Epidemiologic panorama of dental occlusion

By Nagwa Helmy El-Mangoury, BDS, MS, PhD and Yehya A. Mostafa, BDS, MS, PhD

Two centuries ago, the famous English poet William Cowper stated "Variety's the very spice of life, that gives it all its flavour." To paraphrase Cowper, occlusal variation is the real spice of the orthodontic specialty which gives it all its flavor. Many studies[1-20] have been conducted in different parts of the world in order to determine the variation in occlusion. However, a careful review of the literature reveals the absence of a coherent body of knowledge regarding the sex difference in occlusion as well as a valid comparison of the occlusal variation among different world populations.

The purpose of the present research study is three-dimensional: 1. Explore the possible significant relationships of the female-male difference in occlusion. This may offer a reliable and valid research tool for investigating the etiology of malocclusion. 2. Present an epidemiologic panorama of dental occlusion among different ethnic world populations. 3. Provide information about the occlusal variation among Egyptians. This may be used as a basis for preventive as well as interceptive orthodontics.

A research hypothesis was formulated. This hypothesis states that the occlusal variation frequencies are not the same for females and males. In other words, occlusal variation is not independent of sex.

Materials and methods

Sample.

The sample consisted of 501 female and male

Abstract

The purpose of this study was to explore the possible significant sex difference in occlusion, provide information about the occlusal variation among Egyptians, and present an epidemiologic panorama of dental occlusion among different ethnic world populations. The hypothesis was that the occlusal variation is not independent of sex.

A sample of 501 female and male adult subjects was studied. Normal occlusion, Angle's classification of malocclusion, and the Dewey-Anderson modifications for typifications were recorded. Chi-square tests were used.

The results obtained from this study indicate that a significant sex difference in occlusion exists for normal occlusion, Angle Class I, and Angle Class III. Further, considering an anterior crossbite as the sole indicator of an Angle Class III malocclusion is erroneous; an anterior crossbite may exist in other classes, and Angle Class III type 1 (edge-to-edge) is more prevalent than either Class III type 2 (normal anterior overbite) or type 3 (anterior crossbite). Although numerically different, occlusal variation follows a universal general distributional pattern for most world populations. Some speculations are presented for clinical implications and for research suggestions.

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Key Words

Occlusion epidemiology • Sex difference in occlusion • Occlusal variation • Panorama of dental occlusion • Preventive orthodontics

Table 1
Occlusal variation by sex crosstabulation.

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Occlusal variation by sex crosstabulation[a]

Sex	Normal occlusion	Class I	Class II	Class III	Class IV[b]	Total
Females	99	98	56	16	1	270
Males	73	69	49	37	3	231
Total	172	167	105	53	4	501

a Chi-square = 17.22 Degrees of freedom = 4 Significance = 0.005
b Angle Class IV means unilateral Class II accompanied with unilateral Class III

Table 2
Chi-square test for each group.

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Chi-square test for each group

Occlusal variation	Chi-square	Degrees of freedom	Significance
Normal occlusion	3.93	1	*
Angle Class I	5.04	1	*
Angle Class II	0.47	1	n.s.
Angle Class III	8.32	1	**
Angle Class IV	1.00	1	n.s.

** = $P < 0.005$
* = $P < 0.05$

subjects randomly selected from the adult caucasoid Egyptian population.

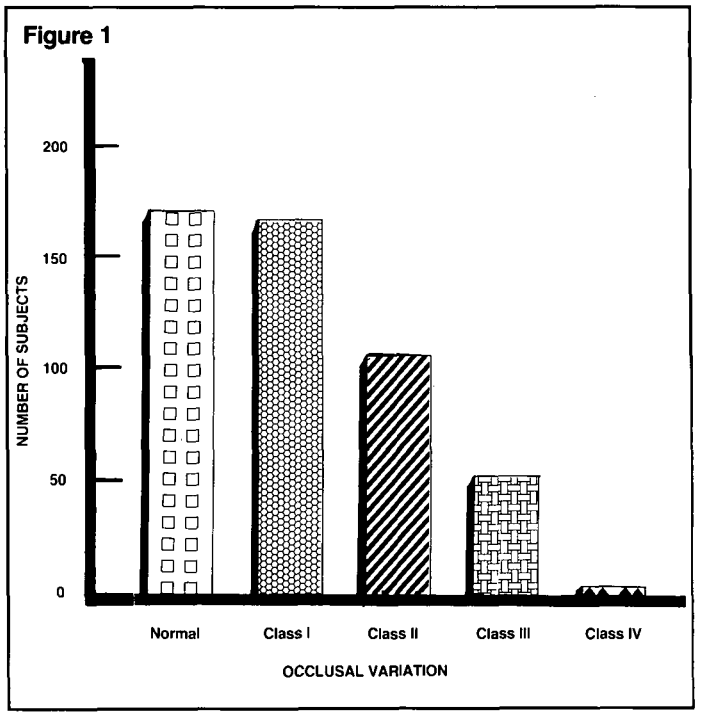
Criteria for selection of subjects.

