Canine location in different maxillomandibular relationships in Egyptians and Saudis

Safa’a Asal a,c,*, Sharifa A. Al-Shehri b, Hoda M.A. Rashad c

aDepartment of Prosthetic Dental Sciences, College of Dentistry, King Saud University, Saudi Arabia and Tanta University, Egypt
bDepartment of Prosthetic Dental Sciences, College of Dentistry, King Saud University, Saudi Arabia
cProsthodontic Department, Faculty of Dentistry, Tanta University, Egypt

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Abstract The standards or proportions commonly used as guides for the selection of maxillary anterior teeth for a removable prosthesis have been developed mainly on Caucasian populations with normal ridge relationships.

Purpose: This study was conducted to determine the canine position in relation to commissures in different maxillomandibular relationships among Egyptian and Saudi populations.

Material and methods: Two hundred subjects participated in this study, 100 from each population. The location of the corners of the mouth for each subject was marked on the buccal surface of a screen previously constructed on the maxillary cast and transferred to the casts. The distances between the corners of the mouth and the canines’ distal aspect were measured on the casts. The measurements were subdivided according to their relation to the commissures: at commissures, medial to commissures, or distal to commissures. The data were then statistically analyzed.

Results: Coincidence between the canine distal aspects and commissures was recorded only within 8% of both Egyptian and Saudi populations. Additionally, within the Egyptian population, coincidence was recorded only at Class-I ridge relationship.

Conclusion: Commissures are not a reliable landmark for determination of the distal aspect of the canine distal aspects of both Egyptian and Saudi populations.

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1. Introduction

The eyes, the mouth and the interplay of the muscles of facial expression around these organs telegraph the personality and the moods of the individual. The anterior teeth framed by the lips are the dominant features of the mouth when the components of the oral region of the face and the oral cavity are in harmony that uniquely human gesture, the smile, can be a most pleasing and attractive attribute for a person (Renner, 1981). Selection of appropriately sized maxillary anterior artificial teeth for denture assembly is a complex process particularly when there are no pre-extraction records (Marquardt...
and Stephen, 2002; Gurel, 2003). Maxillary anterior tooth selection and placement are determined primarily by the esthetics desired. This takes into account lip length, mobility and support, jaw relationship, i.e., the smiling resting positions. To a lesser degree, phonetics is a determining factor (Renner, 1981).

Sharry (1974) emphatically postulated that the tooth size is much more important than the tooth shape. Moreover, the measurement of the mesiodistal width was indicated to be more important than the vertical length of the anterior artificial teeth (Al Wazzan, 2001; Hoffman et al., 1986; Hasanreiso-glu et al., 2005; Abdullah, 2002). Despite the fact that the literature is rich with guidelines for selection of the size of maxillary anterior teeth, it is still apparent that no universally accepted single factor which can be relied on to aid in artificial tooth selection.

For an edentulous patient with no available pre-extraction records of the natural anterior teeth, anatomical landmarks are used for the selection of artificial teeth; for instance, the bizygomatic width, inter-commissural width, interpupillary distance, inter-canthal width, and inter-alar width (Scandrett et al., 1982; Latta et al., 1991; Verjao and Nogueira, 2005; Al Wazzan et al., 1995; Varjao and Nogueira, 2006; Gomes et al., 2006; Sulun et al., 2005).

The selection of the size of anterior teeth is guided by some anatomic considerations including the size of maxillary arch, the maxillomandibular relation, the contour of the residual ridges, the size of the lips at rest and smiling as well as the form and the contour of the face (Rahn and Heartwell, 2002).

Goyal and Bhargava (1974) considered that the maxillary and mandibular ridges are normally correlated when; in centric relation; the anterior segment of the upper ridge is slightly labial to the lower ridge. Any deviation in the anterior/or posterior region from this ridge relationship is considered abnormal (Class II and III ridge relationship).

Any disproportion in size between maxillary and mandibular arches influences the length, width, and the position of the teeth (Rahn and Heartwell, 2002), as well as increases the complexity of the prosthetic restoration, hence; in case of Class II and III ridge relationship esthetics is critical. Lavelle (1972) speculated that Class III individuals had disproportionally smaller maxillary teeth than Class I and II subjects when the size of maxillary and mandibular dentitions was compared.

