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Designing Flaps for Closure of a Variety of Skin Defects

Alfredo Alvarado

Abstract

In this article, I am presenting a variety of working models for closure of skin defects of different shapes along with their corresponding indications and mode of use. These working models can be enlarged or reduced in size using a regular copying machine in order to evaluate the best possibilities related to the position of the incision. The great advantage of this method is that the geometric results are always predictable. Furthermore, this method will improve the survival of the flaps and the cosmetic results. In summary, the surgeon 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. In this article, I have used the minimal tension lines of the skin, because they are easy to demonstrate by simple measures, such as pinching of the skin in different directions. In addition, the surgeon can assess the mobility and the elasticity of the skin on an individual basis.

Keywords: skin defects closure, soft tissue flaps, pedicled skin flaps, reciprocal incisions, circular and semicircular incisions, triangular incisions, oval and elongated hexagonal incisions, skin minimal tension lines, relaxed skin tension lines

1. Introduction

When excising large skin lesions, the ideal incision is a circular one, since most of the skin lesions are round, and because it provides an adequate margin of resection, and at the same time will avoid the removal of sound skin. The main problem with this approach is that the resultant circular defect may prove to be very difficult to close. To solve this problem, the surgeon can use different incisions that can be closed in a more expedite way and with better cosmetic results. Another alternative would be a split-thickness skin graft, which sometimes would not match the color or texture of the recipient area [1–3].

It is for these reasons that the surgeon has to use different methods such as using a rhombic or elliptical incision that leaves a long suture line and will waste more sound skin. In some cases, the circular incision can be transformed into a square incision, such as the Dufourmentel flap [4], or into a rhomboid defect, such as the Limberg flap [5], but both of them will generate loss of sound skin. The Limberg method for closure of a hexagonal defect uses three triangular flaps, but these flaps are rather small which may compromise their survival. Besides this, the resultant triangular suture line is not cosmetically acceptable.

2. Closure of circular skin defects

I designed three “reciprocal incisions” in 1981 aiming to close large circular defects [6] with minimal waste of sound skin and at the same time to avoid the formation of dog ears. The first one is the *double S incision* (**Figure 1**) that is adequate for small defects in which the skin is fairly elastic. The second one is the *bow tie incision* (**Figure 2**) that is indicated in intermediate defects in which the skin is quite elastic. The third incision is the *combined V incision* (**Figure 3**) that is valuable for large defects in which the skin is fairly elastic. These incisions should be considered in view of the anatomical characteristics of the skin, such as the natural creases or the minimal tension lines. In certain cases, the surgeon quite often encounters a problem when the lesion is located in a confined anatomical area or when the