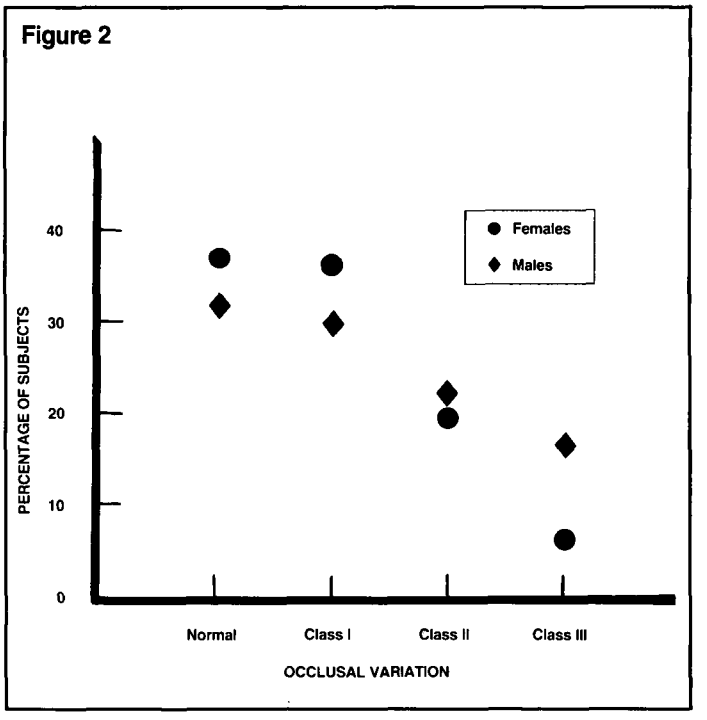
1. Subjects, parents, and grandparents must be caucasoid natives as well as residents of Egypt.
2. Age range 18-24 years.
3. No previous history of orthodontic treatment.
4. Middle socioeconomic status.
5. No serious diseases which could affect craniofacial growth and development.
6. No history of skull fractures.
7. No facial operations.

The materials consisted of head spot-light, dental mirrors, dental probes, and the Angle-Dewey-Anderson[21-23] classification of malocclusion data sheets.

The occlusal status was independently recorded, for each subject, by two orthodontists through clinical examination. Any discrepancy in the records was resolved by discussion. If no resolution occurred, the subject was disqualified. The occlusal status was recorded, in centric occlusion,[24] as either normal occlusion[25] or malocclusion. The malocclusion was classified according to the Angle's classification of malocclusion[21] and the Dewey-Anderson modifications[22,23] for typifications.

A crosstabulation[26] of occlusal variation by sex was done. (A crosstabulation is a joint frequency distribution of the cases according to two or more classificatory variables.) These joint frequency distributions were statistically analyzed using the chi-square test.[26] The statistical





assumption, for this test, was that the variables, in the table, are measured at the nominal scale. The significance level used was 0.05 or less.

Results

The summary of the results is presented in Figures 1 and 2 as well as Tables 1, 2, 3, 5 and 6.

Discussion

The present research study was undertaken for exploring the possible significant sex difference in occlusion, providing information about the occlusal variation among Egyptians, and comparing this information with other world populations.

The age of the subjects in the sample studied ranged from 18-24 years. This age range was a criterion for two main reasons: first, reliable assessment of the occlusion must be made on the permanent dentition only as individual variation in dental patterns at the mixed dentition stage may modify the occlusion;[25] second, reliable appraisal of the occlusal status must be made after total cessation of craniofacial growth and development.

