Relationship of Various Anatomic Landmarks with the Midline of Face and Oral Commissure

Sirish Chandra Regmi,1 Sarita Pradhan Joshi,2 Pragya Shrestha,2 Sanjay Kumar Sah,2 Anand Verma2

1Department of Dental Surgery (Prosthodontics), Nepal Police Hospital, Kathmandu, Nepal.
2Department of Prosthodontics, National Academy of Medical Sciences, Bir Hospital, Kathmandu, Nepal.

INTRODUCTION

Natural beauty depends upon symmetry, youthfulness and normalcy.1,2 The bisector of the pupils, nasion, tip of the nose, tip of the philtrum, incisive papillae and jaw, have been utilized to decide the facial and dental midlines.3-8 There have been studies regarding coincidence of facial anatomic landmarks closest to the midline of the face as well as midline of the oral commissure mouth.

METHODS

Anatomical landmarks Nasion, tip of the nose, tip of the philtrum, were marked clinically on 100 subjects (age range: 20-35 years). Frontal full-face digital images of the subjects in smiling position were then made under standardized conditions. A total of 97 subjects met the inclusion criteria. Upon applying exclusion criteria, images of 73 subjects were used for midline analysis using a concept called the Esthetic Frame. One sample t tests were conducted at alpha values of .005.

RESULTS

The results indicated that anatomic landmarks soft tissue nasion, tip of nose, tip of papillae and dental midline deviated uniquely and significantly (P <.005) from the midlines of the face as well as the mouth (oral commissure).

CONCLUSIONS

Within the limitations of the study, the hierarchy of anatomic landmarks closest to the midline of the face in smile was as follows: the midline of the oral commissures, natural dental midline, tip of philtrum, nasion, and tip of the nose. The hierarchy of anatomic landmarks closest to the midline of the oral commissures was: natural dental midline, tip of philtrum, nasion and tip of nose.

ABSTRACT

Introduction: Currently, there are no exact guidelines which to choose specific anatomic landmarks while determining the midline of the face or midline of the mouth. The purpose of this study was to determine the hierarchy of facial anatomic landmarks closest to the midline of the face as well as midline of the oral commissure mouth.

Methods: Anatomical landmarks Nasion, tip of the nose, and tip of the philtrum, were marked clinically on 100 subjects (age range: 20-35 years). Frontal full-face digital images of the subjects in smiling position were then made under standardized conditions. A total of 97 subjects met the inclusion criteria. Upon applying exclusion criteria, images of 73 subjects were used for midline analysis using a concept called the Esthetic Frame. One sample t tests were conducted at alpha values of .005.

Results: The results indicated that anatomic landmarks soft tissue nasion, tip of nose, tip of papillae and dental midline deviated uniquely and significantly (P <.005) from the midlines of the face as well as the mouth (oral commissure).

Conclusions: Within the limitations of the study, the hierarchy of anatomic landmarks closest to the midline of the face in smile was as follows: the midline of the oral commissures, natural dental midline, tip of philtrum, nasion, and tip of the nose. The hierarchy of anatomic landmarks closest to the midline of the oral commissures was: natural dental midline, tip of philtrum, nasion and tip of nose.
determined in relation to the Facial and Commissural midline drawn in an Esthetic Template as suggested by Bidra et al. and used for analysis in Adobe software version and then relative hierarchy of approximation of these landmarks with facial midline and commissural midline (Mouth) was determined.

This study determined the proximity of anatomical landmarks with facial and commissural midline in staffs and patients visiting National Academy of Medical Sciences, Bir Hospital. The study also compared the hierarchy of various anatomical landmarks in relation to facial and commissural midline constructed in an esthetic template as given by Bidra et al.

