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Research Article

Incidence of Straight, Sloped and Curved Midlines in Adult Humans

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Abstract

It has been traditionally documented and accepted that even though adult humans may have asymmetrical faces, a vertical straight facial midline line has always been used for aesthetics and functional dental rehabilitation. The standardly used landmarks for ascertaining the midline have been the glabella, the tip of the nose, the philtrum and the pogonion. In this study the pogonion has not been used because it is displaced in over 90% of individuals as per the Smylist® observation due to the mandibular rotation. First the horizontal lines were used to define the midline and then the midline plotted. This study has been conducted to ascertain the Smylist® tenet that all facial midlines are not necessarily straight. The tenet is that the midline can be straight, sloped to either side or curved to either side. A total of 100 subjects from Mumbai, India were photo documented in a straight face view in a standardized format and analysed for the type of midline using the Smylist® Aesthetic software. The results showed that the ratio of the three kinds of midlines were as 3.75 % for the straight midline, 55.55 % for the sloped midline and 40.7 % for the curved midline. It can be concluded that this study has shown that the incidence of the straight midline is only a small fraction in all the individuals in an Indian population which would be different from a European population.

Keywords: Smylist; Mandible; Rotation; Unilateral; Balance; Dentistry; Muscles; Midline; Sloped; Curved; Horizontal; Lines; Facial; Skeletal; Pogonion; Philtrum; Straight; Vertical; Tip; Nose

1. Introduction

The human body is a generally bi laterally symmetrical anatomical structure regarding the bones and muscles of the body. The human face, even though bilaterally similar is not necessarily symmetrical. It has been documented in the literature that faces, very often are asymmetrical. There are large number of variables which can be seen on asymmetrical faces. The general workaround to accommodate these variables is to use the rule of "averages" regarding the straight midline and apply it to all faces, symmetrical as well as asymmetrical. This is the reason that even though the asymmetry is accepted, most of dentistry is planned along a hypothetical straight line drawn in the middle of the face to find a reference line to create the occlusal plane and the tooth positions. Such a proposition, only works on symmetrical faces and should not be applied to asymmetrical faces. Hence, Smylist® proposes that the rules of symmetry should be used only if the faces are symmetrical. If the face is not symmetrical, Smylist® proposes logical and geometrical rules to handle the variability of the asymmetry. The proper and accurate midline for the face establishes proper and ideal function in the body. Conventionally, a straight line is plotted along the imagined facial midline and it is assumed that this is the midline of the patient. Even when extensive dentistry is planned and especially if aesthetic dentistry is planned, the treatment is designed around this assumed straight midline. In the field of aesthetic dentistry, it is an accepted norm that midlines on the face are more or less straight. Also, interestingly, the pogonion is often considered as the landmark point to create the midline. This is not advisable from the Smylist® approach. The reason is that the pogonion is a mobile entity which may have shifted depending on the rotation of the mandible. This shift can be discerned on the face pictures. Hence the Smylist® concept does not use the "Pogonion" as a landmark point. Smylist® uses only the fixed points and lines on the face to plot the facial midline using its logical geometrical and midline concepts. This is the only way to create the most reliable diagnosis regarding mandibular rotations by using the visible pogonion point displacement and digitally ascertaining the desired pogonion position using the individual Smylist® midline. The Smylist® concept has a differing view point. The concept states that since faces are not necessarily symmetrical, it would be incorrect to assume that the facial midline is a straight midline. The concept states that the midline is dependent upon the skeletal make up of the individual and hence it is not necessarily straight. The Smylist® tenet is that the midline may be straight, but can also be sloped to the right or left side or may be curved to the right or the left. This is a major paradigm shift in the world of dentistry. The Smylist® concept uses four horizontal lines as a reference which are fixed and can be marked digitally in a conscious and reproducible way. Then the three fixed points are connected and then extended downwards to get the Smylist® individual midline which in turn allows identification of the "desired" position of the "pogonion". The midline is the start of all smile designs and is the key reference point for a digital smile design to be initiated. It is critical not only for aesthetics but also in function. The inter- incisal line, the occlusal plane are all based on the individual midline. Using an average general hypothetical midline would logically lead to functional and aesthetic problems because of the diversity and variability of this midline. This study is a critical study in determining how much away are individuals in general from the hypothetical midline which has been conventionally used all over dentistry. Digitally planning the individual Smylist® Midline is far more reliable than using analog

facebow and articulator without considering the midline for creation of the occlusal plane.