Table 1 shows that the obtained chi-square[26] is very large (17.22). This indicates large discrepancies between the expected and actual frequencies. Further, the magnitude of the calculated test statistic has an associated probability of 0.005 or less. It is unlikely that the occurrence of this chi-square is due to random sampling alone. Therefore, it can be stated that the occlusal variation frequencies are not the same for females and males at a significance level of 0.005.

Table 3
Percentage of occlusal variation

Occlusal variation	Females ($n^a = 270$)	Males (n = 231)	Total sample (n = 501)
Normal occlusion	36.66	31.60	34.33
Angle Class I	36.30	29.87	33.33
Angle Class II	20.74	21.21	20.96
Division 1	15.93	16.45	16.17
Division 2	4.81	4.76	4.79
Angle Class III	5.93	16.02	10.58
Angle Class IV	0.37	1.30	0.80

a "n" refers to the number of subjects

Figure 1
Occlusion bar graph. The occlusal variation among adult Caucasoid Egyptians differs numerically from other studies in different areas of the world. However, the general pattern of occlusal variation among Egyptians does not differ from other patterns.

Figure 2
Sex difference in occlusion. It was found that the occlusal variation frequencies are not the same for females and males. Specifically, occlusal variation is not independent of sex for normal occlusion as well as Angle Class I and Angle Class III malocclusion. Note that Angle Class III malocclusion is about three times higher in the males (16 percent) than the females (5.9 percent).

Table 3
Percentage of occlusal variation.

