Easy Facial Analysis Using the Facial Golden Mask

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For over 2000 years, many artists and scientists have tried to understand or quantify the form of the perfect, ideal, or most beautiful face both in art and in vivo (life). A mathematical relationship has been consistently and repeatedly reported to be present in beautiful things. This particular relationship is the golden ratio. It is a mathematical ratio of 1.618:1 that seems to appear recurrently in beautiful things in nature as well as in other things that are seen as beautiful. Dr. Marquardt made the facial golden mask that contains and includes all of the one-dimensional and two-dimensional geometric golden elements formed from the golden ratio. The purpose of this study is to evaluate the usefulness of the golden facial mask.

In 40 cases, the authors applied the facial golden mask to preoperative and postoperative photographs and scored each photograph on a 1 to 5 scale from the perspective of their personal aesthetic views.

The score was lower when the facial deformity was severe, whereas it was higher when the face was attractive. Compared with the average scores of facial mask applied photographs and nonapplied photographs using a nonparametric test, statistical significance was not reached ($P > 0.05$). This implies that the facial golden mask may be used as an analytical tool.

The facial golden mask is easy to apply, inexpensive, and relatively objective. Therefore, the authors introduce it as a useful facial analysis.

Key Words: Golden ratio, facial golden mask, facial analysis

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Before we consider any surgical operation to correct deformity of the face, we need to establish a concept of "a normal, beautiful face." Beauty is an abstract value quite difficult to define, yet there have been continual efforts made since the ancient Greek era to do so. One of the efforts was "the golden ratio" introduced by Euclid about 3 centuries before Christ. The "golden ratio" (1:1.618), sometimes called "phi," is a ratio obtained when a line is divided into two unequal segments, where the ratio of the longer segment to the whole line is equal to the ratio of the shorter segment to the longer one. This ratio can be observed everywhere, in nature or in the human body.

The golden ratio is widely known in the art world and is also well known in the profession of plastic surgery. Seghers et al[1] reported that the beauty of a human face and body follows this golden ratio. Also, Marquardt[2] created two-dimensional lines using the ratio from which various polygonal structures were designed. He discovered that golden ratios of the decagon fit the beauty of the face best and called it the "facial golden mask" (Fig 1). He claims that this mask applies to the beauty of faces, both Western and Oriental, from ancient to modern day.

Presently, most of the analytical methods being used for facial structure are costly, requiring expensive equipment that only trained technicians can operate and thus limiting the use of the methods for analyses of soft tissues. However, our programs using the Marquardt golden ratio mask solve such problems. We will provide some clinical results and relevant references pertaining to this method.

Patients and Methods

Retrospective analysis was performed on a total of 40 photos taken before and after surgery on 20 patients in our clinic from March 2000 to December 2004. Ten patients were admitted for cosmetic facial contouring surgery and 10 for reconstruction after post-traumatic facial deformities. There were 9 males and 11 females, from 16 to 67 years of age, with an average age of 38. The

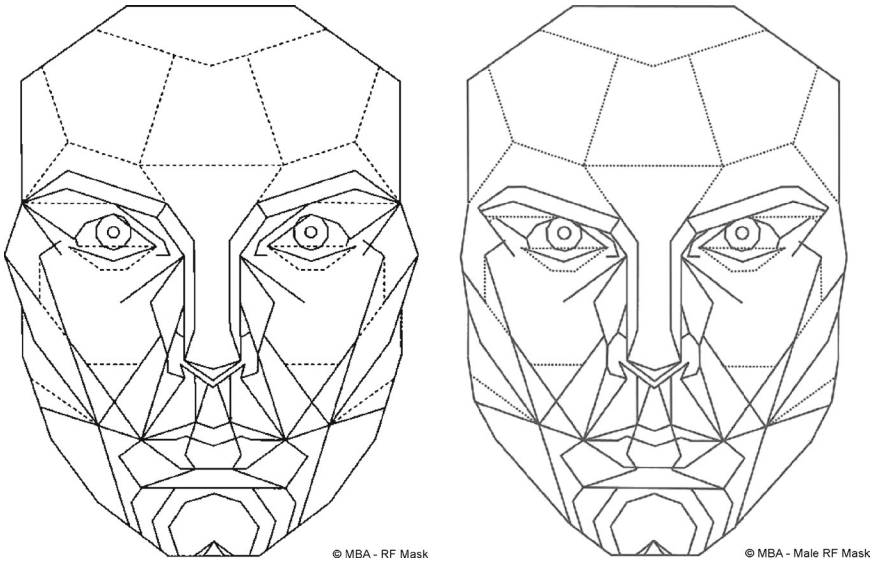

Fig 1 Golden facial mask. Female mask (left) and male mask (right).

postoperative follow-up observation period ranged from 1 month to 48 months, with average period of 14 months.

