth eruption for both age group except for upper jaw from 10-13 years and lower jaw from 6-9 years also significant relation were found in lower jaw from 10-13 years age group between europrosopic with mesoprosopic and leptoprosopic face type.

Table 4: Multiple comparisons of teeth eruption in delay among facial index by age using Games-Howell.

Dependent variable	Age c	(I) Facial index C	(J) Facial index C	MD	P value
Upper delay	6-9 years	Hypereuro	Eury	0.556	0.0012
			Meso	0.256	0.56955
			Lepto	0.394	0.20175
		Eury	Meso	-0.3	0.24297
			Lepto	-0.162	0.72787
		Meso	Eury	0.3	0.24297
			Lepto	0.138	0.91211
Lower delay	10-13 years	Hypereuro	Eury	0.852	0
			Meso	0.235	0.59356
			Lepto	-0.424	0.68592
		Eury	Meso	-0.617	0.0037
			Lepto	-1.277	0.0266
		Meso	Lepto	-0.659	0.3612
T delay	6-9 years	Hypereuro	Eury	0.665	0.0292
			Meso	0.374	0.52862
			Lepto	0.361	0.56618
		Eury	Meso	-0.291	0.65079
			Lepto	-0.303	0.62946
		Meso	Lepto	-0.013	0.99997
	10-13 years	Hypereuro	Eury	1.285	0.0005
			Meso	0.56	0.4035
			Lepto	0.339	0.9529
		Eury	Meso	-0.725	0.10558
			Lepto	-0.946	0.46898
		Meso	Lepto	-0.222	0.98574

Early teeth eruption among different facial types by age

The mean value of accelerated teeth eruption for both age groups with different face type showed in Table 5. Euryprosopic face type shows the highest percent of accelerated teeth eruption in upper and lower jaw for both age groups while the least percent of accelerated teeth eruption were hypereuryprosopic face type. The statistical difference among different groups was significant. Except for lower jaw from 6-9 years age group and upper jaw from 10-13 years age group.

Table 5: Descriptive and statistical test of teeth eruption in early among age and facial index.

Vars.	Age	Facial index								F	P value
		Hyper euro		Eury		Meso		Lepto			
		Mean	SE	Mean	SE	Mean	SE	Mean	SE		
Upper early	6-9 years	0	0	0.379	0.112	0	0	0.2	0.138	5.175	0.002
	10-13 years	0.143	0.052	0.308	0.071	0.243	0.077	0	0	1.6	0.19
	Total	0.095	0.035	0.333	0.061	0.17	0.054	0.133	0.093	4.256	0.006
Lower early	6-9 years	0.082	0.057	0.138	0.067	0	0	0	0	1.2	0.312
	10-13 years	0	0	0.269	0.067	0	0	0	0	9.305	0
	Total	0.027	0.019	0.222	0.05	0	0	0	0	9.229	0
T early	6-9 years	0.082	0.057	0.517	0.165	0	0	0.2	0.138	3.708	0.013

10-13 years	0.143	0.052	0.577	0.089	0.243	0.077	0	0	7.493	0
Total	0.122	0.04	0.556	0.082	0.17	0.054	0.133	0.093	10.467	0

Table 6 showed significant relation in age group 6-9 years between euryprosopic and mesoprosopic face type while in age group from 10-13 years show significant relation between all different groups except between hypereuryprosopic and mesoprosopic.

Table 6: Multiple pairwise comparison of Total early teeth eruption among facial index. Using Games-Howell.

Age	Groups		MD	P value
6-9 years	Hypereuro	Eury	-0.436	0.07043
		Meso	0.082	0.48777
		Lepto	-0.118	0.85638
	Eury	Meso	0.517	0.0144
		Lepto	0.317	0.45869
	Meso	Lepto	-0.2	0.4837
10-13 years	Hypereuro	Eury	-0.434	0.0003
		Meso	-0.1	0.70038
		Lepto	0.143	0.037
	Eury	Meso	0.334	0.0259
		Lepto	0.577	0
	Meso	Lepto	0.243	0.0114

DISCUSSION

Dental eruption has particularities depending on: Population group, gender, dental arch and also facial type.

The relation between the facial forms and the dental arch forms had been studied by different authors. Tsunori et al. [19] found that the long face pattern included a narrow dental arch, while the short face pattern had wide arch. Graber [20] found that leptoprosopic individuals have narrow dental arches, while euryprosopic individuals have broad, round dental arches. Mesoprosopic individuals fit somewhere in between these two.

Studies have shown that there is a wide range in the facial morphological typology, with the ethnic Hungarian population in vojvodina (Serbia) having a mesoprosopic facial type predominating [21], the leptoprosopic facial type predominating in the central region of Serbia [22], the Kosovo Albanian population having a hyper leptoprosopic facial type predominating [23], The majority of the Croatian population has a mesoprosopic face type [24].

This Iraqi study found the most prominent face shape (EuryProsopic) (162) child in a percentage (36.4%) while the least prominent face shape was (leptoProsopic) (30) child in a percentage of (6.74%) this variation in face shape between these studies may be related to racial/ethnic variation.

Kjaer in 2014 suggested that the mechanism of eruption depends on the eruption course created by crown follicle, hypothesis behind this theory depend on many factors. Space in the eruption path were the most important factor.

In this study there were (233) child with delayed teeth eruption which represent the highest percent followed by normal eruption of teeth in (152) child and the least percent were the early eruption of permanent teeth in (60) child.

From the result of this study the normal eruption of permanent teeth were highest in children with euryprospic face shape with a significant statistical relation. The least percent of normal eruption of teeth were in children with leptoprosoic face type. This may be due to the space available in dental arch recent studies Graber [25] found that leptoprosopic individuals have narrow dental arches, while euryprosopic individuals have broad, round dental arches. Mesoprosopic individuals fit somewhere in between these two. That's lead us to explanation that children with euryprosopic face type which have broad, round dental arch have enough space for teeth eruption. While leptprosopic face type which have narrow dental arch that limit the space available for normal eruption of permanent teeth.

CONCLUSION

The children in Baghdad have a dominant euryprospoic facial type. Children with euryprosopic face shape (broad

face) have normal and accelerated teeth eruption more than leptoprosopic face type (narrow face).

In order to ensure the balanced development of the dental occlusion, mandible and faces as whole, preventative and interceptive orthodontic therapies that use the facial type can be helpful.

To identify the dynamics of tooth eruption in connection to facial characteristics, more research must be done on bigger population samples. The gathered information is crucial for the analysis of intra- and inter-population differences, which are relevant to anthropology, forensic medicine and therapeutic practice.

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