Quantifying the Arch Position of the Female Eyebrow

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Objective: To devise a quantitative aesthetic model for the eyebrow arch position (EAP) in women.

Methods: Full-face frontal magazine photographs of 100 fashion models published between January and July 2001 were analyzed. Apparent EAP relative to a line through the medial canthus parallel to the midline was compared with eyewidth (EW). A similar comparison was made between the lateral limbus (LL) and the EW. Standardized full-face frontal photographs of 105 randomly selected women aged 21 to 61 years were taken after obtaining informed consent. The photographs were analyzed in the same manner as those of the fashion models. Both populations had the medial and lateral extents of their eyebrows analyzed.

Results: The mean±SD EAP:EW ratio for the fashion models was 0.978±0.131; the mean±SD LL:EW ratio was 0.735±0.0673. The mean±SD EAP:EW ratio for the randomly selected group was 0.929±0.146; the mean±SD LL:EW ratio was 0.762±0.0420.

Conclusions: The EAP has been described as being above the LL. This does not reflect the EAP seen in both of our study groups. The EAP seems to be 93% to 98% of an EW in the aesthetic model derived from these data.

Arch Facial Plast Surg. 2003;5:235-239

The eyebrow holds a unique quality in the human face. It can help convey expressions such as anger, happiness, sadness, and tiredness. As we age, the eyebrow position may change with the effects of gravity and sun exposure, which often can result in people inquiring about ways to make themselves look younger and more energetic.

Fascination with beauty and eyebrows dates back to early human civilization. Johann Wincklemann (1717-1768) was an art historian who analyzed the ancient Greek’s ideals of beauty. He described the “eyebrows of grace” as being “eyebrows that form a delicate arch just above the brow bone. Of particular appeal were eyebrows that grew together, meeting in the midline.”

Westmore2 proposed the more modern model of the aesthetic eyebrow in 1974 (Figure 1). Westmore’s model states that the highest point of a woman’s eyebrow should lie over the lateral limbus (LL). The medial portion of the eyebrow should fall in a vertical line with the lateral ala and the medial canthus. The lateral extent should fall in a tangential line connecting the lateral canthus and the lateral ala.

Finally, the medial and lateral aspects of the eyebrow should fall in the same horizontal plane. Ellenbogen3 and Brennan4 support this model.

In 1985, Angres5 introduced an arch point that differed from this classic model. He believed that the arch point depended on the amount of space between the eyes. Normally spaced eyes, an eye width (EW) apart, should have the arch above the pupil. Wide-set eyes should have the arch nasal to the medial limbus. Finally, close-set eyes should have the arch above the LL, in agreement with Westmore’s model. In 1987, Tolleth6 made an effort to separate men and women. He believed that the male eyebrow should be flat, that is, without an arch, and that the female eyebrow should have an arch at the junction of the inner two thirds and outer one third of the eye. Cook et al7 also departed from Westmore’s model, believing that the arch above the LL imparted a look of surprise and was unnatural. He reviewed what were considered attractive faces and concluded that the arch should lie more laterally above the lateral canthus. The remaining variables set forth by Westmore remained valid.

Several studies have used computer alterations of the apparent brow and arch...
position. Freund and Nolan8 tested the opinions of plastic surgeons and cosmetologists by using altered photographs of the same models. Both of these groups agreed that the arch should be lateral to the LL. Gunter and Antrobus9 performed a similar study by showing altered photographs to a group of plastic surgeons. All of these plastic surgeons preferred a gentle arch that lay somewhere between the LL and the lateral canthus. Gunter and Antrobus9 also added that the medial brow should be lower than the lateral brow and should start as a continuation of the superciliary ridge.

In 1997, Woffert et al10 also differed from the classic model of Westmore. They believed that the arch should be halfway between the LL and the lateral canthus. However, they agreed that the medial and lateral extents of the brow should lie in the same horizontal plane.

Although there has been considerable literature about eyebrow aesthetics, none of these authors offer a method for quantifying the eyebrow arch position (EAP), allowing individual judgment to supersede a quantifiable measure. We believe that the arch of the female eyebrow is lateral to the LL. Our goal is to quantify the EAP in modern female fashion models and a group of randomly selected women in a simple and reproducible manner. We believe that describing the EAP in women is a realistic goal that may help provide a standard for surgical treatment.