Adobe Photoshop 7.0 (San Jose, CA) was used on a personal computer. A transparent photo of male or female facial golden ratio mask file showing the lines only was put on the screen concurrently with a photo file to be analyzed, and then they were superposed. The golden mask file was selected and the vertical and horizontal sizes

Fig 2 Application of golden facial mask. A 26-year-old woman with long chin (above, left). Follow-up at 2 years after genioplasty (above, right). Golden facial mask was applied upon preoperative and postoperative photography (below, left and right).

were adjusted while maintaining the ratio. The golden ratio mask file was superposed on the photo file to be analyzed by overlapping the lines drawn between middle of both pupils, the lines connecting both lip commissures, and the lines connecting the glabella and chin, with visually confirmation of how close the correction was to the mask (Fig 2).

Pre- and postoperative photos of the patients taken before the application of the mask were evaluated by a group of four consisting of a plastic surgeon, a medical student, a nurse, and a nonprofessional person on a 1 to 5 scale from the perspective of their personal aesthetic views. Then, the mask was applied to the same photo, which was evaluated by the same group with the same method. We asked the evaluators to evaluate their subjective feeling about beauty most of all. Other observation points as guidelines were symmetry, degree of ocular displacement, balance of other soft tissue organ, and adjustment of facial contour line. Evaluation points on pre- and postoperative photos before and after the application of the mask were compared by the same group. Discrepancies of points on such photos were analyzed by means of nonparametric test to confirm their statistical meaning.

RESULTS

The overall average score before application of the mask was 3.7, whereas overall average score after mask application was 3.5 (Tables 1 and 2). Overall average points of pre- and postoperative photos of 10 patients with post-traumatic facial deformity were 2.6 and 4, whereas overall average points after mask application were 2.3 and 4.6. Overall average points of pre- and postoperative photos of 10 patients whose faces had been operated upon aesthetically before application of the mask were 3.6 and 4, whereas overall average points of pre- and postoperative photos after mask application were 2.3 and 4.6. The point difference between pre- and postoperative photos of a group of patients with facial deformity after trauma before and after mask application was 0.9, whereas the difference increased by 1.3 points when compared with the photos after the profile operation on their faces had been performed. There was no statistical significance observed when the results were analyzed by means of nonparametric test ($P > 0.05$).

Table 1. Average Score of Patient With Post-Traumatic Facial Deformity

	No Mask (n = 10)		*With Mask (n = 10)*	
Case	*Preoperative*	*Postoperative*	*Preoperative*	*Postoperative*
1	3.0	4.0	2.8	4.5
2	2.5	4.0	2.3	4.5
3	2.8	4.0	2.3	5.0
4	1.3	3.0	2.0	4.3
5	2.3	4.0	2.0	5.0
6	3.0	5.0	2.8	4.3
7	2.3	4.0	2.0	5.0
8	3.0	4.0	2.0	5.0
9	3.0	4.0	2.3	4.0
10	2.5	4.0	2.0	4.0
Total average	2.6	4.0	2.3	4.6

Table 2. Average Score of Facial Contouring Surgery

	No Mask (n = 10)		*With Mask (n = 10)*	
Case	*Preoperative*	*Postoperative*	*Preoperative*	*Postoperative*
1	4.0	4.5	3.0	4.8
2	4.0	5.0	3.0	5.0
3	3.3	4.3	2.5	5.0
4	3.3	4.0	2.0	5.0
5	3.3	4.3	1.3	3.8
6	4.0	5.0	2.5	4.0
7	4.0	5.0	3.0	5.0
8	3.8	4.0	2.5	5.0
9	4.0	5.0	2.0	3.8
10	2.3	3.8	2.0	4.0
Total average	3.6	4.6	2.3	4.6