Moreover, racial and gender differences in the average dimensions of the maxillary anterior teeth have been reported, however, the standards were valid only for a specific population group. In addition, some populations demonstrated no correlation between dental morphology and gender (Lavelle, 1972; Chiche and Pinault, 1994; Gillen et al., 1994; Sterret et al., 1999; Owens et al., 2002; Isxcan and Kedici, 2003).

The curve distance of the inter-commissural width which supposedly represents the curve distance between the canines’ distal aspects is often used to estimate the size of maxillary anterior artificial teeth. Previous studies attempted to correlate the inter-commissural width and the canines’ distal aspects but showed no significant relationship. Nevertheless, most of these studies were conducted on Caucasian population samples, with little reference to other races (Verjao and Nogueira, 2005).

Al-Wazzan et al. (1995) correlated the length of the vermilion border (measured from commissure to commissure) to the width of the canines’ distal aspects among Saudi population, with no significant relationship. Consequently, the purpose of this study is to determine the location of the canines’ distal aspects to the corners of the mouth in different ridge relationships in two different populations; namely Egyptian and Saudi populations.

2. Materials and methods

A total of 200 subjects were selected for the current study. One hundred Egyptians (51 males and 49 females) were volunteers from Tanta University, College of Dentistry and 100 Saudis (39 males, 61 females) were volunteers from King Saud University, College of Dentistry. Their mean age was 23 years.

All participants showed coincidence of facial midline with dental median line. Additionally, all subjects had a complete set of natural permanent dentition with no history of orthodontic treatment, large restorations or artificial crowns. Other subjects who presented with tooth agenesis, severe attrition, diastema, or crowded teeth, developmental dental or facial anomalies as well as history of facial surgery were excluded from the study.

The occlusion for each participant was examined clinically and radiographically using cephalometric radiograph to determine the dental as well as the skeletal relationships. The subjects were divided into three groups according to jaw relationships, Class I, II and III. The sample of each group was then subdivided according to gender.

For each subject an irreversible hydrocolloid maxillary impression was poured in dental stone. On each cast, two bilateral removable oral screens were fabricated using Omnivac vacuum-adaptor (Omni-Dental Corp., Harrisburg, PA) and 0.02 mm temporary splint material. Each screen was designed to cover the canine and to extend anteriorly to the lateral incisor and posteriorly to the second premolar.

Table 1

<table>
<thead>
<tr>
<th>Location of distal surface of the canine</th>
<th>Number of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egyptian</td>
<td>Saudi</td>
</tr>
<tr>
<td>At commissures</td>
<td>8</td>
</tr>
<tr>
<td>Medial to commissures</td>
<td>66</td>
</tr>
<tr>
<td>Distal to commissures</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 1 A photograph revealing the location of the corner of the mouth on the maxillary cast.
The location of the corners of the mouth for each subject was marked on the buccal surfaces of the screens with a pointer. The screens were then removed from the patient’s mouth and positioned on the corresponding maxillary cast where the marks were transferred to the cast with a scalpel (Fig 1).

The distance between the marks corresponding to the corners of the mouth and the canine distal aspect was measured bilaterally using an electronic polygauge then divided by two. The measurements were then subdivided according to their relation to the commissures into: at commissure, medial to commissure, or distal to commissure.

For the sake of reliability, the same examiner performed all the measurements and records three times, on different days and times. From the three results, a mean value was calculated.

The data were statistically analyzed using descriptive statistics to determine the location of the canine distal aspect to the corner of the mouth; in each subject at different jaw relations. Independent t-test and one-way analysis of variance

### Table 2  Representing percentages, mean and standard deviations in the relation between the canines’ distal aspects and commissure for Egyptian subjects.

<table>
<thead>
<tr>
<th>Ridge relationships</th>
<th>Gender</th>
<th>At commissures</th>
<th>Medial to commissures</th>
<th>Distal to commissures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. %</td>
<td>No. %</td>
<td>Mean ± Std.</td>
</tr>
<tr>
<td>Class I 59 subjects</td>
<td>Males</td>
<td>6 24%</td>
<td>14 56%</td>
<td>1.13 ± 0.78</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>2 8%</td>
<td>27 79%</td>
<td>3.3 ± 1.17</td>
</tr>
<tr>
<td>Class II 15 subjects</td>
<td>Males</td>
<td>Zero 9%</td>
<td>5 56%</td>
<td>5 ± 1.73</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>Zero 6%</td>
<td>4 67%</td>
<td>3.5 ± 1.00</td>
</tr>
<tr>
<td>Class III 26 subjects</td>
<td>Males</td>
<td>Zero 17%</td>
<td>11 65%</td>
<td>3.7 ± 1.05</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>Zero 9%</td>
<td>5 56%</td>
<td>3.4 ± 1.1</td>
</tr>
</tbody>
</table>

**Mean ± Std.:** Mean ± Standard deviation.

### Table 3  Illustrating percentages, mean and standard deviations for the relation between the canines’ distal aspects and commissure for Saudi subjects.