Figure 3

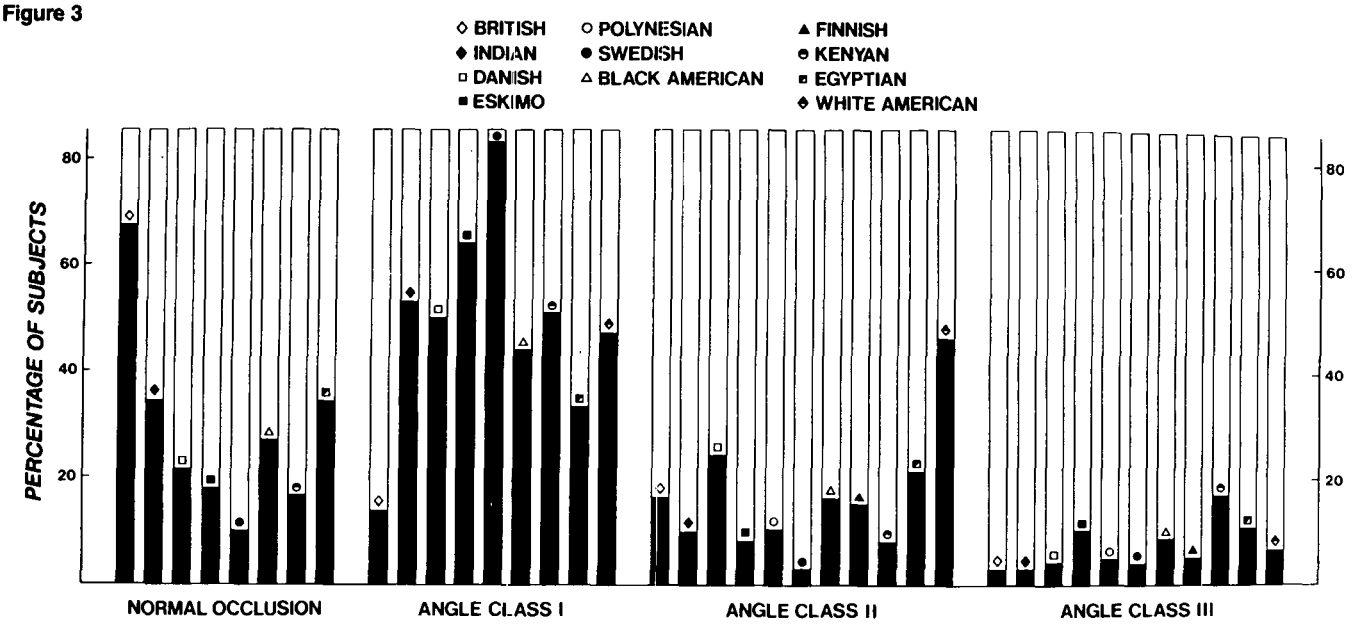


Table 4
Occlusal variation among different ethnic groups

Authors	Nationality	Sample Size	Age	% Prevalences Malocclusion	Class I	Class II	Class III
Baume[10]	Polynesian	19,854	3-60	a	a	10.0	5.5
El-Mangoury & Mostafa[b]	Egyptian	501	18-24	65.7[c]	33.3	21.0	10.6
Garner & Butt[17]	Black American	445	13-15	73.0[c]	44.0	16.0	8.7
Garner & Butt[17]	Kikuyu Kenyan	505	13-14	83.2[c]	51.7	7.9	16.8
Goose et al.[1]	British	2,956	7-15	32.7	13.7	16.1	2.9
Grewe et al.[4]	Indian	651	9-14	65.5	53.0	9.6	2.9
Helm[5]	Danish	3,842	6-18	78.5	49.7	24.5	4.3
Horowitz[7]	American	718	10-12	93.2	65.2	22.5	5.5
Ingervall[11]	Swedish	301[d]	18[e]	90.0	83.0	3.0	4.0
Laine & Hausen[16]	Finnish	451	17-51	a	a	15.0	5.0
Salzmann[13]	American	7,514	12-17	100.00[f]	54.0	32.0	14.0
Siriwat & Jarabak[20]	American	500	8-12	100.00[f]	47.2	46.4	6.4
Solow & Helm[6]	Danish	275	g	72.8	37.4	34.0	1.4
Sputh[15]	American	455	14[e]	84.5	39.3	36.5	8.7
Wood[8]	Eskimo	100	11-20	82.0	64.0	8.0	10.0

a No figures reported
b The present article
c Malocclusion prevalence including Angle Class IV
d Male sample only
e Only mean age reported (age range not reported)
f Malocclusion sample only
g Children but age range not reported

Table 5
Percentage of types of Angle Class I

Dewey-Anderson modifications[22,23] for typifications of Angle Class I	Females (n = 270)	Males (n = 231)	Total sample (n = 501)
Type 1 (crowded maxillary anterior teeth)	14.81	9.96	12.57
Type 2 (maxillary incisors in labioversion)	8.52	3.03	5.99
Type 3 (maxillary incisors in linguoversion)	1.11	1.30	1.20
Type 4 (molars or premolars in bucco- or linguoversion)	1.85	2.60	2.20
Type 5 (mesioversion of the molars only)	2.96	3.46	3.19
Type 6[a] (diastemata)	4.81	5.63	5.19
Type 7[a] (deep anterior overbite)	2.22	3.90	2.99

a Types 6 and 7 were added by the present authors to the original Dewey-Anderson modifications[22,23] for typifications of Angle Class I

In other words, occlusal variation is not independent of sex.

The chi-square test informs us whether the variables are related or independent. However, it does not indicate the strength of the relationship because the sample size and table size influence it. For this reason, a chi-square test was performed for each group (Table 2).

Table 2 suggests that occlusal variation is not independent of sex for Angle Class III at a significance level of 0.005. In addition, the occlusal variation is not independent of sex for both normal occlusion and Angle Class I at a significance level of 0.05. However, the occlusal variation is independent of sex for Angle Class II and IV only. (Angle[21] indicated the presence of a fourth class of malocclusion, but did not give it a Roman numeral. Nowadays, this fourth class is called Angle Class IV. Angle Class IV occurs when the subject has a unilateral Class II accompanied with a unilateral Class III. Angle Class IV has no divisions. Because of its nature, it does not have a subdivision.)