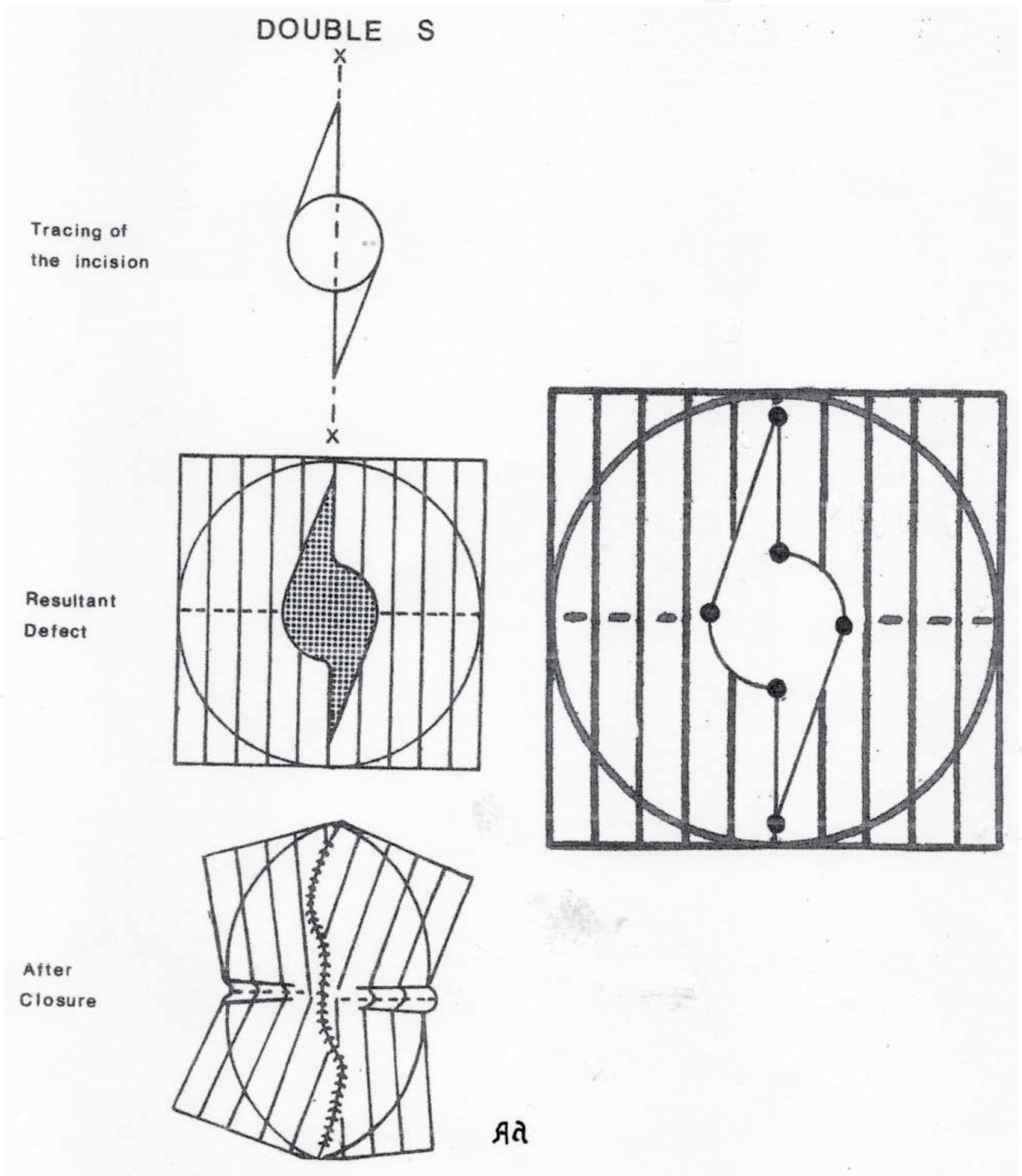


Figure 1. Here, the double S incision represents half of the rhombic incision which has a wastage of 103%, so the wastage of skin is reduced in half and the resultant suture line shows a mild wave shape. The vertical lines represent the minimal tension lines of the skin, and the axis X-X represents the center of these lines.

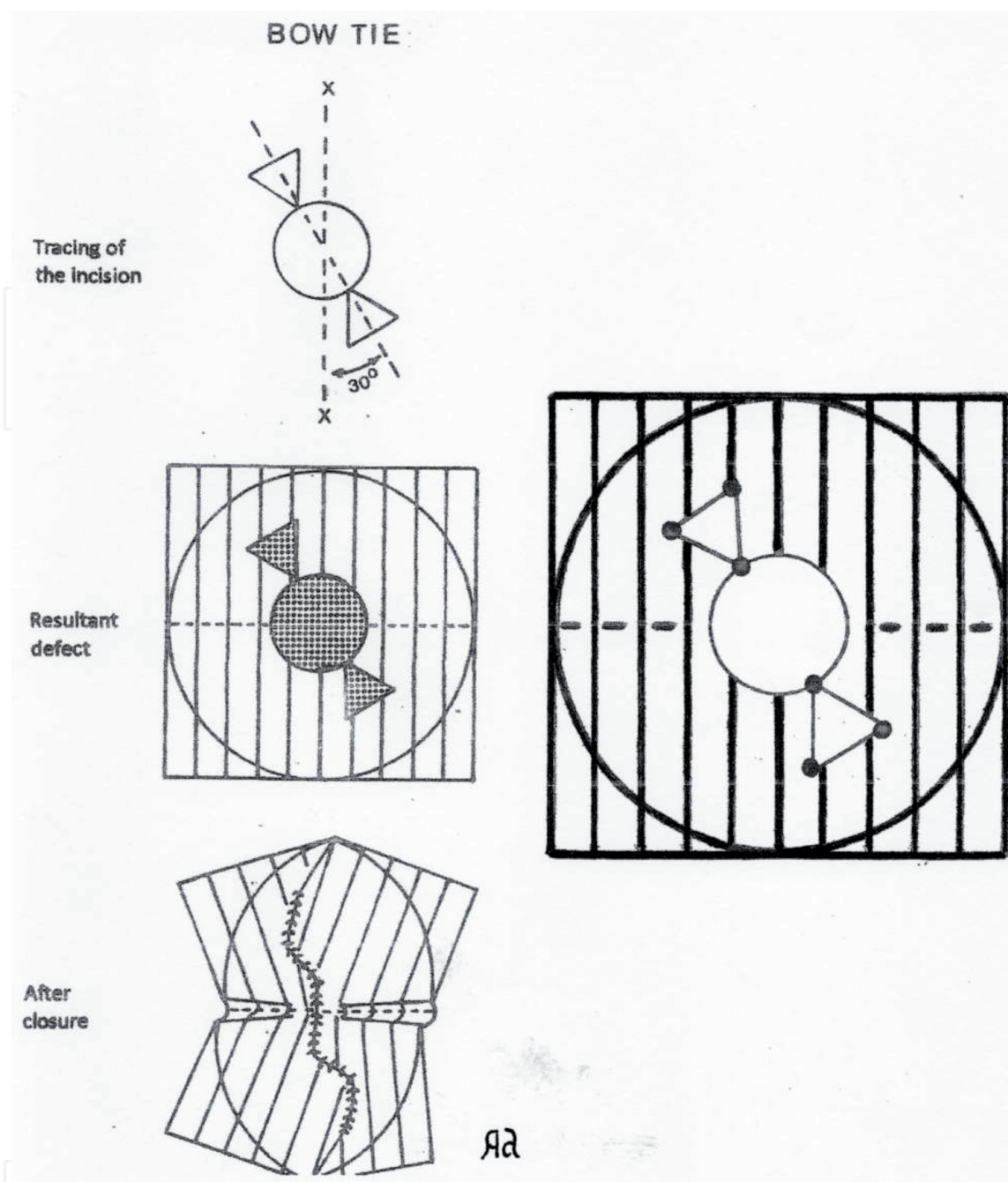


Figure 2. The bow tie incision is one of the reciprocal incisions in which the length of both sides of the incision is equal, which eliminates the formation of dog ears. The wastage of sound skin for this incision is 36%.