<table>
<thead>
<tr>
<th>Ridge relationships</th>
<th>Gender</th>
<th>At commissures</th>
<th>Medial to commissures</th>
<th>Distal to commissures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. %</td>
<td>No. %</td>
<td>Mean ± Std.</td>
</tr>
<tr>
<td>Class I 68 subjects</td>
<td>Males</td>
<td>Zero 18%</td>
<td>18 100%</td>
<td>3.4 ± 0.42</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>5 26%</td>
<td>32 64%</td>
<td>3.69 ± 1.29</td>
</tr>
<tr>
<td>Class II 14 subjects</td>
<td>Males</td>
<td>3 64%</td>
<td>6 67%</td>
<td>2.89 ± 1.78</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>3 5%</td>
<td>3 60%</td>
<td>4.67 ± 2.36</td>
</tr>
<tr>
<td>Class III 18 subjects</td>
<td>Males</td>
<td>Zero 12%</td>
<td>6 50%</td>
<td>3.67 ± 0.41</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>Zero 6%</td>
<td>5 83%</td>
<td>4.26 ± 1.98</td>
</tr>
</tbody>
</table>

**Mean ± Std.:** Mean ± Standard deviation.
ANOVA) were performed for comparisons with respect to
the medial position of the canines’ distal aspects to the com-
missures, $P$ value < 0.05 was considered to be significant.

3. Results

Summary of the relative locations of the canine distal aspect to
the corners of the mouth in both Egyptian and Saudi subjects
were illustrated in Table 1. The majority of Egyptian and Sau-
di subjects had the canine distal aspect medial to commissures
(66% and 70%, respectively). Only 8% in both groups had the
canine distal aspect at commissures.

The results of the locations, percentages, means of the dis-
tances of the canine distal aspect to commissures in millimeters
and their standard deviations in both males and females are
represented in Table 2 for the Egyptian subjects and in Table
3 for the Saudi ones. Coincidence between the canine distal as-
pect and the commissures was observed in Egyptian subjects
having Class I jaw relation in both males and females. How-
ever, in case of Saudi populations, coincidence was only
observed in females with Class I and in males with Class II
ridge relation.

Within Egyptian subjects, the greatest mean distance medi-
tal to the commissures recorded for males with Class II and III
was 5 ± 1.73 and 3.7 ± 0.105 mm, respectively.

Meanwhile, for Saudi subjects, the highest mean distance medi-
tal to the commissures observed in females with Class II
and III ridge relation was 4.67 ± 2.36 and 4.26 ± 1.98 mm,
respectively.

The highest mean distance distal to the commissures was
2.5 ± 1 mm documented for Egyptian males with Class II
while females demonstrated equal mean distances 2 mm in
all ridge relation.

On the other hand, the highest mean distance distal to the
commissures 4.7 ± 1.55 mm was reported among Saudi fe-
males with Class-I ridge relation. While, lowest mean distance
distal to the commissures 2.8 ± 1.33 mm was observed in Sau-
di males with Class III ridge relation.

Since, most of the edentulous patients preferred the nar-
rrower mesiodistal teeth, and because of few percentages of

| Table 4 | Revealing the comparison between males and females as regards the medial position of the canine in relation to the
| commissures in different ridge relationships. |
|---------|----------------|
| Population | Ridge relationships | Male | Female | t test | P value |
| Egyptian | I | 1.13 ± 0.78 | 3.3 ± 1.17 | 6.24 | 0.001* |
| | II | 5 ± 1.73 | 3.5 ± 1 | 1.55 | 0.604 |
| | III | 3.7 ± 1.05 | 3.4 ± 1.1 | 0.52 | 0.609 |
| Saudis | I | 3.4 ± 0.42 | 3.69 ± 1.29 | 0.681 | 0.498 |
| | II | 2.89 ± 1.78 | 4.67 ± 2.36 | 1.35 | 0.22 |
| | III | 3.67 ± 0.41 | 4.26 ± 1.98 | 0.761 | 0.466 |