1.1 Aims and objectives

The objective of this study is to find out the incidence of straight, sloped or curved midlines in adult humans in an Indian population based on the Smylist® rules regarding facial midlines. The purpose of this study is to evaluate how many midlines of randomly selected subjects fall in each of these three categories. Within the sloped and the curved midline groups, it is to be ascertained what is the percentage of right vs left sloped or curved. The Smylist® concept believes that there is an ethnic variation in the most common types of facial midlines. This study is being done with all subjects from the city of Mumbai and of Indian ethnicity. The Smylist® hypothesis is that European origin populations have more of curved midlines with preliminary data from an ongoing study on Europeans.

1.2 Review of literature

There is hardly any literature available on the types of facial midlines in general population. The facial midline is expected to be straight and if any aberration has been documented, it has been considered to be abnormal. It has been suggested that the landmarks which are used to ascertain the facial midline are the glabella, the tip of the nose, the tip of the philtrum and the pogonion [1]. Using these landmarks a straight vertical facial midline is plotted. In case the landmarks do not follow the midline, it is accepted as an acceptable shift away from the normal. As mentioned earlier, the "pogonion" should not be taken as a landmark as it is not a fixed position by the Smylist® approach. The Smylist® concept provides a logical and reliable way to create facial midlines which are in accordance with the skeletal structure and aids in setting all the aesthetic and functional parameters much more individually in patients in a way that has not been documented or suggested in dental literature. In fact, one very interesting study showed that the landmarks deviated significantly from the assumed straight vertical midline [2]. The study could not determine any landmarks which would consistently coincide with the hypothetical straight midline. This study is essentially a confirmation of the suggestions made by the Smylist® concept that the facial midline cannot be just straight and bisect the face into two equal halves. Most of the other available literature has made observations regarding the dental midline. One study showed that the coincidence of inter-maxillary midlines was seen in two-thirds of the participants only. The dental midlines were coincident with the facial midline in less than half of the sample [3]. Another study showed that 80 % of the sample studies showed that the maxillary and mandibular dental midlines never coincide [4]. Majority of the study population showed deviation between facial midline and anterior teeth midline within the range of 0-1 mm. This is most probably because of a curved or sloped midline. One interesting study checked for the ability of observers to recognize deviations of facial and dental midlines [5]. As is logically evident, the greater the deviation, the higher the detection rate. Almost all the dental aesthetic concepts suggest that the incisal plane and the occlusal plane should be perpendicular to the incisal plane and parallel to the midline of the face [1, 6]. Minor discrepancies between facial and dental midlines are acceptable and, in many instances, not noticeable. However, a canted midline would be more obvious, and therefore, less acceptable. An article states that the maximum allowed discrepancy can be 2 mm and sometimes greater than 2 mm discrepancy is esthetically acceptable so long as the dental midline is perpendicular to the interpupillary line [7]. A very

interesting observation from Smylist® is that in case of curved midlines, where all the horizontal lines are converged, the inter pupillary line is reversed from the occlusal plane. Using this Smylist® midline concept about curved midlines makes it much more easier tio understand how the converging horizontal lines can be harmonious. Thus setting the occlusal plane can be set in a very easy and logical way avoiding later functional and aesthetic errors. The literature has focused mainly on the aesthetic aspects of the dental midline and its relation to the facial midline. There is no data in the literature that suggests a link between the facial midline and the functional aspects of the mandible and its consequent impact on the entire musculo-skeletal system. This is the first such study using a complex method that takes cognizance of the originally developed classification of facial midlines in the Smylist® concept to confirm the incidence of midlines based on this classification. Based on the Smylist® midline rules, the occlusal plane, the inter incisal line, the canine inclination can be set in a very logical and reliable way. By using the digital designing software this process becomes easiry and more accurate. This approach not only establishes the midline but also ensures that functional problems do not arise subsequently.