Patient 1

A 19-year-old male patient who had a traffic accident 7 months before his visit to the clinic complained about left orbital dystopia. An enophthalmos of 7 mm and vertical dystopia of 10 mm were confirmed with examination. Vertical orbital dystopia could be confirmed on a photo using the facial golden ratio, and the dystopia was corrected through a surgical operation. Pre- and postoperative points before the golden mask application were 1.5 and 3.5, respectively, whereas the pre- and postoperative points after the golden mask application were 1.3 and 4, respectively (Fig 3).

Patient 2

A female patient of 27 years with a square facial contour as a major complaint visited the clinic. Mandible angle prominences as well as cheek bone and chin protrusion were confirmed visually as well as by means of golden ratio mask application. Good results were obtained through angle resection, reduction malarplasty, and genioplasty. Pre- and postoperative points before mask application were 2.3 and 4.5, respectively, whereas pre- and

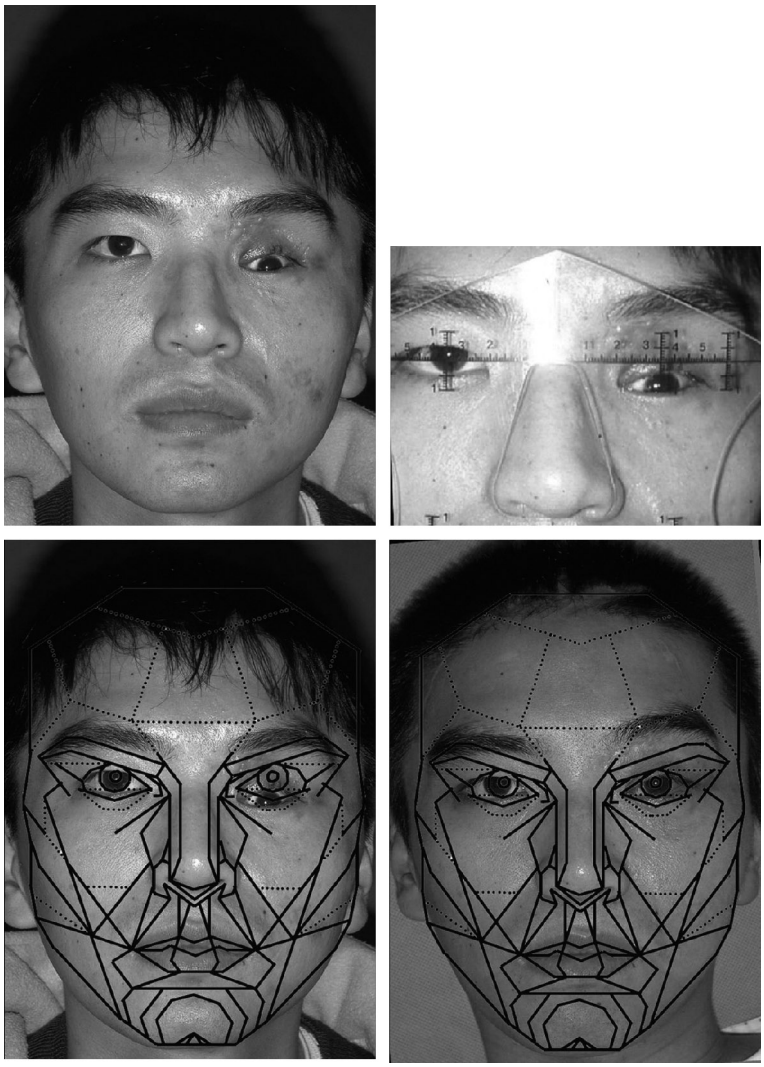

Fig 3 A 19-year-old man with orbital dystopia (above, left). Seven millimeter enophthalmos and 10 mm vertical dystopia was checked (above, right). Golden facial mask was applied upon preoperative and postoperative photograph (below, left and right).

postoperative points after mask application were 2.5 and 4.8, respectively (Fig 4).