elasticity of the skin is limited or when the lesion is too large. To obviate these problems, I published various methods for closure of circular and semicircular skin defects in 2016 [7, 8].

For circular skin defects, two incisions were described, the *cat's ear* (**Figure 4**) and the *bird's beak* (**Figure 5**) incisions that are very versatile because they can adapt to different anatomic configurations. The first one is a modification of the *bow tie* incision and the second one is a modification of the *combined V* incision mentioned before. They require minimal dissection of the flaps and produce a relative short suture line. The cat's ear and the bird beak's incisions have the great advantage of allowing the positioning of the incision along the normal creases of the skin which will produce better cosmetic results. For instance, the bird's beak incision is very useful when dealing with a skin lesion near the eye [5] or when dealing with a pilonidal cyst that is too low and near the anus.

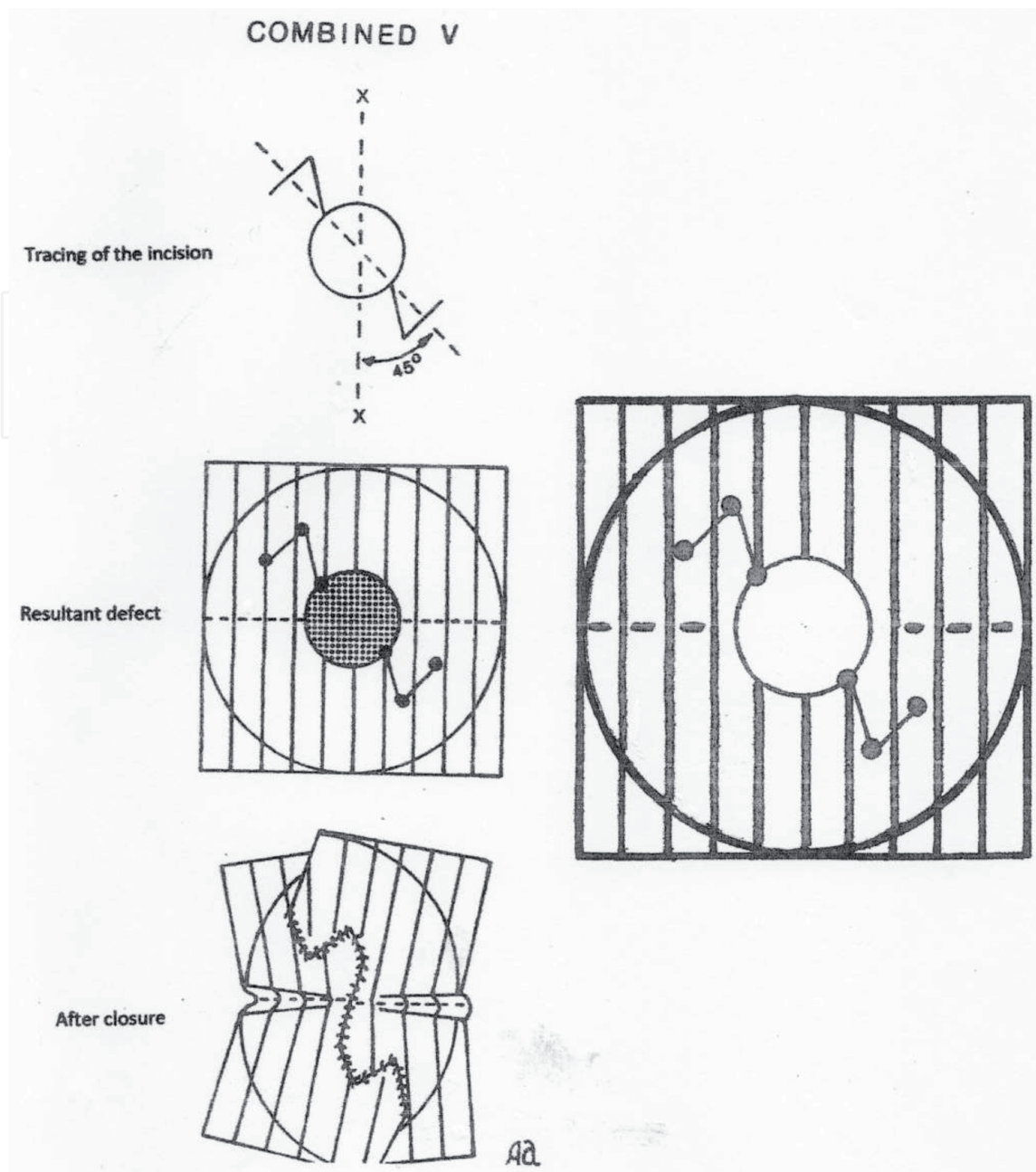


Figure 3. The combined V incision is other reciprocal incision that is very useful when trying to save sound skin, since the wastage of the skin is reduced to 0%. It could be very useful for removal of large skin lesions because the wastage of sound skin is null.