2. Materials and Methods

A total of 100 subjects were recruited for this study. The subjects had all been informed about the purpose of the study and permissions have been taken from all the subjects. Consent has also been taken from the subjects whose pictures have been used in this article. Full face extraoral standardized digital photographs of all the subjects have been taken with a TTL camera having a 35-105 equivalent lens. All photographs have been taken with a black or grey backing and using a flash at an exposure speed of 1/125th of a second. The built in flash of the camera was used for the photographs. All the pictures were taken in the Cheese A format as suggested in the Smylist® concept. For making this picture the subject was asked to say aloud the word "Cheese" with an extended "eeeeseee" followed by the letter "A" in an extended fashion. The letter should sound as "aaaaaaaa". The picture is to be taken with the subject having completely stretched lips and displaying as much of the maxillary teeth as possible. All the pictures have been obtained in the JPG format and have not been digitally touched up. It is important to note that the natural head position (NHP) of the patient was taken for all the photographs. This head position may be canted to one side to balance a very strongly rotated mandible. This NHP position is very critical for later posture diagnosis and functional TMJ diagnosis.

The inclusion and exclusion criteria for the subjects is as follows

a) Should be between the age of 20 and 50
b) Should not have any history of facial trauma or injury
c) Should not have had any surgical correction done on the face
d) Should not be undergoing orthodontic treatment
e) Should not have any congenital facial or skeletal deformity
f) Should not be having Downs syndrome
g) Should not have undergone hospitalization in the past one month
h) Should not be edentulous
i) Should not be wearing a partial denture for missing anterior teeth

Figure 1: The Cheese A front face picture.

Figure 2: The Cheese A front face picture.

The pictures were then individually loaded onto the Smylist® Aesthetic Design Software. The four standard horizontal lines were plotted for each face. These lines may not be hundred percent horizontal but are along the X axis of the face. These four horizontal lines are

a) The horizontal eyebrow line
b) The inter pupillary line
c) The inter alar line
d) The inter commissure line

After plotting the four horizontal lines the Smylist® Midline was adjusted based on the following landmarks

a) The Glabella - Center of the forehead between the eyebrows
b) Center of the tip of the nose
c) The middle of the philtrum

It is emphatically restated that the pogonion was not considered as a landmark for plotting the midline. The reason for this is that it is possible that the mandible is

rotated to either side, thereby deviating the pogonion point to the right or the left. Hence the "Pogonion" is not a fixed entity and should not be used in plotting the facial midline. In fact, extending the Smylist® Midline helps in ascertaining the desired position of the pogonion and thus the desired position of the mandible in the horizontal plane. The horizontal lines may or may not be parallel to each other. Even if they are parallel, they could be canted to the right or left. If not parallel, they could be converging towards the left or the right. There can be multiple variations in the horizontal line patterns, but it has been the Smylist® observation that the majority will fall under the given classification with very minor variatioins. If there is one particular horizontal line that is not following the other lines, it is usually due to an aberration on the face. This will assist in the formulation of a dental diagnosis and treatment in a much more individualized manner. The horizontal lines were assessed and classified into one of five possible patterns in two groups – parallel and converging

A) Parallel

a) Parallel to each other but not canted to the right or left (Straight)
b) Parallel to each other but canted downwards to the right on the x axis
c) Parallel to each other but canted downwards to the left on the x axis

B) Converging

a) Converging to the right
b) Converging to the left

A graphic representation of the two groups of horizontal line patterns is presented below.

Image 1: Parallel.