Discussion

It is a difficult task for anyone to define what "beauty" is. However, efforts have been made to quantify "beauty" with mathematical standards since the ancient Greek era. Many scientists and artists, such as Pythagorus, Plato, Euclid, and Da Vinci, have been interested in the ratio of the beauty of the human body, and such interest is maintained today.

The "golden ratio" was one of the results of such efforts. The "golden ratio" which is a ratio (1:1.6180339887...) obtained when a line is divided into two unequal segments, where the ratio of the longer segment to the whole line is equal to the ratio of the shorter segment to the longer, was first introduced by Euclid about 3 centuries before Christ. In the Fibonacci sequence, in which a term is a sum of two preceding terms, if a larger number is divided by a smaller neighboring number, it always results in 1.618, which equals the golden ratio. This ratio can be observed in a variety of natural phenomena, such as length-width ratio of an egg or the ratio of radii in the arrangement of fern leaves, the tail of a comet, a vortex, a spiral galaxy, a hurricane, the spiral arrangement of sunflower seeds, or the spirals in

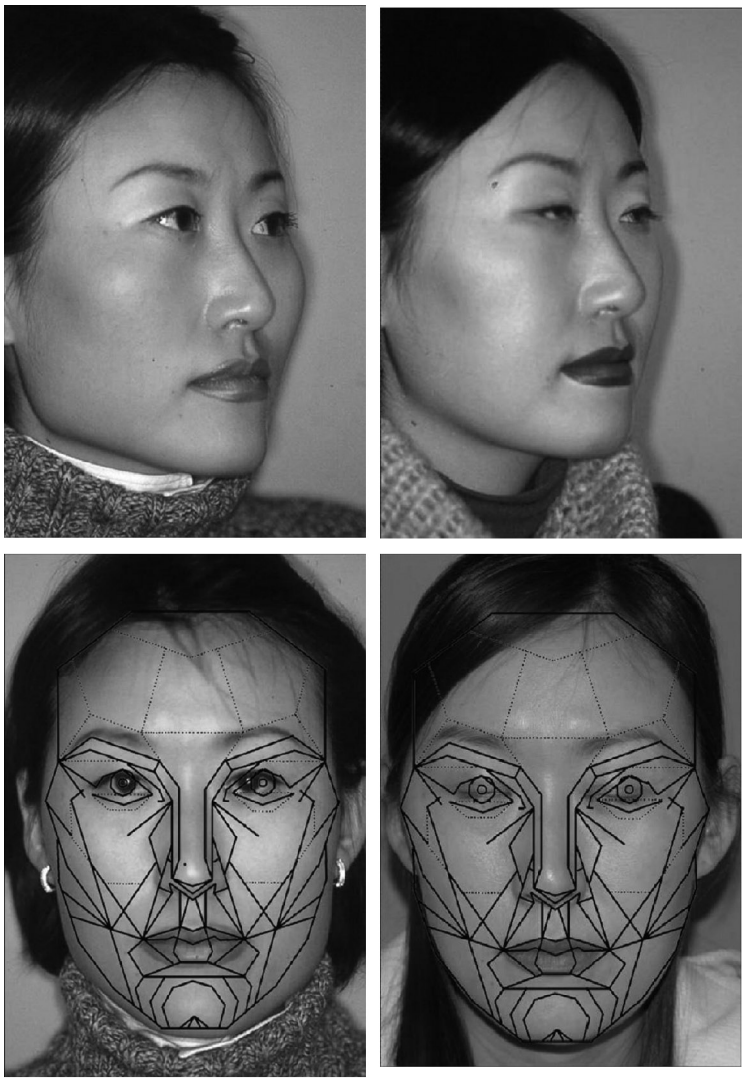

Fig 4 A 27-year-old woman who complained of a square mandible angle (above, left). We found malar protrusion and chin protrusion. Follow-up at 1 year after angle ostectomy, reduction malarplasty, and genioplasty (above, right). Golden facial mask was applied upon preoperative and postoperative photograph (below, left and right).

most mammal ears. We can look at a cross-section of the B-DNA molecule and compare its chemical structure side by side with the golden decagon matrix.