METHODS

The first part of the study entailed looking at recent fashion magazines (January to July 2001) for full-face frontal photographs of modern female fashion models. The left eyebrow was analyzed in all cases. A reference line was drawn from the midline point between the eyes and the midline of the upper lip. A line parallel to this was drawn through the medial canthus. A tangential line was drawn through the lateral canthus and the lateral ala of the nose. The EW was measured by taking the distance between the medial and lateral canthi. A perpendicular line was drawn from the apparent EAP and from the LL to the line drawn between the 2 canthi. The EAP was defined as the highest point along the superior aspect of the eyebrow. A ratio was made between the EAP and the EW as well as between the LL and the EW. All measurements were made using a metric ruler.

After obtaining approval for this study from the Louisiana State University Health Sciences Center institutional review board, a group of randomly selected women aged 21 to 61 years had full-face frontal photographs taken by us (J.M.R. and S.E.M.). Participants signed informed consent forms for participation in the study and for the use of their photographs. They completed a survey asking about age, ethnic background, any former surgery, trauma, plucking, waxing, and use of cosmetics. Participants stood 1.2 m from the photographer and had a full-face frontal photograph taken in repose using a 110-mm zoom lens.

Measurements were made on these photographs in the same manner as on the photographs of the fashion models. Participants were assigned a number related to their photograph.

In both populations, a qualitative assessment of the medial and lateral extents of the eyebrows was made. A horizontal line perpendicular to the line through the medial canthus was drawn from the inferior edge of the medial aspect of the eyebrow across to the lateral aspect of the eyebrow. The lateral extent of the eyebrow was noted to be superior to, inferior to, or within this horizontal plane. The line drawn through the medial canthus was used to see whether the medial eyebrow lies medial to, lateral to, or within the same vertical plane. Finally, the tangential line was used to see whether the lateral eyebrow is medial to, lateral to, or within this tangential plane (Figure 2).

RESULTS

The mean EAP:EW and LL:EW ratios for the female fashion models are summarized in Table 1. Of these 100 women, 76 were white and 24 were African American.

One hundred five women aged 21 to 61 years (average age, 35 years) signed the consent forms, completed the surveys, and had full-face frontal photographs taken. Seven women reported trauma to the eye, eyelid, or eyebrow, including being hit in the face, having a small cut in the eyebrow, a broken nose, a second-degree burn due to waxing the eyebrow, and a retinal detachment. Two of these individuals required surgical intervention. One person stated that she had undergone a blepharoplasty, another had a birthmark removed and required a skin graft, and 2 had laser surgery to improve their vision. Individuals with ophthalmologic surgery for either visual correction or retinal detachment and those with a history of a black eye or a broken nose without requiring surgical intervention were included. Individuals with significant trauma requiring surgery or who had cosmetic surgery to the eye, eyelid, eyebrow, or surrounding structure were removed from the study, giving a final number of 100 participants. Of these women, 65% admitted to plucking their eyebrows or having them waxed; 70% stated daily or regular use of cosmetics to the eye, eyelid, eyebrow, or surrounding area; and 63% were white, 33% were African American, and 2% were Asian. The mean EAP:EW and LL:EW ratios are summarized in Table 1.

Age assessments of the fashion models could not be made. Of the random group of women photographed, 38

Figure 1. Westmore’s model of eyebrow aesthetics.
were aged 21 to 29 years, 35 were aged 30 to 39 years, 16 were aged 40 to 49 years, and 11 were 50 years or older. The breakdown of the EAP:EW and LL:EW ratios is given in Table 1. The data generated for each ethnic background (both populations), for those who reported plucking or waxing vs those who did not, and for those who reported daily use of cosmetics vs those who did not are also summarized in Table 1.

A qualitative assessment of the medial and lateral eyebrows was made in both populations (Table 2).