3. Closure of semicircular skin defects

For semicircular skin defects, two incisions were described, the *half-moon* (Figure 6) and the *goblet* (Figure 7) incisions. The first one was especially designed for closure of semicircular defects, and the second one for closure of robust semicircular defects. Both incisions do not have a basic extension but have a complementary extension at the curved side of the incision. The axis of the incisions (axis X-X) follows the minimal tension lines and is centered at the upper corner of the incision. The calculated wastage for the cat's ear incision is 41 and 24% for the bird's beak incision which is in contrast to the wastage of 21% for the half-moon incision and 19% for the goblet incision. All of these configurations are much better as compared with the ellipsoid incision that has a wastage of 156% [6]. One advantage of the goblet incision is that it is more versatile because it has two options for the rotation of the flaps.

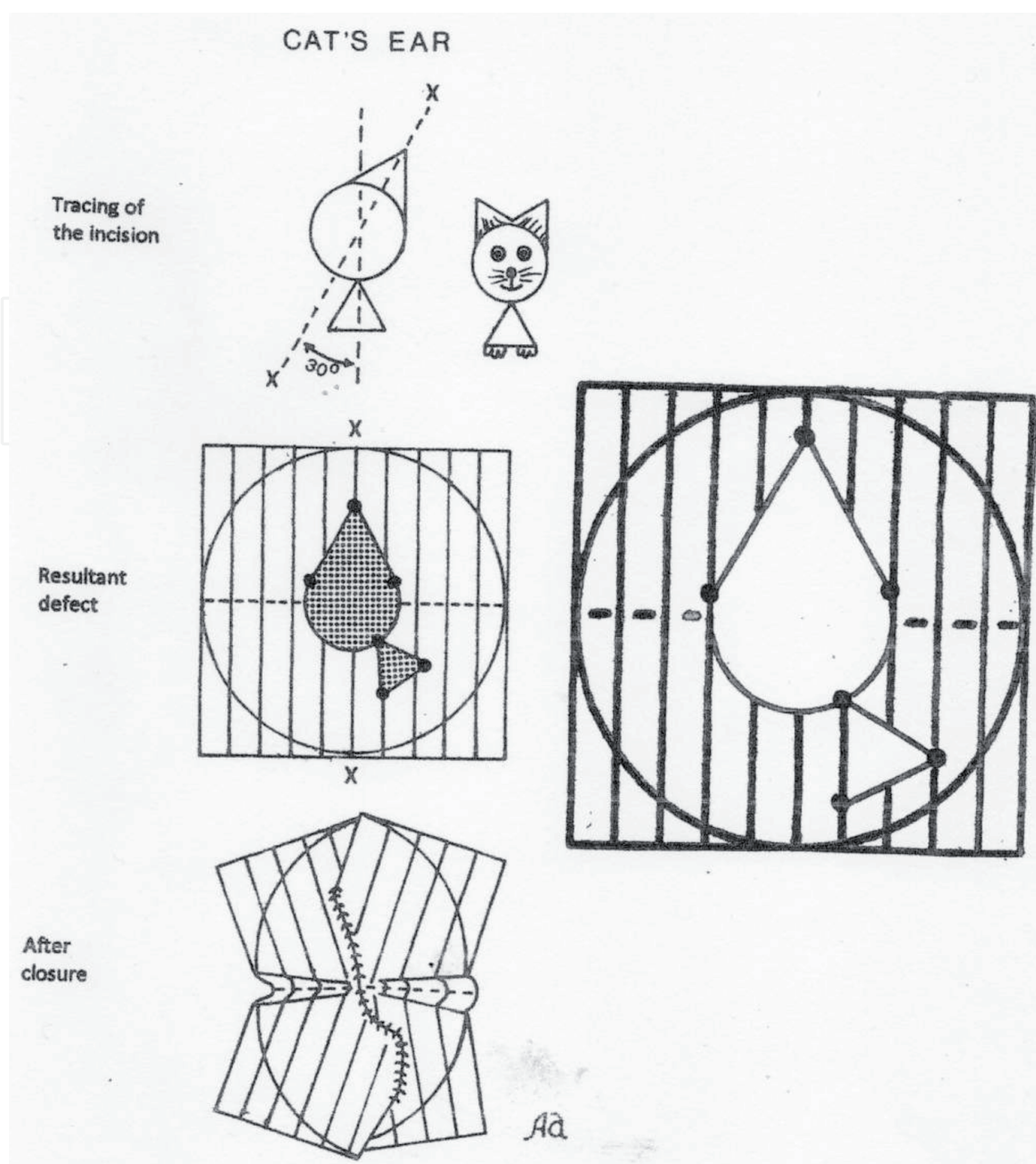


Figure 4.
The cat's ear incision is very useful for skin lesions of the face, where the suture line has to follow the minimal tension lines of the skin. The wastage of skin for this incision is 41%.