METHODS

The ethical clearance was obtained from Institutional Review Board, NAMS. The sampling methods used was convenience sampling. Cross sectional observational study done for the period of 1 year (Oct. 2019-Oct. 2020) with sample size 73 calculated using the mean and standard deviation of relative facial midline value of commissural midline (RCV5) and relative facial midline value of nasion (RFV1). The general objectives of the study were to identify the various facial anatomical landmarks closest to the midline of the face and midline of mouth (oral commissure). The specific objectives of the study were to determine the relationship of anatomical landmarks (nasion, philtrum, tip of nose, dental midline) with the midline of face and commissure of mouth and to determine the relationship of midline of commissure with midline of face.

The inclusion criteria was age range of 20-35 years, ability to understand written informed consent documents and the verbal explanation. The exclusion criteria were congenital anomalies, obvious ophthalmic asymmetry, inaccurate clinical markings, images without a good resolution, history of orthodontic treatment, missing maxillary anterior teeth, prosthetic maxillary anterior teeth, interdental spacing in the maxillary teeth, subjects with neuromuscular disorder, misaligned maxillary anterior teeth and maxillary anterior teeth with pathologies.

The subjects for the study were selected from patient and staffs visiting the Dental Department of National Academy of Medical Sciences, Bir Hospital, Kathmandu. Total 97 subjects were selected based on the inclusion criteria and standardized photography was performed under similar lighting condition environments. Among them, 24 subjects who did not meet the inclusion criteria were excluded and rest of the 73 subjects were included in the study.

The null hypothesis is that: There would be no difference between the chosen facial anatomic landmarks (nasion, philtrum, tip of nose, dental midline) and the midlines of the face and oral commissures.

The materials used in this study were digital camera (Nikon D3500 with 55mm lens), the HP Pavilion Laptop had the following configurations: Hardware HP Pavilion laptop model-dv6000, with 1,024 MB of random access memory in Adobe Photoshop Version 7.0, fine tipped erasable marker with a tip diameter 0.5mm. The methodology used in this study was divided into following parts standardized photography of subjects, drawing of esthetic templates, various lines in photographs as suggested by Bidra et al., measurements of various values in adobe Photoshop version 7.0 and obtained values filled in excel sheet for statistical analysis.

Standardized photographs were taken of all subjects included in this study. A camera with an aperture setting of F4.5 was used where the height of camera was adjusted on the tripod to match the eye level of the subject when seated upright with shoulders and head held straight and facing forward. Tripoding of the camera was done and a standard marking was made on the floor in each tripod. The height of camera was adjusted thereafter to standardize the distance between camera and subject which was kept 5ft (1.5m). Each subject was guided in assuming the natural head position as documented in literature, advocated by Cooke et al, 1990 and Robert et al in 1948. The natural head position was evaluated in horizontal and vertical axis. A computer assisted technology as suggested by Bidra et al was used. Image of the subject at posed smile was taken in static posture and used for analysis. (Figure 1)
Markings were placed carefully by indelible pencil 0.5mm in diameter in soft tissue nasion, tip of nose, and tip of philtrum. A rectangle known as the esthetic frame was used to define the facial midline. (Figure 2)

Operational definitions of Constructed lines 10 in Adobe Photoshop version 7.0

In this study, the facial midline is defined as the midline of esthetic frame of the face constructed through Adobe Photoshop version 7.0. At first an esthetic template was constructed on included subjects, then later on, other lines were drawn as depicted in figure 5 and 6. The dental midline is defined as the vertical line through the tip of incisal embrasure between the two maxillary central incisors and parallel to the vertical lines of the esthetic frame of face. The midline of oral commissures is defined as a line bisecting the distance between the cheilions of the subject in smiling posture. Relative facial midline value (RFV) and Relative commissorial midline value (RCV) are 2 operational tools used to quantify the relationships of anatomic landmarks to the respective midlines.

The Esthetic Frame was first constructed on a subject’s image digitally. The Facial midline was established by bisecting the distance between the 2 lateral borders of frame. Three vertical lines were then drawn along each of the anatomic points, which had been marked clinically on the patient face, the fourth line was drawn along patients existing dental midline. Relative facial midline value (RFV) and Relative commissorial midline value (RCV) are 2 operational tools used to quantify the relationships of anatomic landmarks to the respective midlines.

