Comparison of techniques used to locate the malar eminence

Patrik Nechala BSc[1], James Mahoney MD FRCSC FACS[1], Leslie G Farkas MD PhD DSc FRCSC[2]
[1]*Division of Plastic Surgery, St Michael's Hospital;* [2]*Craniofacial Measurement Laboratory, Craniofacial Program, Division of Plastic Surgery, The Toronto Hospital for Sick Children, Toronto, Ontario*

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INTRODUCTION: The malar eminence is of surgical interest for several reasons including facial trauma, esthetics and congenital anomalies.
OBJECTIVE: To compare several techniques developed to locate the malar eminence on live subjects.
METHODS: An initial trial involving 30 men and women located the malar eminence using Hinderer's, Wilkinson's, Powell's and maxillozygion methods. A subsequent trial used a custom-made measuring device called the anthropometer to examine 11 volunteers. In this part of the study, only Hinderer's and Wilkinson's methods of intersecting lines were used in addition to the palpated maxillozygion. The location of the three points was recorded relative to the vertex, opisthocranion and facial midline.
RESULTS: During the initial trial, it was recognized that Powell's method of intersecting lines describes a point too lateral to use concomitantly with the other methods of intersecting lines. The distances of Hinderer's, Wilkinson's and Powell's points from the maxillozygion were 8.5±2.9 mm, 7.6±3.3 mm and 28.4±4.8 mm, respectively. In the second part of the study, Hinderer's point, in general, is medial and inferior to the maxillozygion, while Wilkinson's point is lateral and an equal distance from the vertex as the maxillozygion. The three points appear to be randomly interspersed in their distances from the opisthocranion.
CONCLUSIONS: By combining the techniques of intersecting lines and direct palpation, a more comprehensive evaluation of the malar complex can be made. This is especially true in cases where there exists an asymmetry in the bony skeleton that is then compensated by the overlying soft tissues.

KEY WORDS: *Anthropometry; Facial landmark; Malar eminence*

Comparaison des techniques utilisées pour localiser l'éminence malaire

INTRODUCTION : L'éminence malaire revêt un certain intérêt chirurgical pour plusieurs raisons comprenant traumas faciaux, esthétique et anomalies congénitales.
OBJECTIF : Comparer plusieurs techniques développées pour localiser l'éminence malaire sur des sujets vivants.
MÉTHODES : Un essai initial impliquant 30 hommes et femmes a localisé l'éminence malaire au moyen des méthodes de Hinderer, de Wilkinson, de Powell et en repérant le maxillo-zygion. Un essai subséquent a utilisé un appareil de mesure conçu sur mesure appelé anthropomètre pour examiner 11 volontaires. Dans cette partie de l'étude, seules les méthodes des lignes de croisement de Hinderer et de Wilkinson ont été utilisées en plus de la palpation du maxillo-zygion. La localisation des trois points a été enregistrée par rapport au sommet, à l'opisthocrânion et à ligne médiane faciale.
RÉSULTATS : Pendant le premier essai, il a été reconnu que la méthode des lignes de croisement de Powell décrit un point trop latéral pour l'utiliser concomitamment avec les autres méthodes des lignes de croisement. Les distances des points de Hinderer, de Wilkinson et de Powell à partir du maxillo-zygion étaient respectivement de 8,5 ± 2,9 mm, 7,6 ± 3,3 mm et 28,4 ± 4,8 mm. Dans la deuxième partie de l'étude, le point de Hinderer, en général, est médian et inférieur au maxillo-zygion, tandis que le point de Wilkinson est latéral et situé à la même distance du sommet que le maxillo-zygion. Les trois points semblent être éparpillés au hasard relativement à leurs distances par rapport à l'opistocrânion.
CONCLUSIONS : En combinant les techniques des lignes de croisement et la palpation directe, on peut pratiquer une évaluation plus globale du complexe malaire. Ceci est particulièrement vrai dans les cas où il existe une asymétrie dans le squelette osseux qui est alors compensée par les tissus mous sus-jacents.