4. Closure of triangular skin defects

Most of times, skin lesions have a round shape; but in certain cases, the lesions could present themselves in a triangular shape. In the recent medical literature, there are few methods that can be used for closure of triangular skin defects such as the L-shaped flap for triangular skin defects of Sakai and Soeda [9] and the Mutafl triangular closure [10], or the triangular excision for small lesions of Filho and colleagues [11]. The tracing of the first two incisions is rather complicated and the resultant flaps have a narrow base that could jeopardize their survival.

It is for these reasons that I published a "Simple method for closure of triangular skin defects" [12] in 2016. These incisions are easy to trace and to memorize, and more important, they are provided with wide base flaps. Furthermore, the resultant suture lines are away from the central area of the incision and the edges of the

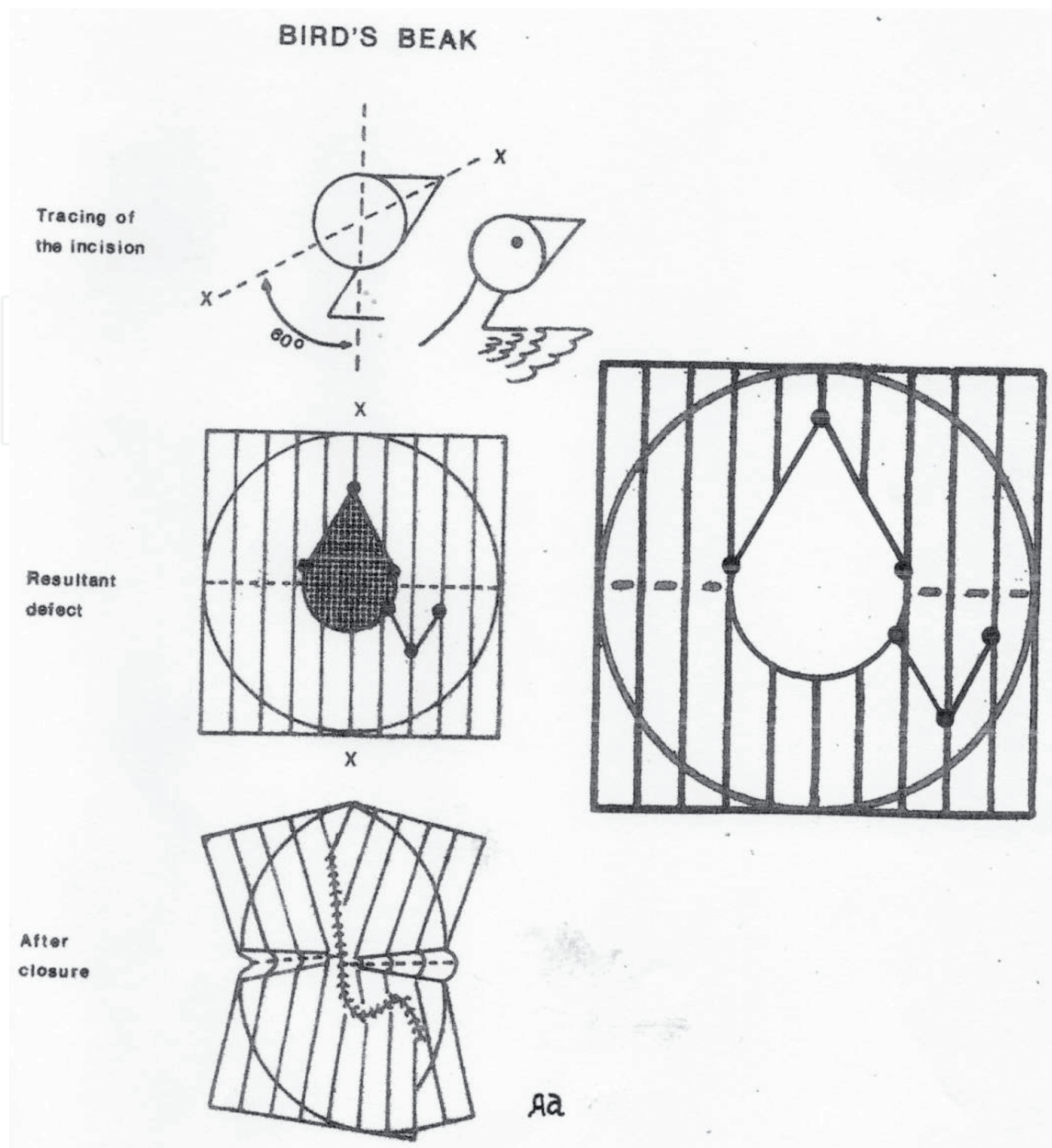


Figure 5. The bird's beak incision is very useful in confined regions, where it is important to save sound skin as much as possible, for instance when dealing with lesions near to the orbit or nose. The wastage for this incision is 24%.

suture lines complies with the principle of reciprocity by which the edges of the skin end up even and without the formation of dog ears. In addition, these incisions have the advantage of producing a short suture line, as compared with the Sakai Soeda and the Mutaf incisions.