The assignments for relativity of landmarks for both midlines were:

RFV1 and RCV1: relativity of nasion to midline of the face and commissures
RFV2 and RCV2: relativity of tip of the nose to midline of the face and commissures
RFV3 and RCV3: relativity of tip of the philtrum to midline of the face and commissures
RFV4 and RCV4: relativity of dental midline to midline of the face and commissures
RFV5: relativity of the midline of the commissures with the midline of the face.

Thus, in perfect symmetry, all 5 of the RFVs and all 4 of the RCVs would be equal to each other and to the numeral 1. If a line drawn along one anatomic landmark coincided with any of the other landmarks, the same RFV or RCV value was recorded for both. If an anatomic landmark coincides with the facial or the commissorial midline, then it was assigned an RFV or RCV value of 1. After obtaining all of these values in Microsoft Excel sheet, the data was used for statistical analysis.
RESULTS

Data were entered, edited and coded in Microsoft excel. The data were transferred to Statistical Package for Social Sciences (SPSS) 23.0 for further analysis. The numerical variables were summarized with the help of mean, median, standard deviation and range. The data were presented through bar diagrams and frequency distribution tables.

Two sets of one sample t test were used to analyse Relative facial midline values (RFV) and Relative commissural midline values (RCV).

This statistical analysis done with RCV in table no.1 clearly illustrates that the hierarchy of anatomic landmarks in proximity to the midline of face is

1. Dental midline  2. Tip of papillae  
3. Nasion  4. Tip of nose

<table>
<thead>
<tr>
<th>Table 1: One sample Test with Test value = 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFV</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>RFV1 = n/F</td>
</tr>
<tr>
<td>RFV2 = t/F</td>
</tr>
<tr>
<td>RFV3 = p/F</td>
</tr>
<tr>
<td>RFV4 = d/F</td>
</tr>
<tr>
<td>RFV5 = CxF</td>
</tr>
</tbody>
</table>

The above diagram depicts the one sample t test done for Relative Facial Midline Value (RFV) to determine the proximity of various anatomic landmarks which shows the proximity of RFV5 at 95% confidence interval. It clearly indicates, inter commissural line (RFV5 = 0.98229) as closest the landmark to facial midline defined while tip of nose (RFV2 = 0.940) as most deviated landmarks from midline of esthetic template. This statistical analysis done with RFV in table no.2 clearly illustrates that the hierarchy of anatomic landmarks in proximity to the midline of face is midline of commissure followed by dental midline, tip of papillae, nasion and tip of nose.

DISCUSSION

Symmetry in face is known as one of the fundamental indicators of beauty. It is defined as “correspondence in size, shape, and relative position of parts on opposite sides of a dividing line or median plane or about a centre or axis” but clinically, it means “existence of balance and coordination”. Correlation between the midlines i.e., facial and dental which vary between professional as well as between dentist and patients also. Historically a number of facial landmarks such as the bisector of interpupillary line, nasion, tip of nose, tip of philtrum and chin have been used to determine the facial and dental midlines.

Clinical studies mentioned in the literature are limited to the amount of tolerance of deviated dental midlines from facial midline (span of nearly 2-3 mm). This has led the clinician to a situation with no predictable guidelines and most of them determine the midline based on non-verified landmarks. Standardized definitions for facial midlines are not available in the literature. Therefore, the facial midline was determined by using the esthetic frame concept.

<table>
<thead>
<tr>
<th>Table 2: One sample Test with Test value = 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCV</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>RCV1 = nx/F</td>
</tr>
<tr>
<td>RCV2 = tx/F</td>
</tr>
<tr>
<td>RCV3 = px/F</td>
</tr>
<tr>
<td>RCV4 = dx/F</td>
</tr>
</tbody>
</table>