Normal occlusion exists in 34.3 percent of the total sample (Figure 1 and Table 3). It is significantly higher in females (36.7 percent) than males (31.6 percent) as evidenced from Tables 2 and 3, and Figure 2. Table 4 and Figure 3 indicate that the incidence of normal occlusion among different ethnic groups occurs in the following ascending order: Americans,[7] Swedish,[11] Americans,[15] Kenyans,[17] Eskimos,[8] Danes,[5] Black Americans,[17] Danes,[6] Egyptians (the present article), Indians,[4] and British.[1]

By examining Tables 2 and 3 as well as Figure 2, one can notice that the prevalence of Class I malocclusion in the females (36.3 percent) is significantly higher than that of the males (29.9 percent). This is in disagreement with the findings of Helm[5] on Danes who reported a higher incidence of Class I among males than females. However, it is in agreement with the findings of Goose et al.[1] on British, Solow and Helm[6] on Danes, Wood[8] on Alaskan Eskimos, and Siriwat and Jarabak[20] on Americans.

Table 5 shows that Angle Class I females tend to have more type 1 (i.e., more crowded maxillary anterior teeth) than males. This is in agreement with the findings of Grewe and colleagues[4] on Chippewa Indians. Further, by looking at Table 5, one can state that the Angle Class I females have more protruded maxillary incisors (i.e., more Class I type 2) than the males. This is the exact opposite of the reported incidence of Grewe et al.[4] For Class I types 3 through 7, no sex difference was observed (Table 5).

Angle Class I malocclusion constituted 33.3 percent of the total sample (Figure 1 and Table 3). According to Table 4 and Figure 3 the prevalence of Angle Class I malocclusion among different ethnic groups tends to occur in the following ascending order: British,[1] Egyptians (the present article), Danes,[6] Americans,[15,17,20] Danes,[5] Kenyans,[17] Indians,[4] Americans,[13] Eskimos,[8] Americans,[7] and Swedish.[11]

The incidence of Angle Class II malocclusion of the total sample was 21 percent in which division 1 constituted 16.2 percent and division 2

Table 5
Percentage of types of Angle Class I.

Figure 3
This panoramic epidemiologic bar graph is based on the dental occlusion data of British,[1] Indians,[4] Danes,[5] Eskimos,[8] Polynesians,[10] Swedish,[11] Black Americans,[17] Finns,[16] Kenyans,[17] Egyptians (the present article), and White Americans.[20] For further description, please return to Table 4.

Table 4
Occlusal variation among different ethnic groups.

Table 6
Percentage of types of Angle Class III.

Table 6
Percentage of types of Angle Class III

Dewey-Anderson modifications[22,23] for typifications of Angle Class III	Females (n = 270)	Males (n = 231)	Total sample (n = 501)
Type 1 (edge-to-edge bite)	3.70	8.23	5.79
Type 2 (normal anterior overbite)	1.11	4.33	2.59
Type 3 (anterior crossbite)	1.11	3.46	2.20

was composed of 4.8 percent (Table 3). Table 4 and Figure 3 indicate that the incidence of Angle Class II malocclusion among different ethnic groups occurs in the following ascending order: Swedish,[11] Kenyans,[17] Eskimos,[8] Indians,[4] Polynesians,[10] Finns,[16] Black Americans,[17] British,[1] Egyptians (the present article), Americans,[7] Danes,[5] Americans,[13] Danes,[6] and Americans.[15,20]

It is evident that the incidence of Angle Class II malocclusion in females (20.7 percent) is similar to that of males (21.2 percent) as evinced from Tables 2 and 3 as well as Figure 2. This is in contradiction to the reported data on British,[1] Indians,[4] Danes,[5] Eskimos,[8] and Americans.[20] However, it is in accordance with the reported data on Danes.[6]

The incidence of Angle Class III malocclusion of the total sample was found to be 10.6 percent (Figure 1 and Table 3). By looking at Table 4 and Figure 3, one may indicate that the prevalence of Angle Class III malocclusion among different ethnic groups tends to occur in the following ascending order: Danes,[6] British,[1] Indians,[4] Swedish,[11] Danes,[5] Finns,[16] Americans,[7] Polynesians,[10] Americans,[15,17,20] Eskimos,[8] Egyptians (the present study), Americans,[13] and Kenyans.[17]

The incidence of Angle Class III malocclusion differs in females and males at a significant level of 0.005 (Tables 2 and 3, and Figure 2). Specifically, Angle Class III is about three times higher in males (16 percent) than females (5.9 percent). This is in disagreement with the work of Goose et al.,[1] Grewe and associates,[4] Helm,[5] and Solow and Helm[6] who reported similar incidences of Class III for both sexes. Further, Wood[8] reported the opposite of our finding: Class III 15 percent for female Eskimos and five percent male Eskimos.

