For centuries surgeons have been using various methods to close large skin defects, and one of the oldest methods is the Celsius method\(^1\) that creates a secondary defect, which would require a skin graft to cover this defect. In 1865, Shimanovskij\(^1\) described a method for closure of a circular skin defect by using a forward rotation flap, but this flap, despite being the same size as the defect, does not conform to its circular shape (Fig. 1).

Eighty-two years later, Hadjistamoff\(^1\) described a quadrangular flap that does not correspond to the size or shape of the defect and produces an uneven approximation of the wound (Fig. 1). Pick,\(^2\) in 1949, described a method to repair a circular skin defect using triangular flaps, but this method is difficult to follow and has no predictable results. In contrast to these techniques, the same circular defects can be closed with simpler and more reliable incisions such as the “reciprocal incisions” that I described in a previous article in 1981.\(^3,4\) These incisions can be used with advantage in most situations.

However, when dealing with difficult sites, such as the periorbital or nasal areas, we can experience some limitations to these techniques. For instance, the available skin is not in line with the long axis of the incision or the skin on one side of the incision is not movable.

Sometimes the scar would cross the natural skin creases or would pull on the normal components of the face.\(^5-9\)

**INTRODUCTION**

Removing skin lesions from the human body is a relatively simple procedure, but closing the resultant defect may prove to be a difficult task. The surgeon quite often finds a problem when the lesion is located in a confined anatomical area where the elasticity of the skin is limited or when the lesion is large. To obviate these difficulties, I present 4 new incisions for closure of circular and semicircular skin defects on difficult parts of the human body such as the scalp, face, axilla, back, and sacrococcygeal areas. This article describes a working model made of white bond paper that can be enlarged or reduced in size using a regular copying machine that can be prepared in advance of surgery to make sure that it adapts to a particular anatomical location. Also, it describes a geometrical analysis in order to determine the distortion of the minimal tension lines of the skin, skin wastage, and length of the suture lines. In summary, it is possible to use a variety of skin incisions, taking advantage of the minimal tension lines of the skin and also taking into consideration the anatomical characteristics of the region involved. (Plast Reconstr Surg Glob Open 2016;4:e607; doi: 10.1097/GOX.0000000000000583; Published online 26 January 2016.)
elasticiy of the skin is limited or when the lesion is quite large.

To obviate these difficulties, I am presenting here 4 new incisions for closure of circular and semicircular skin defects. The first one is the “bird’s beak” incision (Fig. 2), which is a modification of the “combined V” incision described in my article (Fig. 3). The second incision is called the “cat’s ear” incision (Fig. 2), which is a modification of the “bow tie” incision also described in the above-mentioned article. The third incision is the “half moon” incision (Fig. 4), especially designed for closure of a semicircular skin defect. And the fourth incision is called the “goblet incision” (Fig. 4) designed for closure of a robust semicircular skin defect.

WORKING MODELS

On a piece of white bond paper a 10-cm square is drawn with black lines and subdivided with vertical lines 1 cm apart representing the minimal tension lines of the skin (Figs. 1–5). A dashed line is traced perpendicular to the vertical lines at the center of the model to represent the axis of the maximal tension lines. A large circle is inscribed in the square to represent the skin around the defect, and the defect, measuring 3 cm in diameter, is drawn at the center of the model. Then the flaps under study can be traced on this model, and the resultant defect is closed using a running suture with a black thread. I found that these paper models are very useful to determine the final measurements of the incision even though they are more difficult to handle than the cloth or felt models used in the study of the reciprocal incisions. For practical purposes, this working model can be enlarged or reduced to a desired size using a regular copying machine.

BRIEF DESCRIPTION OF THE RECIPROCAL INCISIONS

Here I am reintroducing, in a brief manner, the reciprocal incisions (Fig. 3) described in my previous article for the benefit of the readers.
The double S incision is very simple to construct and can be used in many situations where an elliptical incision is indicated but with the advantage of being able to save more sound skin. If we consider the waste of the skin as the skin excised in addition to the circular defect, the waste for this incision is less than 78% when compared with 156% for the elliptical incision. The double S incision is useful in small defects of the scalp (less than 1 cm in diameter) and moderate defects of the face (2–3 cm in diameter).

The bow tie incision is very useful when the skin is not quite elastic, such as in small intermediate defects of the scalp (1 to 2 cm in diameter), because the waste of sound skin for this incision is 36% only. The combined V incision is very useful in large defects of the scalp (more than 2 cm in diameter) because with this incision there is no wastage of normal skin. For the same reason, it is very useful in very large lesions of the trunk (5–10 cm in diameter). In addition, I am presenting here 4 new incisions for closure of circular and semicircular skin defects.
NEW INCISIONS FOR REPAIR OF CIRCULAR DEFECTS

The cat’s ear incision is traced with the ear portion pointing to the long axis of the skin defect and with a small triangular excision located at 30 degrees of this long axis (Figs. 6, 7). The bird’s beak incision is traced with the beak pointing to the long axis of skin defect and the with the V flap located on either side at 60 degrees of this long axis.