Correspondence: Dr JL Mahoney, St Michael's Hospital, 30 Bond Street, fourth floor-080, Toronto, Ontario M5B 1W8. Telephone 416-864-5385, fax 416-864-5888, e-mail james.mahoney@utoronto.ca

The malar eminence is of surgical interest for several reasons. Facial trauma and congenital anomalies often result in malar asymmetries. Esthetically, prominent cheekbones are desirable. Several methods of locating the malar eminence have been developed (Figure 1). Techniques using intersecting lines to derive the location of the malar eminence include Hinderer's (1), Wilkinson's (2), Powell's (3), Silver's (4) and Prendergast's (5) methods. In addition, a previously described point called the maxillozygion derives the location of the malar eminence by palpation only (6). We thought that it would be interesting to compare these techniques and their usefulness for examining the malar eminence in a clinical setting.

The technique of locating the maxillozygion begins by locating the superior and inferior borders of the zygomatic arch. These borders are then traced anteriorly to the area

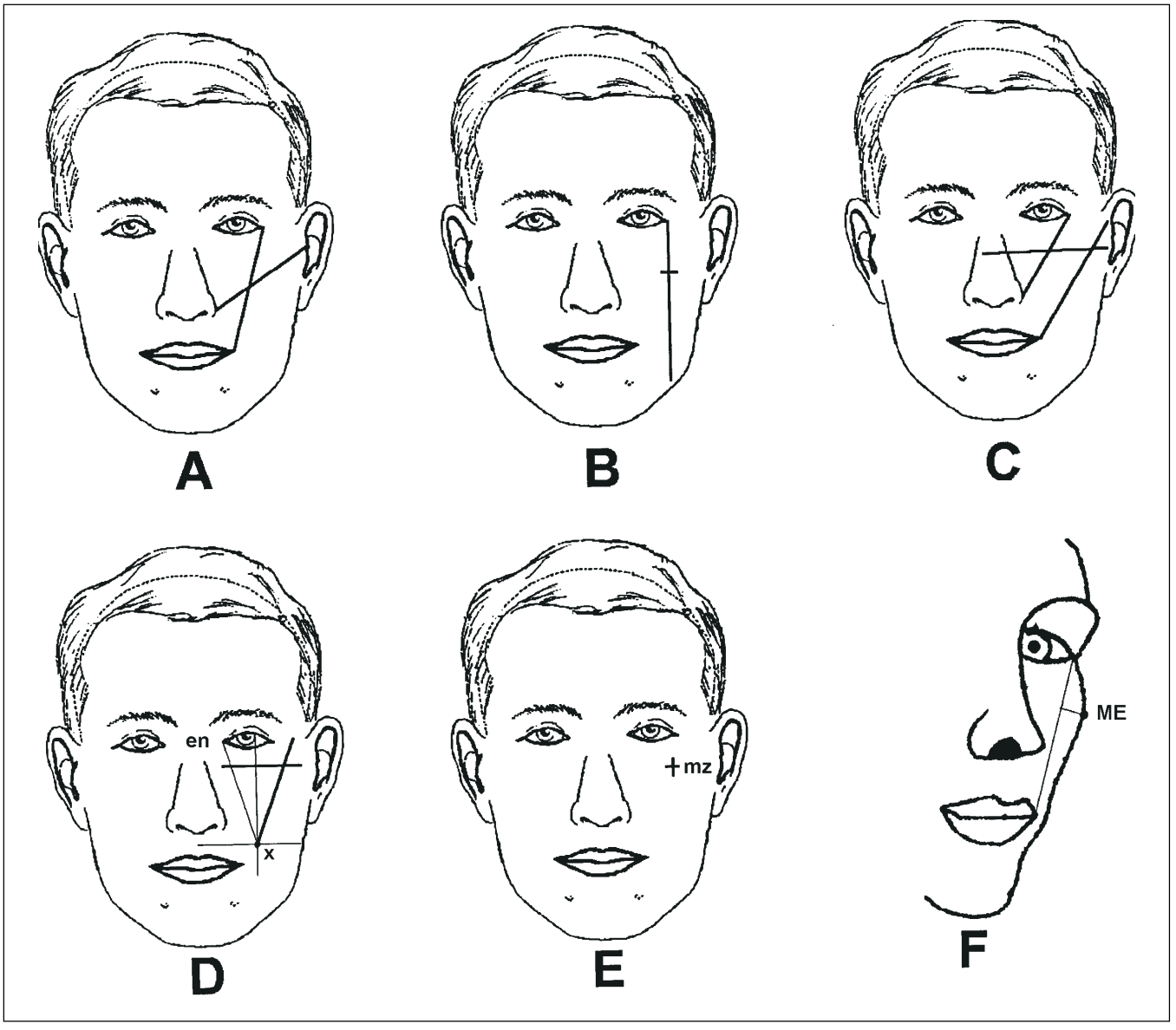

Figure 1) **A** *Hinderer's method locates the malar eminence at a point of intersection of two lines. The first line connects the ala and tragus, and the second line connects the commissure of the lip and the exocanthion.* **B** *Wilkinson's method drops a line vertically downwards from the exocanthion to the edge of the mandible. The malar eminence is located at one-third the distance from the exocanthion to the mandible.* **C** *Powell's method connects the ala to the exocanthion. A second line parallel to the first originating at the commissure of the lip is drawn. Finally, a third line is drawn horizontally that bisects the distance from the nasion to the nasal tip. The intersection of the second and third lines is the malar eminence.