### Table 1. Summary of the EAP:EW and LL:EW Ratios for Both Populations and Subsets

<table>
<thead>
<tr>
<th>Group</th>
<th>EAP:EW</th>
<th>LL:EW</th>
</tr>
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<tbody>
<tr>
<td><strong>Fashion models</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.978 ± 0.131</td>
<td>0.735 ± 0.0673</td>
</tr>
<tr>
<td>White</td>
<td>0.978 ± 0.133</td>
<td>0.733 ± 0.0696</td>
</tr>
<tr>
<td>African American</td>
<td>0.973 ± 0.126</td>
<td>0.738 ± 0.0690</td>
</tr>
<tr>
<td><strong>Random women</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.929 ± 0.146</td>
<td>0.762 ± 0.0420</td>
</tr>
<tr>
<td><strong>Age, y</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-29</td>
<td>0.952 ± 0.156</td>
<td>0.753 ± 0.4060</td>
</tr>
<tr>
<td>30-39</td>
<td>0.918 ± 0.107</td>
<td>0.752 ± 0.0448</td>
</tr>
<tr>
<td>40-49</td>
<td>0.942 ± 0.130</td>
<td>0.747 ± 0.5860</td>
</tr>
<tr>
<td>≥50</td>
<td>0.870 ± 0.266</td>
<td>0.766 ± 0.2760</td>
</tr>
<tr>
<td><strong>Pluck and/or wax</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.937 ± 0.146</td>
<td>0.753 ± 0.0443</td>
</tr>
<tr>
<td><strong>Asian</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.909 ± 0.150</td>
<td>0.753 ± 0.0402</td>
</tr>
<tr>
<td><strong>Use cosmetics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.936 ± 0.142</td>
<td>0.750 ± 0.0442</td>
</tr>
<tr>
<td><strong>Do not use cosmetics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.929 ± 0.124</td>
<td>0.744 ± 0.4160</td>
</tr>
</tbody>
</table>

**Abbreviations:** EAP, eyebrow arch position; EW, eye width; LL, lateral limbus.

*Ratios are given as mean ± SD.

Our data are mainly from white and African American women and may not be accurate for Asian women. The models of eyebrow aesthetics derived from both populations are displayed in Figure 2 and Figure 3.

In female fashion models, the EAP seems to be medial to the lateral canthus, or 98% of an EW. The lateral brow should be slightly superior to the medial brow in the horizontal plane, although our study does not delineate how much more superior it should be. The medial extent of the brow should be medial to directly superior to the medial canthus in the vertical plane, and the lateral extent of the brow should lie in the tangential plane through the lateral ala and the lateral canthus.

In the group of random women, the EAP again seems to be more lateral than suggested by Westmore’s model, being 93% of an EW. The medial and lateral brows were most frequently found in the same horizontal plane. The lateral brow was more often found below the medial brow in this population and may be due to age-related changes. The medial extent of the brow most often is superior to the medial canthus in the vertical plane, but the lateral extent of the brow was more lateral than the tangential plane in most cases.
Several physiologic processes can affect the EAP. The most common process is ptosis of the eyebrow. Lemke and Stasior\textsuperscript{11} described the physiologic features of eyebrow ptosis in 1982. They described the eyebrow as a specialized area of sliding superficial musculature. It lies superior to where the frontalis and orbicularis oculi interdigitate. This area forms a firm attachment to the underlying bone similar to the nuchal line in the posterior aspect of the skull. This attachment exists especially over the medial aspect of the eyebrow, extending laterally approximately half to two thirds the length of the brow. Because the lateral half to one third is less densely adherent to the underlying skull, the lateral brow is more subject to ptosis. In addition, the orbicularis oculi muscle plays the predominant role laterally and pulls down on the eyebrow laterally, which has led some authors\textsuperscript{12} to state the need for more emphasis on correction of the lateral brow than the medial brow.

Ptosis of the brow may be so severe that it can give the appearance of blepharochalasis. Most authors\textsuperscript{4,12,13} stress the need to address the brow in these circumstances. Undesirable outcomes may occur if eyelid skin is removed when elevation of the brow is more appropriate. At the same time, there is controversy over the role of blepharoplasty and the lowering of the eyebrow, with some authors\textsuperscript{12} believing that it can lower the brow secondary to loss of visual incentive to keep the eye open and others\textsuperscript{13} believing that it is unchanged in its position.