These 2 incisions, cat’s ear and bird’s beak, are very versatile because they can adapt to different anatomical configurations. They require minimal dissection of the flaps and produce a relatively short suture line (Fig. 6). The wastage of normal skin for these incisions is 41% and 24%, respectively (Fig. 8). Both incisions are easy to learn and easy to memorize, as we can see in the accompanying drawings, and are useful in the excision of skin lesions of the face, such as the nose and periorbital areas. The bird’s beak incision is very useful when dealing with a pilonidal cyst that is too low and near the anus. In this case, the beak would point upwards to the midline and the additional incision can be placed on either side at the lower part of the defect. The cat’s ear incision would be very useful in closing the skin defect after a modified radical mastectomy to prevent the formation of a large dog ear at the dorsal end of the incision. In this situation, the ear portion should point to the sternum and the complementary extension, below the axila, eliminates the extension of the elliptical incision toward the back.

Fig. 3. This figure shows the tracing of the incision, the resultant defect, and the suture line after closure for the double S, bow tie, and combined V incisions. Note that the axis of these incisions is different in relation to the axis of the minimal tension lines (X–X). For the bow tie incision the angle is 30 degrees and for the combined V incision it is 45 degrees. The suture line of the double S incision has mild curvatures, and the suture line of the combined V incision is more angulated. However, the distortion of the minimal tension lines is similar for these 3 incisions.
NEW INCISIONS FOR REPAIR OF SEMICIRCULAR DEFECTS

Sometimes, the resultant skin defects have a semicircular shape, so in these cases, we can use the half moon or the goblet incision (Figs. 4–8). The half moon incision is positioned with its upper corner pointing to the long axis of the skin defect (line X–X) and the additional incision (resembling a curved triangle) is made at the opposite side of the defect. The goblet incision is positioned with the upper corner pointing to the long axis of the skin defect (line X–X) and the additional incision is made at the midpoint of the curved side of the skin. The flaps of the half moon incision can be rotated in only 1 way and the flaps of the goblet incision can be rotated in 2 different ways. These 2 incisions are excellent in
**Fig. 5.** Paper models of the cat’s ear and bird’s beak incisions showing the defects and the resultant suture lines. Note that the suture line for the cat’s ear incision is less angulated than the one for the bird’s beak incision.

**Fig. 6.** Tracing of the rhombus, cat’s ear, and bird’s beak incisions. The figure shows the length and shape of the suture line. Note that the triangles point to the minimal tension lines, and the length of the suture lines is longer for the rhombus incision and shorter for the cat’s ear incision. The suture line for the bird’s beak shows more angulations than the other 2 incisions.
avoiding depression at the center of the wound and are indicated in large surfaces, such as the back and pelvic areas. The resultant suture lines from both incisions have a mild Z-shape.

**GEOMETRICAL ANALYSIS**

The cat’s ear incision (Fig. 6) has 1 basic extension corresponding to the ear portion and follows the long axis of the incision, and a complementary extension in the form of an equilateral triangle at the opposite side of the basic extension. The axis of each extension intersects at the center of the circular defect at 30 degrees, and the height of these 2 triangles is equal to the radius of the defect. In this particular model, the length of the suture line is 8.3 cm, which compares favorably with the standard elliptical incision that is 9.6 cm, and this obviously reduces the number of sutures required to close the wound.

The bird’s beak incision (Fig. 6) has 2 extensions, 1 at the beak portion and other at the V-portion, which has a size similar to the complementary extension of the cat’s ear incision. The axis of each extension intersects at the center of the circular defect at 60 degrees. The length of the suture line in this model is 9 cm, which is slightly less than in the standard elliptical incision.

If we consider wastage as the skin excised in addition to the circular defect, the wastage for the cat’s ear incision is 41% (Fig. 8) and for the bird’s beak incision is 24% (Fig. 8). This is much better than 103% for the rhombus incision and 156% for the standard elliptical incision. Figure 9 is a graphic representation of the position possibilities for the cat’s ear and the bird’s beak incisions in relation to the circular excision. The ear or the beak (A) points to the axis X–X representing the minimal tension lines and the lines B and E represent the V incision of the bird’s beak.