* **D** *Silver's method begins by dropping a vertical line from the limbus as the patient stares forward. A second horizontal line that divides the distance from the vermillion border of the upper lip and the nasolabial angle in half is then drawn across the first line. The intersection of the first two lines is point x, and from this point a line is drawn to the endocanthion (en). The angle between the first line and line x-en is reflected laterally to form a new line originating at x. Finally, where this last line and the Frankfurt Horizontal cross is defined as the malar eminence.* **E** *The approximate location of the maxillozygion (mz), which is derived by palpation.* **F** *Prendergast's method connects the commissure of the lip to the exocanthion. At 66% of the length of this line, a second line is drawn at 90°. The intersection of the second line and the edge of the cheek is the malar eminence (ME)*

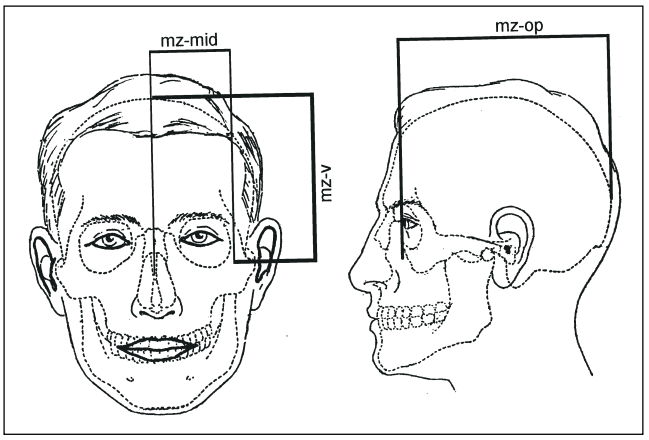

Figure 2) *The distances measured in the second part of this study are represented by the maxillozygion-vertex (mz-v), maxillozygion-opisthocranion (mz-op) and maxillozygion-facial midline (mz-mid). Note that the distances Wilkinson's point-vertex, Hinderer's point-vertex, Wilkinson's point-opisthocranion, Hinderer's point-opisthocranion, Wilkinson's point-facial midline and Hinderer's point facial-midline were measured in a similar fashion*

below the exocanthion, and the most anterior protruding point lying between the extended zygomatic arch borders is palpated (6).

Hinderer's (1) method locates the malar eminence at a point of intersection of two lines (Figure 1A). The first line connects the ala and tragus, and the second line connects the commissure of the lip and the exocanthion.