* Significant.

| Table 5 | Demonstrating the comparison between mean of medial distance of the canine distal aspect to commissure regarding ridge
| relationships between males and females in both populations. |
|---------|----------------|
| Ridge relationships | Egyptians | Saudis |
| | Male Mean ± Sd. | Female Mean ± Sd. | Male Mean ± Sd. | Female Mean ± Sd. |
| I | 1.13 ± 0.78 | 3.3 ± 1.17 | 3.4 ± 0.42 | 3.69 ± 1.29 |
| II | 5 ± 1.73 | 3.5 ± 1 | 2.89 ± 1.78 | 4.67 ± 2.36 |
| III | 3.7 ± 1.05 | 3.4 ± 1.1 | 3.67 ± 0.41 | 4.26 ± 1.98 |
| F. test | 8.992 | 3.648 | 2.26 | 2.88 |
| P value | 0.004* | 0.104 | 0.056 | 0.088 |

* Significant.

| Table 6 | Representing comparison between Saudi and Egyptian males regarding medial distance of the canine distal aspect in relation
to the commissures at Class I, II and III ridge relationships. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Ridge relationships</td>
</tr>
<tr>
<td>Male</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>II</td>
</tr>
<tr>
<td></td>
<td>III</td>
</tr>
<tr>
<td>Female</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>II</td>
</tr>
<tr>
<td></td>
<td>III</td>
</tr>
</tbody>
</table>

* Significant.
subjects in both racial groups reported with posterior position of the canine to the commissures, a comparison was performed with respect to the anterior position of the canine distal aspect to the commissures, using one-way analysis of variance. For Egyptian subjects, there was a statistically significant difference between males and females only at Angle’s class I ($P = 0.001$). Whereas, in the Saudi subjects, there was insignificant difference between males and females at each class of ridge relation (Table 4).

Table 5 listed the data comparing the mean of medial distances of the canines’ distal aspects to the commissures at different ridge relationships within each examined gender for both populations. The results demonstrated significant differences only between Egyptian males ($P = 0.004$). Though, there was insignificant difference between Egyptian females as well as between both Saudi males and females ($P = 0.104, 0.056, \text{and } 0.088$), respectively.

Table 6 shows a significant difference between Egyptian and Saudi males in Class I and II ridge relationships ($P = 0.001$ and 0.050, respectively). Yet, insignificant differences were detected on comparing Saudi and Egyptian females at Class I, II and III ridge relationships ($P = 0.472, 0.422, \text{and } 0.44$, respectively).

4. Discussion

Successful complete dentures require a blend of science and art, in addition to the clinician’s experience to achieve a pleasing appearance and function. Selection of the denture teeth for their shape, size, and color is the most important phase of complete denture service as far as the patient is concerned. The size of the maxillary anterior teeth is important in achieving a pleasing dental and facial esthetics and one of the most difficult aspects of complete denture prosthodontics is the selection of appropriately sized maxillary anterior teeth.

Normally, geographical location and historical background could genetically give rise to many dental and facial variations. Consequently, information regarding the location of the canines’ distal aspects in relation to the corners of the mouth in both populations may provide a useful guide for clinicians when restoring anterior teeth. This study was conducted on young subjects, to avoid continuous, progressing physiological aging process that affect the natural dentition changing its morphology and appearance (Abdullah, 2002; Scandrett et al., 1982; Latta et al., 1991).

Moreover, for more reliability and in order to minimize other sources of error, in the present study all measurements were performed directly from the casts and similar to the study conducted by Zilberman et al. (2003) who found that measurement with digital calipers on plaster models showed the highest accuracy and reproducibility. In addition, all measurements were preformed by the same operator for all the subjects in order to minimize the personal variability factors.

Inter-canine width method is based on the hypothesis that the maxillary canines’ distal aspects should be located approximately at the commissures of the month. However this was not the case in most of the subjects included in the present study, where only 8% of both groups recorded the canine distal aspect at the commissure, and the majority showed medial position to the commissures. Concerning the distal location of the canine distal aspect to the commissure in the current study, it was reported in 26% Egyptians and 22% Saudis with average 2 mm in different ridge relationships, in turn the size of the anterior teeth would be wider than the commissures of the mouth. In support of this finding, Verjao and Nogueira (2005) reported in his investigation which was carried out on white, mulatto, black, and Asian subjects; that a distal location of the canine distal aspect to the commissures for all the studied groups, leading to the selection of narrower teeth with selection error greater than 4 mm.