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**Fig. 7.** This figure shows the size and the profile of the elliptical incision, the cat’s ear incision, and the bird’s beak incision. Note that the width of these models is very similar, and the profile of the bird’s beak incision is more discrete. The distortion of the minimal tension lines is similar for these 3 incisions.
The triangular defects (C and D) represent the complementary excision area of the cat’s ear incision. The half moon incision and the goblet incision do not have a basic extension but have a complementary extension at the curved side of the defect (Fig. 4). The axis of the incision (axis X–X), representing the minimal tension lines, is centered at its upper corner and measures 30 degrees in relation to the straight side of the incision. The wastage for the half moon incision is 21% and for the goblet incision is 29% (Fig. 10). These calculations were made comparing the size of the complementary excision with the whole excised area. However, if they are made comparing the complementary excision with the circular defect, inscribed within the semicircular incision, the wastage would be 43% for both.

**DETAILED GEOMETRIC CALCULATIONS**

Details for these calculations are given here for the rhombus, circular, and semicircular incisions (Figs. 8, 10). The calculation for the rhombus incision was based on a rhombus $ABC$ measuring $3.2 \times 9$ cm resulting in $14.4cm^2$ ($3.2 \times 9/2 = 14.4$) where $A$ is a circular defect of 1.5 radius ($\pi \times 1.5^2 = 7.06$), so the total wastage would be $ABC$ minus $A$. 

Fig. 8. This figure shows the calculated wastage for the rhombus incision compared with the wastage for the cat’s ear and the bird’s beak incisions. The maximal wastage is for the rhombus incision and the minimal wastage is for the bird’s beak incision.

Fig. 9. This is a graphic representation of the position possibilities for the cat’s ear and the bird’s beak incisions in relation to a circular incision. The ear or the beak points to the axis X–X that represents the minimal tension lines, and the lines B and E represent the V incision of the bird’s beak. The triangular defects C and D represent the complementary excision for the cat’s ear incision.
(14.4 – 7.06 = 7.34), which represents a wastage of 103% (7.08/7.06 = 1.03). The calculation for the beak of the bird’s beak incision was made based on a parallelogram $ABC$ measuring 3.5 by 3.0 cm ($3.5 \times 3.0 = 10.5$) and subtracting the circular defect $A (\pi \times 1.5^2 = 7.06)$, so wastage $B$ would be $1.72 \text{cm}^2 (10.5 – 7.06/2 = 1.72)$, which represents a wastage of 24% ($1.72/7.06 = 0.24$).

The triangular defect ($C$) of the cat’s ear incision was calculated using the formula for an equilateral triangle measuring 1.6 by 1.5 ($1.6 \times 1.5/2 = 1.2$). The total wastage for the cat’s ear incision would be the sum of ear $B$ (1.72) plus triangular defect $C$ (1.2), which equals to 2.92 cm$^2$, and this represents a wastage of 41% ($2.92/7.06 = 0.41$).

The calculation for the half moon incision (Fig. 10) was made using the semicircle $ABC$ that measures $14.14 \text{cm}^2 (\pi \times 32/2 = 14.14)$ and the semicircle $Defghi$ which is equal to semicircle $ABC$. Segment $i$ is equal to $ABC$ divided by 3 that is $4.71 (14.14/3 = 4.71)$, segment $h$ is equal to 3.89 ($32 \times \sqrt{3/4} = 3.89$), $g$ equals to $i$ minus $h$ that is 0.82 ($4.71 – 3.89 = 0.82$), and $e\text{ }$ is equal to $e$ and $f$ (0.82). Segments $e$ plus $f$ equals to 1.64 ($0.82 + 0.82 = 1.64$), and $D$ is equal to $i$ minus $ef$ that is 3.07 ($4.71 – 1.64 = 3.07$), so the total waste would be $D$ divided by $ABC (3.07/14.14 = 0.21)$, which represents a wastage of 21%.

The calculation for the goblet incision (Fig. 10) was made using the area of a robust semicircle $ABC$ formed by a quadrilateral measuring 0.75 by 4.5 ($0.75 \times 4.5 = 3.37$) plus a semicircle with a radius of 2.25 measuring 7.06 ($\pi \times 2.25^2/2 = 7.06$), so the total area for this robust semicircle would be 10.43 ($7.06 + 3.37 = 10.43$). The quadrilateral $Def$ equals to 10.43 ($2.25 \times 4.5 = 10.43$) where $e$ equals to 3.53 ($\pi \times 2.25^2/4 = 3.53$) and $f$ is equal to $e$, so $e$ plus $f$ equals to 7.06 ($3.53 + 3.53 = 7.06$), and $D$ is equal to $Def$ minus $ef$ that is 3.06 ($10.12 – 7.06 = 3.06$), which represents wastage of 29% ($3.06/10.43 = 0.29$).

**SUMMARY**

In summary, we can use a variety of skin incisions taking advantage of the minimal tension lines of the skin and also taking into consideration the anatomical characteristics of the region involved. For this purpose, the paper models described here can be prepared in advance of the planned surgery to make sure that they adapt to a particular location and according to the elasticity and mobility of the surrounding skin.

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