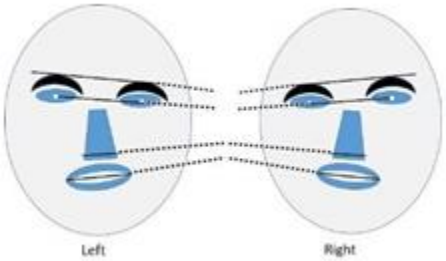

Image 2: Converging.

The dotted line is just a hypothetical extension of the horizontal lines to show the convergence to the right or the left side. For the Smylist® diagnosis it is necessary to first have the horizontal line pattern which will guide our aesthetic and functional design and find out the individual midline as well as the desirable pogonion point and thus the canine position/inclination and the appropriate condylar position. The plotted midline is naturally a vertical line along the Y axis of the face. The was then assessed and classified again as one of five types

a) Straight
b) Sloped to the right on the Y axis
c) Sloped to the left on the Y axis
d) Curved to the right
e) Curved to the left

The ”straight” or “sloped” midline can exist in conjunction only with the “parallel” horizontal patterns. While the “curved” midline is only existent with the “converging” horizontal pattern. This is represented in the graphics below.

Image 3: Straight Midline.

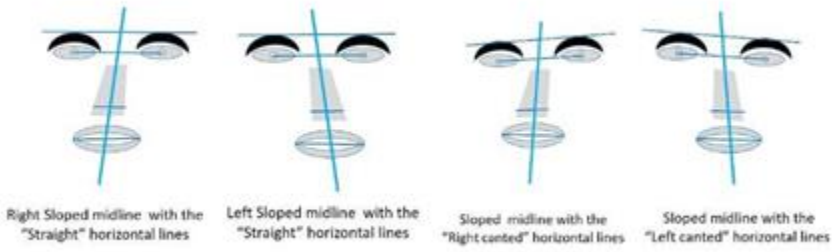

Image 4: Sloped Midline.

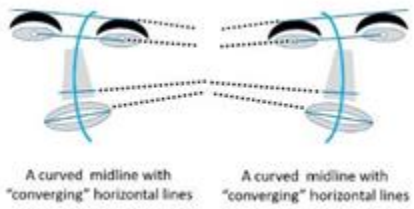

Image 5: Converging Midlines.

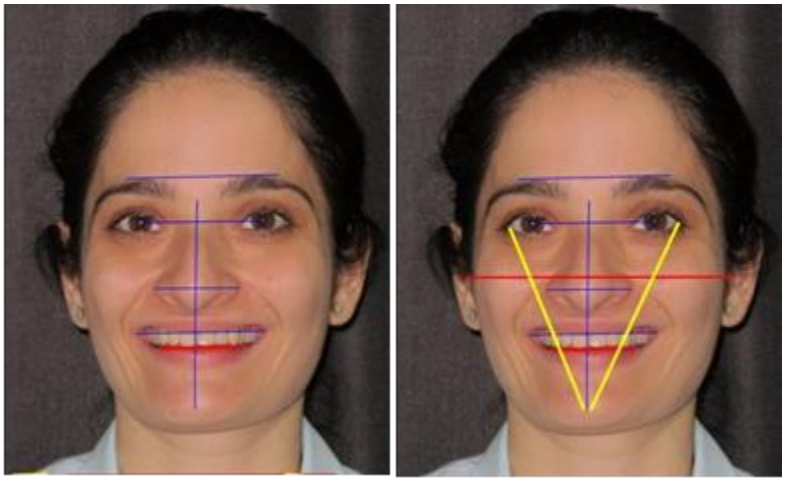

Figure 3 and 4: Horizontal lines drawn and Smylist® Sloped Midline.

Figure 3 and 4 are an example of one of the subjects of the study exhibiting the "straight parallel" horizontal line pattern and the "right sloped" vertical midline. This information was then extrapolated into a spreadsheet and a table was generated for all the 100 subjects. The data required very simplistic statistical work to find out the percentage of subjects having each of the five types of horizontal line patterns. A similar statistical analysis was carried out for each of the five classification of midlines. The results tables presents the incidence of the horizontal lines and the midlines.