As a consequence, this simple method for closure of triangular skin defects could very useful for closure of large meningoceles or when resecting pilonidal sinuses or when removing triangular defects of the face. In the present article, these incisions have been slightly modified in order to produce a better suture line (**Figures 8 and 9**). Besides this, their tracing is easier to memorize, since the base of the triangles are always divided in half instead of dividing in quarters.

5. Closure of oval and elongated hexagonal skin defects

In some occasions, the skin defects take the configuration of an oval (**Figure 10**) or an elongated hexagon (**Figure 11**) which would require considerable extensions at their extremities that in some confined anatomical regions is not feasible.

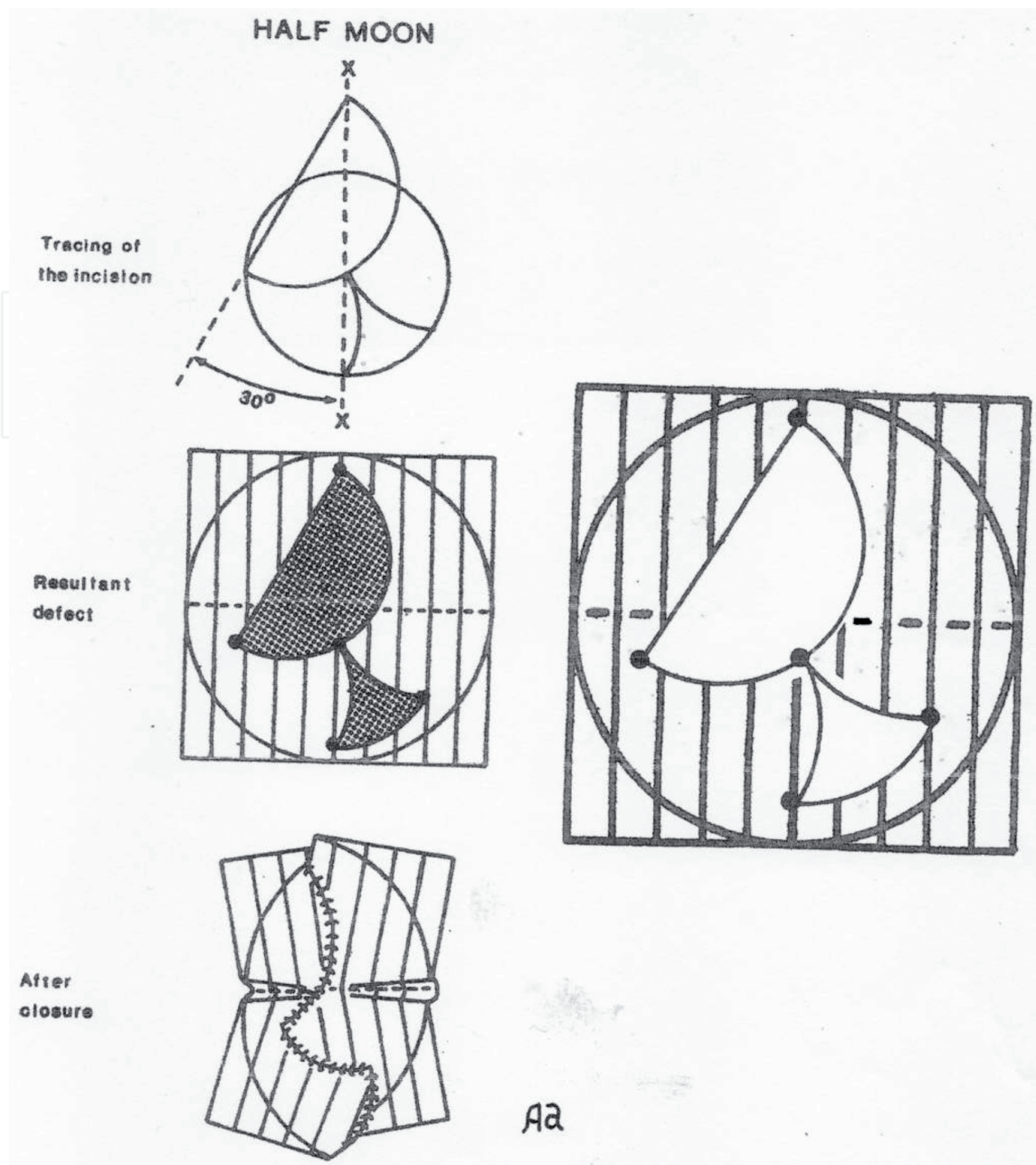


Figure 6.
 The half-moon incision can be used for skin lesions of similar shape and have the advantage of saving sound skin. The wastage for this incision is 21%.

To solve this problem, I am presenting here two new paper models that are easy to trace and to memorize with the advantage of generating a short suture line and with practically no wastage of skin.