Wilkinson's (2) method requires only one line (Figure 1B). The line begins at the exocanthion and proceeds vertically downwards to the edge of the mandible. The malar eminence is located at one-third the distance from the exocanthion to the mandible.

Powell's (3) method is based on three-dimensional reconstruction of computed tomography scans conducted on normal subjects (Figure 1C). Powell makes no mention regarding the usefulness of his technique in a clinical setting; however, because it is based on three dimensions it can be used directly on a subject. The method begins by drawing a line that connects the ala to the exocanthion. A second line is then drawn parallel to the first originating at the commissure of the lip. Finally, a third line is drawn horizontally that bisects the distance from the nasion to the nasal tip. The intersection of the second and third lines is the malar eminence. It should be noted that according to Powell's (3) study, the horizontal line that bisects the distance from the nasion to the nasal tip often matches the location of the Frankfurt Horizontal.

Silver's (4) method begins by dropping a vertical line (A) from the limbus as the patient stares forward (Figure 1D). A horizontal line (B) that divides the distance from the vermilion border of the upper lip and the nasolabial angle in half is then drawn across line (A). The intersection of line A and B is point x, and from this point a line is drawn to the endocanthion (en). The angle between line A and line x-en is reflected laterally in line A to form a new line originating at x. Finally,

TABLE 1
Distance measured on the face to compare methods of locating the malar eminence

Direction	Maxillozygion (mz)	Wilkinson's point (wilkin)	Hinderer's point (hinder)
Vertical	mz-v	wilkin-v	hinder-v
Sagittal	mz-op	wilkin-op	hinder-op
Horizontal	mz-mid	wilkin-mid	hinder-mid

mid Facial midline; op Opisthocranion; v Vertex

where this last line and the Frankfurt Horizontal cross is defined as the malar eminence. It is clear that Silver's method is quite complicated, and for this reason it is not useful in a clinical setting. Furthermore, Silver (4) does not clarify whether his method is based on direct anthropometric studies or whether it is based on photogrammetric studies. Because the method depends on the limbus of the eye, the technique might not be useful on patients with esotropion or exotropion. Due to the above difficulties with Silver's method, it was not used in this study.

Prendergast's (5) method is based on a photogrammetric evaluation of the malar eminence using oblique views of the subject (Figure 1F). After obtaining an oblique photograph of the subject, a line from the most lateral point of the malar complex is intersected at 90° to the commissure-canthus line at 66% of its length. The reproducibility of this method is in question because Prendergast (5) provides no guidelines on how to obtain the oblique photographs. Moreover, because this method is based on photogrammetry, its clinical usefulness is limited. For these reasons, this method was not used in this study.

PATIENTS AND METHODS

Approval for this study was obtained from the ethics committee at St Michael's Hospital, Toronto, Ontario. All subjects were healthy with no notable facial asymmetry. The initial trial involved 30 men and women; malar eminences were located using Hinderer's, Wilkinson's and Powell's methods of intersecting lines. In addition, the maxillozygion was also located. The techniques used for locating these points are described above. Once the points were located, the distances between the points were recorded.

The subsequent trial used a custom-made measuring device called the anthropometer (L Farkas, personal communication), which was used to examine 11 volunteers. The subjects' heads were placed in the anthropometer, and its use allowed the recording of the three-dimensional coordinates of any selected point relative to any other point in the craniofacial complex. In this part of the study, only Hinderer's and Wilkinson's methods of intersecting lines were used, in addition to the palpated maxillozygion. The locations of Hinderer's point, Wilkinson's point and the maxillozygion were recorded relative to the vertex, opisthocranion and facial midline (Figure 2). Essentially, nine distances were measured on each side of the face (Table 1).

RESULTS

During the initial trial, it was recognized that Powell's method of intersecting lines describes a point too lateral to use concomitantly with the other methods of intersecting lines. For this reason, Powell's point was not used in the second trial. The distance of Hinderer's, Wilkinson's and Powell's points from the maxillozygion were 8.5±2.9 mm, 7.6±3.3 mm and 28.4±4.8 mm, respectively. It was also noted that Hinderer's point tended to lie inferomedial to the maxillozygion; Wilkinson's point tended to lie lateral to the maxillozygion (either superior or inferior to it), and Powell's point tended to lie superiolateral to the maxillozygion.