Meanwhile in the present investigation, most of studied subjects (66% Egyptians, 70% Saudis) showed medial location of the canine distal aspect to the commissures. This is in agreement with the study performed by Al Wazzan et al. (2001) which showed narrower distance between the canine distal aspect than that between the commissures of the mouth in Saudi population ($45.16 \pm 3.28 \text{ and } 50.79 \pm 5.09$), respectively, and only 40% of the subjects had the inter-canine distance within 4 mm of the width of the mouth Al Wazzan et al. (1995). However, Lieb et al. (1967) reported that the maxillary canine distal aspect was $4 \text{ mm}$ distal or medial to the commissures.

Since most of the edentulous patients preferred the narrower mesiodistal dimension of their artificial teeth and because of few percentages of subjects in both populations reported with distal position of the canine distal aspect to the commissures, the comparisons regarding gender and ridge relationships had been performed only with respect to the medial position of the canine distal aspect to the commissure. Within the Egyptian population, there was a significant difference between males and females only at Class-I ridge relationship ($P = 0.001$). Gender variations in the dimension of anterior teeth for most racial groups have been reported, with men exhibiting wider anterior teeth than women with the canines showing the greatest gender variation (Owens, 2002; Hasanreisoglu et al., 2005) i.e. for men, the canines distal aspects are distal to commissures. Moreover, Arja et al. (1974) reported some gender differences, meanwhile the significant difference was recorded between all males at different ridge relationships ($P = 0.004$). This may be explained on the basis that the majority of studied subjects were in Class-I ridge relationship and this may lead to a wider range of variability in this sample more than those represented with Class II or III.

On the other hand, among Saudi population there was no significant difference between males and females at different ridge relationships that is incompatible with the gender variations reported for most racial groups Arja et al. (1974). In addition, Al El-Sheikh et al. (1998) concluded that the biometric ratio 1:1:6 does not exist in the Saudi population denoting variations exhibited within Saudi population. This may be as a result that, today’s Saudi society is a diverse mix of populations that have immigrated to and settled in Saudi Arabia. Some of the ethnic groups have remained racially pure, while others have mixed with other races leading to mixed gender populations.

Moreover, there was a highly significant difference between Egyptian and Saudi males at Class I and less significant for Class II ridge relation though, insignificant difference reported at Class III. The application of gender hypothesis on Class I only may be attributed to the fact that regardless to the gender in Class II. According to skeletal features of the maxilla, it is larger than mandible with the canine distal aspect most probably present in medial relation to the commissures. In agreement with this postulate, Lavelle (1972) speculated that Class
III individuals had disproportionately smaller maxillary teeth than Class I and Class II subjects when maxillary and mandibular dentition sizes were compared.

Meanwhile, no significant difference was reported between Egyptian and Saudi females at different ridge relationships despite the supposed differences of their genetic makeup. This could support the pure Arabian ethnic origin that link between these two different populations. It is a consensus of data established that genetic heritage is the main cause for the similarities found between north American and European white individuals (Latta et al., 1991; Verjao and Nogueira, 2005; Gomes et al., 2006; Sulun et al., 2005; Lavelle, 1972).

Moreover, among each class of ridge relationships, the canine distal aspect was established to be in a medial relation in the majority of examined females even in Class III. This may be contributed to the characteristic Arab feminine features of the females.

Although, the results of this study suggested the presence of correlation between the canine distal aspect and commissure on one side, and ridge relationships on the other side within Egyptian populations, these results are not enough to be used as a predictive factor.

5. Conclusions

Within the populations studied and the sample size available, the following conclusions were drawn:

(1) Egyptian males show significant difference as regards the mean of the medial position of the canines' distal aspects to the commissures at Class I, II, and III ridge relationships (1.13 ± 0.78, 5 ± 1.73, and 3.7 ± 1.05 mm, respectively).

(2) Egyptian females show insignificant difference as regards the mean of the medial position of the canines’ distal aspects to the commissure at different ridge relationships (3.4 ± 1.1 mm).

(3) No coincidence between the canine distal aspect and the commissure was recorded within Egyptian subjects with Class II or III ridge relationships.

(4) The only significant difference between Saudi and Egyptian populations regarding gender with respect to the mean distance was the canine distal aspect and commissure was recorded between males with Class I and II ridge relationships.

References