6. Indications

Any of the incisions described in this article can be selected to accommodate to the characteristics of a particular anatomical region. For instance, the **double S incision** (Figure 1) is indicated for closure of multiple small skin defects of the face and other parts of the body. This incision is useful in small defects of the scalp (>1 cm in diameter) and moderate defects of the face (2–3 cm in diameter).

The **bow tie incision** (Figure 2) is very useful when the skin is not quite elastic, such as in small defects of the scalp (1–2 cm in diameter), because the waste of sound skin for this incision is 36% only. For the same reason, it is very useful in very large lesions of the trunk (5–10 cm in diameter).

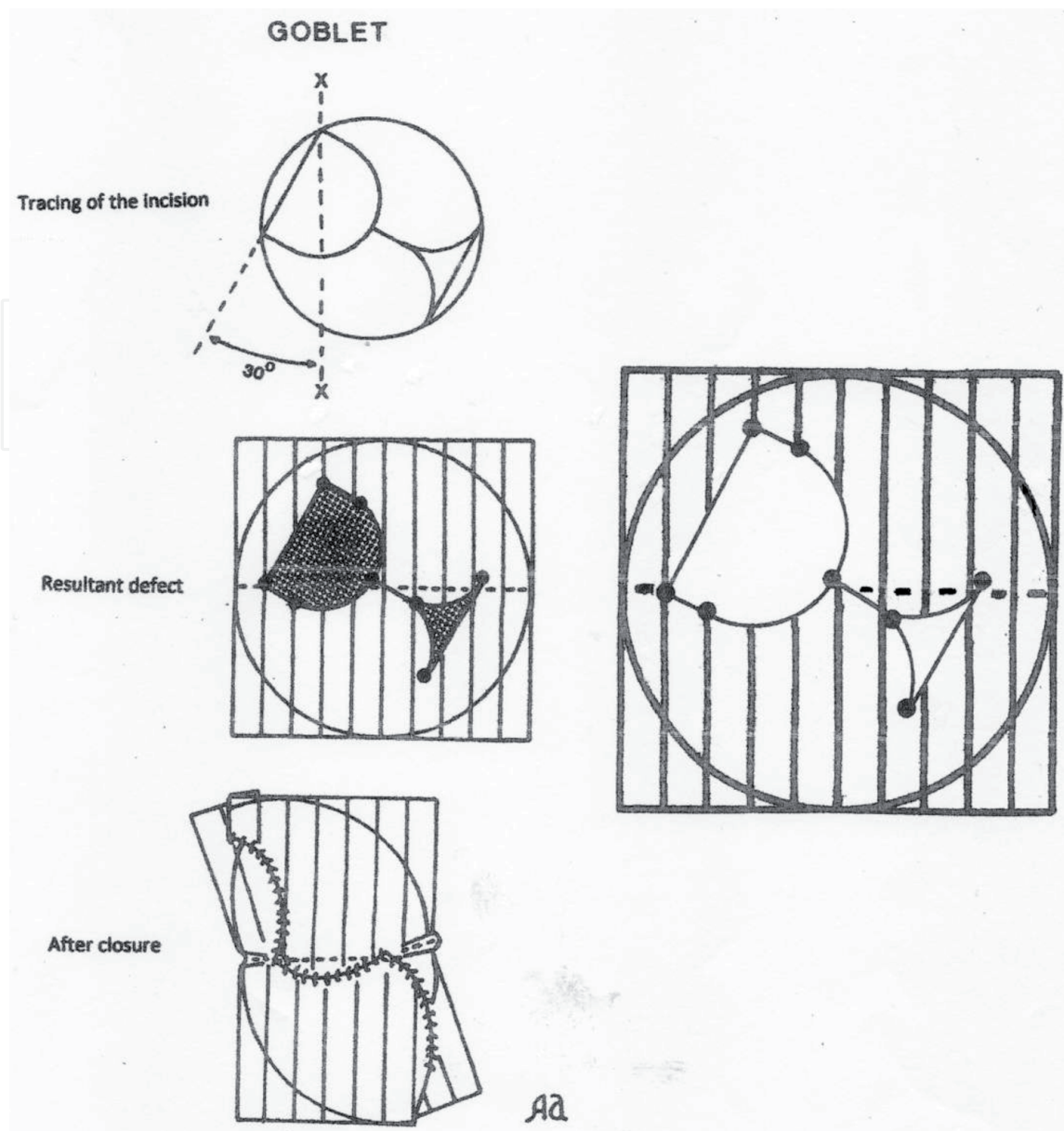


Figure 7.

The goblet incision is similar to the half-moon incision, but is more robust and saves more sound skin (19%).

The **combined V incision** (Figure 3) is indicated in very 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 thorax and abdomen where saving of sound skin is important.

The **cat's ear** and the **bird's beak incisions** (Figures 4 and 5) are very convenient for closure of large lesions of the face near the eye and nose where the elasticity of the skin is poor and where a good cosmetic result is desired. These two incisions can be aligned following the natural creases of the skin so there is no distortion of the periorbital area or nose.

The **cat's ear** incision would be very useful in closing the skin defect after a 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 axilla, eliminates the extension of the elliptical incision toward the back.

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 should point upward and to the midline and the additional incision can be placed on either side at the lower side of the defect.