3. Results

The data for the 100 subjects was grouped into males and females and the distribution of the subjects based on the gender was an equal 50 %. This is presented in Table 1. The data was then tabulated on the basis of the positioning of the horizontal lines. This was subdivided by gender into male and female. The data is presented in Table 2. In the Parallel group the "Straight" was a total of 30% of the sample size. Females contributed 18% and the males 12% of the sample. The total of the "Canted" pattern was 42% of the total, being almost equally divided between the right and the left canted groups. The "converging" pattern made up 27% of the sample size with 11% converging to the right and 16% to the left. The third and most important table presents the incidence of the various kinds of midlines. This data has also been divided into male and females. The straight midline was only 5% of the total while the sloped was present in 68% of the subjects. As expected the curved midline was seen in 27% of the subjects which is in concurrence with the horizontal converging pattern. It is important to realize that the Straight Smylist® Midline can exist only with the "straight"" horizontal lines but will not be observed in the "converging" horizontal line pattern. The Sloped Smylist® Midline could be present with the "straight" and the "canted" horizontal lines. The Curved Smylist® Midline only presents itself when the horizontal lines are converging to either side of the face. Therefore it is very important to look at the horizontal line pattern which helps in identifying which kind of midline is present in the individual. The three tables amply display the incidence of the various kinds of facial midlines that can exist in any human population. The next table is a subset of all subjects who had a Sloped Smylist®

Midline. The distribution of these subjects across the two horizontal line patterns was assessed. These findings are presented in Table Four. It is an interesting piece of data, that 40% of subjects who had a Sloped Smylist® Midline exhibited the straight horizontal lines while the balance 60% were the canted horizontal lines. Conversely it should be noted that out of the five subjects who had a Straight Smylist® midline, all exhibited a straight horizontal lines. It is possible to have a Straight Smylist® Midline with canted horizontal lines but none of the 100 subjects exhibited this combination.

	Male	**Female**
Subject	50	50

Table 1: Gender Distribution.

	Parallel				**Converging**		
	Straight	**Canted**					
	Total	**Right**	**Left**	**Total**	**Right**	**Left**	**Total**
Males	12 %	9 %	14 %	22 %	6 %	9 %	15 %
Females	18 %	13 %	7 %	20 %	5 %	7 %	12 %
Both	30 %	22 %	21 %	42 %	11 %	16 %	27 %

Table 2: Horizontal lines distribution.

	Straight Total	**Sloped Right**	**Sloped Left**	**Sloped Total**	**Curved Right**	**Curved Left**	**Curved Total**
Males	3%	19%	13%	30%	6%	9%	15%
Females	2%	21%	15%	38%	5%	7%	12%
Both	5%	40%	28%	68%	11%	16%	27%

Table 3: The Smylist® individual midline.

	Straight	**Canted**
Subjects with sloped midlines	40 %	60 %

Table 4: Horizontal lines pattern in sloped midlines.