The above diagram depicts the one sample t test done for Relative Commissural Midline Value (RCV) to determine the proximity of various anatomic landmarks which shows the proximity of RCV4 at 95% confidence interval. Table 2 also shows that the hierarchical order so obtained was in order that the dental midline (RCV 0.9527) ranked highest, followed by philtrum, soft tissue nasion and tip of the nose. The tip of the nose was the only landmark which deviated most in relation to facial midline. The statistical analysis done with RCV in table no.3 clearly illustrates that the hierarchy of anatomic landmarks in proximity to the midline of face is tip of papillae, nasion followed by tip of nose.
as suggested by Bidra et al. Moshkelgosha et al did a study using similar esthetic frame concept to study the relationship of anatomical landmarks with facial and commissural midline. Validity of the natural head position and its long term reproducibility over a period of up to 15 years has been proved by various authors. It was found that natural head position (NHP) represented a realistic appearance of patients and could be used as basis for cephalometric analysis. Subject in smiling position was chosen for, as it is a standard for esthetic analysis and revealed dental midline as well.

The results of this study support rejection of the null hypothesis that there would be no difference between the chosen facial anatomic landmarks and the midlines of the face and oral commissures. The anatomic landmark that was closest to the facial midline in this population as shown by the results of this study was the inter-commissural line. The hierarchical order so obtained was in order of inter commissural line followed by dental midline, tip of philtrum, nasion and tip of the nose. It was found for the present population that the dental midline and inter commissural line differed in hierarchical position with a minute difference. The second part of the study evaluated the proximity of these anatomical landmarks with the centre of the mouth (commissures). The methodology of study utilizes lowest the value of F (Facial midline) and Cx (Commissural midline) taken from either right or left side making the mean value always less than 1. The use of common denominator to determine relative value of facial and dental midline has made photographic methods easier.

Similar results were found from a study done by Bidra et al that the midline of the oral commissures was the most reliable anatomic landmark while analyzing the hierarchical order for facial midline as it ranked closest to the facial midline. Similar study by Farhani et al showed that the anatomical landmark hierarchies, in proximity to the facial midline were found to be commissural midlines, nasion, tip of philtrum, tip of nose and dental midline respectively. The anatomical landmark hierarchies, in proximity to the commissural midline were found to be dental midline, tip of philtrum, tip of nose, and nasion which was different in regard to this study. In the study done by Farahani et al, they used incisive papillae as another anatomical landmark and images of dental casts were taken after marking the labial frenum and incisive papillae. The results showed that labial frenum was less deviated from the dental midline than the incisive papillae.

Many of the studies relies on use of esthetic template as advised by Bidra et al and the results showed that midline of commissure of mouth in smiling patients was in hierarchy in relation to the facial midline. The esthetic frame was designed to analyse the problems caused by the lack of an attractive smile.

In this study, the Natural head position was used and controlled carefully because it is valid and reliable, and it is absolutely necessary for the subjects to avoid turning the head around the vertical axis. Nevertheless, human error in detecting this rotation should not be completely ruled out. The posed smile of subjects was selected and none of the cases had a highly asymmetrical smile or a smile that does not show the maxillary central incisors. The study was designed to be completely clinically applicable. Thus, the markings of each anatomical landmark were done clinically (and not on a digital image), and the connecting lines were drawn along these markings. Despite the high precision, inherent human errors in marking anatomical landmarks cannot be ignored. Among the clinical landmarks, it was difficult to mark the nasion soft tissue and nasal tip for deviation of nasal anatomy. More studies should be conducted with comparison on the basis of various other variables like gender, ethnicity, age group ranges.

CONCLUSIONS

The following conclusions were drawn:

1. There was a significant difference in the relationship of midline of oral commissure with the facial midline.
2. There was a significant difference in the relationship of nasion, tip of nose, tip of papillae and dental midline with midline of face and midline of oral commissure.
3. The hierarchy of anatomic landmarks closest to the midline of the face was: (1) midline of the commissures, (2) dental midline, (3) tip of philtrum, (4) nasion, and (5) tip of the nose.
4. The hierarchy of anatomic landmarks closest to the midline of the commissures was: (1) dental midline, (2) tip of philtrum, (3) nasion and (4) tip of nose.
REFERENCES