The golden ratio is widely known in the art world and is also well known in the field of facial surgery. Seghers et al[1] reported that the beauty of human body follows this golden ratio and planned operations to correct the facial deformity by using the golden ratio. Levin[3] and Lombardi[4] used the golden ratio in correctional surgery of the lower face in the field of dentistry. Ricketts[5–7] and Farkas et al[8–10] reported that they carried out facial measurement of Westerners living in America to find that the overall structure of their faces followed this ratio. And Kawakami et al[11] reported that they found the application of the golden ratio on Japanese patients to be quite useful.

Recently, Marquardt[2] prepared various types of polygons with two-dimensional lines using the golden ratio. These polygons show the golden ratio with their adjacent diagonal lines. The "facial golden division mask" was devised by making facial structures with these polygons and then by placing these facial structures on the apexes of the golden ratio created by the diagonals of a decagon. Marquardt[2] claimed that when photos of sculptures and portraits from ancient Greece to modern days

were compared with the facial golden mask, it was confirmed that the beauty ratios came very close to those of the mask, regardless of time period or races.

Standardized cephalometry, frequently used for facial analysis, is very convenient for recording measurement of the same patient repeatedly, enabling one to closely track and observe changes as well as yield precise measurements and angles. However, only trained technicians can operate the equipment and interpret the information, making the data not so easily usable by every physician. Also, this method has limitations in its use for analyses of soft tissues. Three-dimensional imaging that makes measuring, imaging, and storing easy is being used in some parts of the medical field; however, it is not widely used because of the high cost of the software and difficulty in operating the equipment.

In this article, we applied the golden division mask using a concept different from the preexisting facial analysis method. When making a preoperative plan, cephalometry and computed tomographic images were useful to measure the bony relationship. The golden mask was also used as one of the facial analysis methods so as to instantly recognize the balance and arrangement of facial structures on an aesthetic basis for the soft tissues rather than on the exact measurements necessary for the operation itself. We found that this method can be used ubiquitously as a facial analysis.

When the mask is not used, the score was lower when the facial deformity was severe, whereas it was higher when the face was very attractive. Of 20 preoperative photos of the patients, the score decreased in 19 patients when the mask was applied, whereas only one showed a score increase when the mask was used. In postoperative photos, only two patients showed a decrease in their scores when the mask was used, whereas the remaining patients showed an increase or maintained the same score. Score differences in pre- and postoperative photos before and after mask application was analyzed by means of a nonparametric test method, but no statistically significant differences were observed ($P > 0.05$), implying that the golden mask may be used as an analytic tool. The evaluators had no difficulties in consistently matching the line connecting the centers of two pupils, the line connecting the two lip commissures, and the line connecting the glabella and the center of the chin with the golden division mask. They all agreed on its convenience in scoring and its better precision.

In spite of the fact that the concept of the golden division originated in the Western world, it shows some discrepancy with the average Western facial structure, signifying that the golden mask represents an ideal face regardless of ethnic group or time period. Therefore, authors have come to believe that the golden mask may be used for any ethnic groups in the world. The golden division mask makes facial analysis so easy that one can make comparisons practically at a glimpse and quite objectively as well. It can be used in many different clinical situations, including consultation with patients. Other merits are that it is economic to operate, and data are easy to store.

However, ethnic or individual discrepancies cannot be totally ignored. One needs to take and use an exact photograph because otherwise it is hard to quantify the data. To overcome this difficulty, we need to develop golden division masks that recognize such ethnic or individual differences and also to develop a standardized photography-taking devise for obtaining the precision of cephalometry. The present authors believe that many more prospective studies with the golden division mask should be performed in the future.

Conclusion

In 40 cases, the authors applied the facial golden mask to preoperative and postoperative photographs and scored each photograph on a 1 to 5 scale from the perspective of their personal aesthetic views. The score was lower when the facial deformity was severe, whereas it was higher when the face was attractive. Score differences of pre- and postoperative photos before and after mask application were analyzed by means of nonparametric test method, but no statistically significant differences were observed ($P > 0.05$), implying that the golden mask may be used as an analytic tool.

Facial analysis using the golden division mask is easy to apply in recognizing the balance and arrangement of the facial structure and to use as a tool during interview with patients. Other merits are its economic operating costs and the ability to easily store data. We found that this method can be used ubiquitously for facial analysis.

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