4. Discussion

As presented in the review of literature, the concept of the hypothetical straight midline has been accepted by the dental profession as a sacrosanct truth. When landmarks have been found to be deviating away from the hypothetical facial midline, it has been accepted a minor deviation and the hypothetical midline has still been used for aesthetic and functional dental rehabilitation. Dental professionals have observed that there are issues and problems which come up at a later stage when the dentistry is planned around this hypothetical midline. It has required a very critical thought process to move away from this assumption and to lay down a new basis for understanding why anatomical landmarks are not consistent with the hypothetical straight midline. This new basis is the Smylist® classification of facial midlines as straight, sloped and curved rather than assume that it is always straight. This is much more closer for an individual midline rather than use the "average" straight midline for all cases. The results of this study clearly demonstrates the very low incidence of the Smylist® Straight Midline as was suggested in the Smylist® concept. The sloped midline is the most prevalent facial midline observed with the curved midline a distant second. This confirmation of the Smylist® concept makes a very emphatic statement, especially when any kind of aesthetic treatment planning is considered. Furthermore, these findings become extremely clinically significant when considering the functional component of the dentition. Very little significance has been given to the maxillary occlusal plane and its harmony with the skeletal make up of the patient. When the maxillary occlusal plane is not designed in harmony with the skeletal structure in a full mouth rehab, it can lead to serious consequences. These can impact the body very adversely in many different aspects. Details are available on articles on the "Negative Cascade Effect" as presented by the Smylist® concept. Since the Smylist® Straight Midline is observed in a very small percentage of the general population it would be prudent to very seriously consider this parameter as one of the most critical parameter when delivering dental therapy rather than creating an arbitrary midline and using it for all cases. Smylist® strongly recommends using the "Smylist® Individual Midline" of the patient in the development of aesthetics and function in the dentition rather than an average straight vertical midline. This "Smylist® Individual Midline" should be the basis for the maxillary occlusal place which in turn ensures full harmony and complete body balance. The Smylist® Aesthetic Design software proves to be the most important tool in confirming the midline for any patient. It just takes a matter of minutes to position the horizontal lines and then mark the landmarks to plot the midline. It is suggested that this step should be carried out for all patients desiring dental therapy. The Smylist® Midline has been used for over a decade in clinical practice and found to be the most critical basis for treatment planning with a very stable end result.

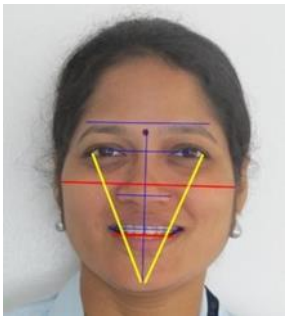

Figure 5: The Sloped Midline.

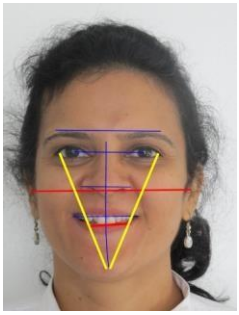

Figure 6: The Curved Midline.

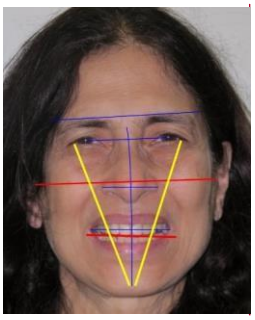

Figure 7: The Curved Midline.

The pictures in Figure 5,6 and 7 are shown with the lines plotted by using the Smylist® Aesthetic software and demonstrates how the horizontal lines are made in the Smylist® Aesthetic Software and a midline created. These are three examples of sloped and curved midlines. It can be observed that there are additional lines visible in all these photographs. The two red horizontal lines are the TMJ horizontal line and the occlusal plane line. There are two vertically angulated lines in yellow which help in creating the line angle for the canines. All of these are generated by the Smylist® Aesthetic Software which is the most wonderful tool for creating the basis for ideal treatment planning. This system has been used by the principal author for over a

decade in clinical practice. This subjects recruited in this study have been all of Indian origin and from the city of Mumbai. It is proposed that such studies should be carried out in various ethnic groups around the world to ascertain the distribution patterns in various populations around the world. The Smylist® concept believes that different ethnic groups would show different patterns. An observation made in an European population in an ongoing study shows that the Smylist® Curved Midline is the predominant one rather than the Sloped.

5. Conclusions

The results of this study show that the individual Smylist® Midline in humans can have three main variations. These variations are as defined in the materials and methods and the incidence of the generally accepted straight midline is only 5 % which is consistent with existent literature. The incidence of the Sloped Smylist® and the Curved Smylist® Midlines are 68 % and 27 % respectively. This sheds a completely new light on how the maxillary teeth should be positioned especially as regards to positioning the maxillary occlusal plane and the placement of the midpoint of the central incisors and the position/inclination of the canines. Aesthetic and functional dentistry should be planned and delivered according to this very critical element. The Smylist® midline concept can be used in any subject in dentistry.

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