The above results were quantified in the second part of the study. When examining the vertical relationship of the points, the vertex was used as a reference point. This meant that points further away from the vertex were lower on the face. More specifically, it was noticed that Wilkinson's point was 3.0±5.1 mm lower on the face than the maxillozygion, and Hinderer's point was 5.5±4.7 mm lower on the face than the maxillozygion. To compare vertical asymmetries of the three points, we defined asymmetry as a difference of 3 mm. Specifically, the maxillozygion-vertex distance was asymmetric in four subjects, the Hinderer's point-vertex distance was asymmetric in one subject and the Wilkinson's point-vertex distance was asymmetric in six subjects.

Sagittal distances were measured using the opisthocranion as a reference point. In this case, points further away from the opisthocranion protrude further forward from the face. Wilkinson's point was 0.7±4.6 mm further from the opisthocranion than the maxillozygion, and Hinderer's point was 2.7±4.0 mm further from the opisthocranion than the maxillozygion. Using the previous definition of asymmetry, the maxillozygion-opisthocranion distance was asymmetric in seven subjects, the Wilkinson's point-opisthocranion distance was asymmetric in three subjects and the Hinderer's point-opisthocranion distance was asymmetric in eight subjects.

Horizontal distances were measured using the facial midline as a reference point. Points further away from the facial midline were more lateral on the face. For all of the subjects, the point closest to the facial midline was Hinderer's point. The maxillozygion was 7.1±4.3 mm further from the facial midline than Hinderer's point, and Wilkinson's point was 3.6±3.8 mm further from the facial midline than the maxillozygion. The maxillozygion-facial midline distance was asymmetric in four subjects, the Wilkinson's point-facial midline distance was asymmetric in one subject and the Hinderer's-facial midline distance was asymmetric in one subject.

DISCUSSION AND CONCLUSIONS

Several techniques have been devised to locate the malar eminence, including techniques of intersecting lines such as those proposed by Hinderer, Wilkinson, Powell, Silver and Prendergast. Of these, only Hinderer's, Wilkinson's and Powell's methods are relevant clinically. Silver's method is too complicated to be used clinically, and in his description it is not clear whether the technique was meant to be used on live subjects or photogrammetrically. Prendergast's method is dependent on photogrammetry, and it is inconvenient to use clinically. Furthermore, Prendergast's method relies on oblique photographs, for which he provides no standardization, bringing into question the reproducibility of his method. Powell's technique provides a reproducible landmark on the face, but his method of intersecting lines provides a point too lateral on the face to be used concomitantly with other techniques. The methods of Wilkinson and Hinderer are simple, reproducible and designed for clinical use on live subjects. Other techniques of assessing the malar eminence include direct palpation as described in elucidating the maxillozygion. This technique is also easy to use, applicable clinically and reproducible.

To assess the malar eminence thoroughly, no one technique can be used in isolation. The combination of Hinderer's and Wilkinson's methods in conjunction with palpation of the maxillozygion provides an assessment of both the soft and bony constituents of the malar eminence.

The technique of using intersecting lines to locate the malar eminence tends to locate the eminence in a symmetric fashion because it relies on other superficial landmarks. On the other hand, direct palpation of the malar eminence, used in locating the maxillozygion, is symmetric only if the underlying bony skeleton is symmetric. This is confirmed by the fact that fewer subjects with facial asymmetries were found when Hinderer's or Wilkinson's methods were used to define the malar eminence compared with the high number of facial asymmetries noted when the maxillozygion was defined.

By combining the techniques of intersecting lines and direct palpation, a more comprehensive evaluation of the malar complex can be made. This is especially true in cases where there exists an asymmetry in the bony skeleton that may be compensated by the overlying soft tissues.

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