It is important to indicate that Laine and Hausen[18] found a tendency for larger dimensions in males than females, notably in the maxillary alveolar arch width. Further, the same researchers[19] noted a tendency for more maxillary posterior spacing in males than females. However, they indicated the existence of more mandibular anterior spacing in females than males. It is the observation of the present authors that the Egyptian females have certain facial characteristics which differentiate them from Egyptian males. These facial differences might be a predisposing factor for the sex difference in occlusion. This is just a speculation which necessitates further research. This research might offer a valid tool for the investigation of the etiology of malocclusion.

Angle Class III type 1 (i.e., edge-to-edge) is more prevalent than either Angle Class III type 2 (i.e., normal anterior overbite) or Angle Class III type 3 (i.e., anterior crossbite) as obtained from Table 6. This is in accordance with the reported data of Grewe and colleagues[4] on female subjects.

A great number of general dentists fail to detect the Angle Class III malocclusion. This failure of detection may be because some dentists seldom examine the occlusion. Another reason is that other dentists consider an anterior crossbite the sole indicator for Angle Class III. This consideration is erroneous because the anterior crossbite may exist in other classes, and because Angle Class III type 1 (edge-to-edge) is more common than either Angle Class III type 2 (normal anterior overbite) or type 3 (anterior crossbite). Accordingly, the orthodontists must make greater efforts to educate dental colleagues. The Greek philosopher Aristotle has said: "The roots of education are bitter, but the fruit is sweet."

The present researchers strongly recommend early detection of Angle Class III malocclusion as well as early detection of other Angle Classes. Further, they endorse preventive and interceptive orthodontics and dentofacial orthopedics for young persons. The purpose is to avoid, or at least to minimize the occurrence of malocclusion at the adult stage.

It must be clearly stated that the occlusal variation among Egyptians differs numerically from other studies in different areas of the world. These differences may be attributed to genetic background[27] (which is now largely discredited[28-31]), dietary consistency,[28,29,31] diverse

criteria,[32] and subjective interexaminer disparity.

Nevertheless, it must be emphasized that the general pattern of occlusal variation among Egyptians (Table 1 and Figure 1) does not differ from other patterns (Table 4 and Figure 3). In other words, the incidence of Angle Class I malocclusion tends to be more common than Angle Class II. In addition, Angle Class II division 1 occurs more often than Angle Class II division 2. Further, the prevalence of Angle Class II malocclusion is higher than Angle Class III. Furthermore, Angle Class IV occurs the least.

Summary and conclusions

A sample of 501 female and male adult subjects was studied. Normal occlusion,[25] Angle's classification of malocclusion,[21] and the Dewey-Anderson modifications[22,23] for typifications were recorded. The hypothesis was that the occlusal variation frequencies are not the same for females and males. Chi-square tests were used. An epidemiologic panorama of dental occlusion was presented through a comparison of several world populations. Clinical implications were made.

On the basis of the results obtained from this study, the following conclusions were drawn:

1. A significant sex difference in occlusion exists. Specifically, occlusal variation frequencies are significantly different for females and males for normal occlusion, Angle Class I, and Angle Class III. Normal occlusion and Angle Class I are significantly more common in females than males. Further, Angle Class I females tend to have more crowded maxillary incisors (more Class I type 1) and more protruded maxillary incisors (more Class I type 2) than males. However, the incidence of Angle Class III is about three times higher in males than females.

2. Occlusal variation differs numerically among different world populations. These differences could be attributed to a number of factors. However, the occlusal variation follows a universal general distributional pattern for most world populations. Specifically, this pattern is arranged in the following descending order: Angle Class I, Angle Class II division 1, Angle Class II division 2, Angle Class III, and Angle Class IV.

3. It is speculated that the failure of detection of Angle Class III malocclusion, by general dentists, may be because some dentists seldom examine the occlusion, other dentists consider an anterior crossbite the sole indicator for Angle Class III. This consideration is erroneous because the anterior crossbite may exist in other classes, and because Angle Class III type 1 (edge-to-edge) is more common than either Angle Class III type 2 (normal anterior overbite) or type 3 (anterior crossbite).

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