A multitude of surgical corrective procedures and types of incisions has been described for raising the eyebrow, including direct browlift,\textsuperscript{4,14-16} midforehead browlift,\textsuperscript{7,14} pretrichial browlift,\textsuperscript{14} coronal browlift,\textsuperscript{3,7,14,17} and endoscopic browlift.\textsuperscript{18} Sometimes the brow can be addressed as an adjunct to blepharoplasty,\textsuperscript{3,19,20} and the use of botulinum toxin to raise the eyebrows has also been described.\textsuperscript{21} All of these procedures try to re-create the common appearance of the eyebrow and to conform to set eyebrow aesthetics.

The surgical procedures rely on vectors of pull to create a distinct eyebrow arch in female patients. Under the classic definition, a vector of pull is placed above the LL to re-create this arch appearance to conform to Westmore’s model. Ellenbogen\textsuperscript{3} describes vectors of pull to re-create Westmore’s aesthetic model in the coronal forehead lift. Byrd\textsuperscript{15} describes a vector of pull that achieves a more lateral lift in patients with lateral brow ptosis. He believes that the lateral vector of pull should follow the tangential line through the lateral ala and the LL, as this tries to create an arch or high point at the junction of the medial two-thirds and lateral one-third similar to the aesthetic model proposed by Tolleth.\textsuperscript{6} Daniel and Tirkanis\textsuperscript{18} describe a vector more in line with the tangen-

| Table 2. Summary of the Position of the Lateral Brow to the Medial Brow in the Horizontal Plane (LB:MB), the Medial Brow to the Medial Canthus in the Vertical Plane (MB:MC), and the Lateral Brow to the Tangential Line in the Tangential Plane (LB:TL) |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Fashion models, %            | 72             | 24              | 4               | 55              | 42              | 3               |
| Random women, %               | 20             | 40              | 32              | 28              | 61              | 11              |

Figure 3. Eyebrow arch position and qualitative eyebrow position in each aesthetic model: Westmore’s model (A), a fashion model (B), and a random woman (C).
tial line running through the lateral canthus and the lateral ala through a temporal incision. His lateral incision is often placed above the lateral canthus to help accentuate this lateral pull. Our data suggest a more lateral pull to give a further lateral appearance of the arch as the more common appearance seen in fashion models and professional women.

Eyebrow position has been measured in a variety of ways in the past. Cartwright et al measured eyebrow height from the upper eyelid lash line to the first row of mature eyebrow hairs at the inferior margin of the eyebrow in the papillary axis. They discovered that the height was consistently greater in females than in males, with variation between 5.8 and 7.1 mm. Oestreicher and Hurwitz used a specialized device to measure eyebrow height in several positions, believing that it more accurately reflected the 3-dimensional nature of the face. Connell et al stated that the opening between the upper eyelid crease and the eyebrow should be 15 mm. Flowers et al suggested that a minimum of 27 mm of upper eyelid skin is required between the upper lash line and the eyebrow, with 30 mm being preferable. McKinney et al measured the distance from the pupil to the top of the brow before surgery to be 1.6 to 2.2 cm and after surgery to be 2.4 to 2.8 cm in patients undergoing aesthetic forehead lifts. Matassaro and Tering summarized these vertical measurements in the midpupil horizontal plane as follows: inferior edge of the brow to the supraorbital rim, 1 cm; inferior brow to eyelid crease, 1.6 cm; brow to midpupil, 2.5 cm; and superior brow to the hairline, 5 to 6 cm. None of these measurements address the arch position or exactly how much higher this point should be relative to the medial and lateral extent of the eyebrow. Although we address position in the horizontal plane of the eye, this vertical height would also be an interesting measurement.

If we accept the thought that fashion models display our ideals of beauty, then the aesthetic model derived from them should be adopted. Two major changes to the classic model of eyebrow aesthetics proposed by Westmore can be derived from these data. First, the EAP should be more lateral than the LL and should be just medial to the lateral canthus. This would make the EAP 98% of an EW. Second, the lateral brow should be superior to the medial brow in the horizontal plane.

We present a simple and reproducible method for determining the EAP in women. Our data differ significantly from the previously established models and quantifies its position. The EAP is definitely more lateral than the model proposed by Westmore and as suggested by others in the past. We quantified the EAP to be 93% to 98% of an EW in the horizontal plane in a group of random women and female fashion models. Future studies may benefit from trying to clarify how much higher in the vertical plane this variable should be.

Accepted for publication February 26, 2002.

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REFERENCES