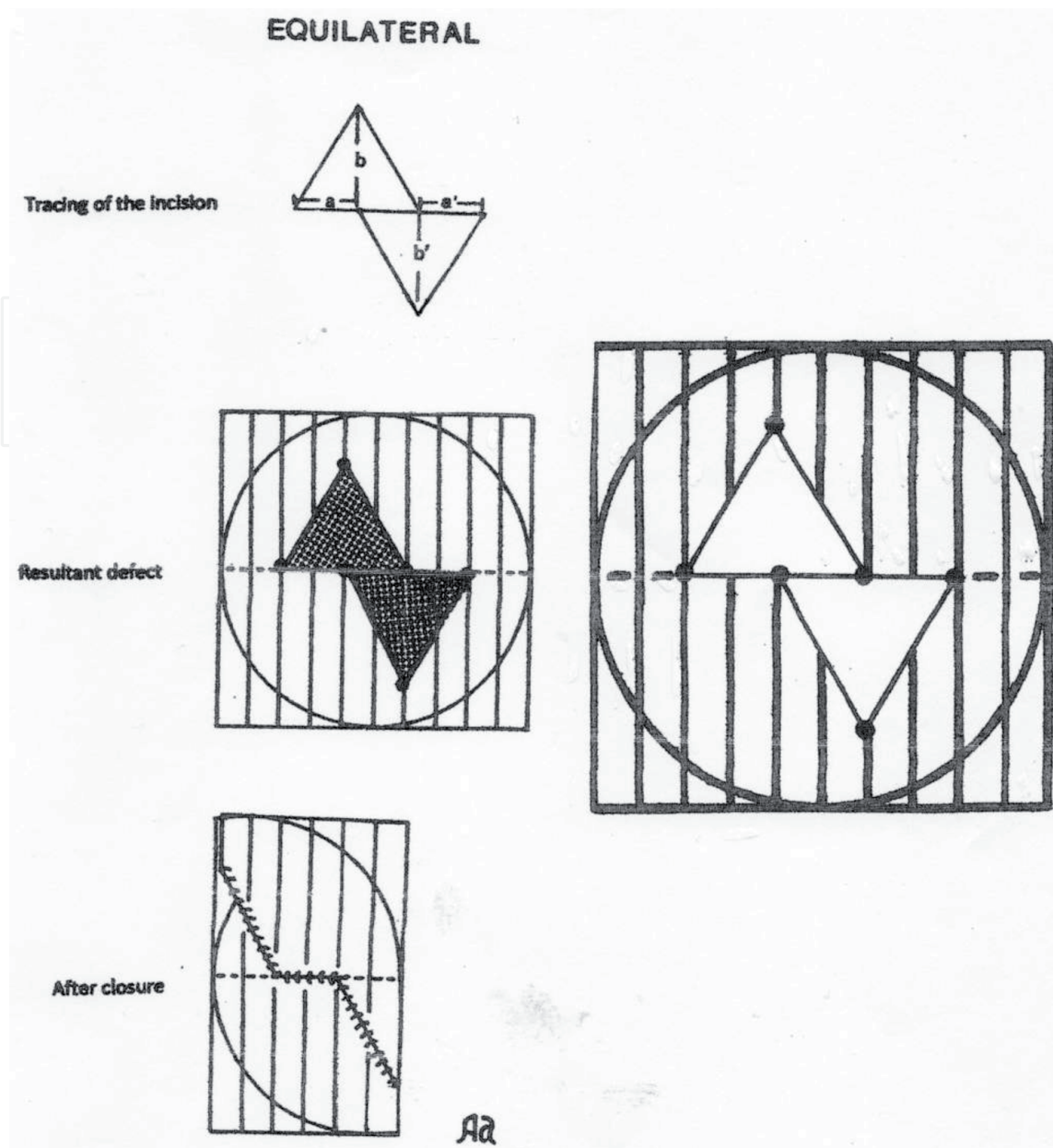


Figure 8.

The equilateral triangular incision is useful for lesions of similar shape, for instance when repairing meningoceles or when resecting pilonidal sinuses or when removing triangular defects of the infraorbital region. However, the wastage of sound skin for this incision is 100%, but this is better than the wastage of the rhomboid or elliptical incisions (103% and 156%, respectively).

The **half-moon** and the **goblet** incisions (Figures 6 and 7) are indicated when the lesions have the same shape and when the surrounding skin is very scarce such as in the case of large meningoceles because the wastage of sound skin is minimal (29 and 19%, respectively). They are also indicated when dealing with large pressure ulcers of the sacral area or when dealing with pilonidal cysts where the defect should be closed with wide base flaps that should cover the skin defects avoiding a suture line in the middle of the defect.

The **triangular incisions** (Figures 8 and 9) are indicated when the skin lesions have a similar shape, and when the skin defect has to be covered with a suture line away from the central portion of the defect, such as in the case of large meningoceles. In these cases, the skin can be mobilized without compromising their blood supply since these incisions are provided with wide based flaps. These triangular incisions are also useful when resecting pilonidal sinuses or when removing triangular defects of the infraorbital region.

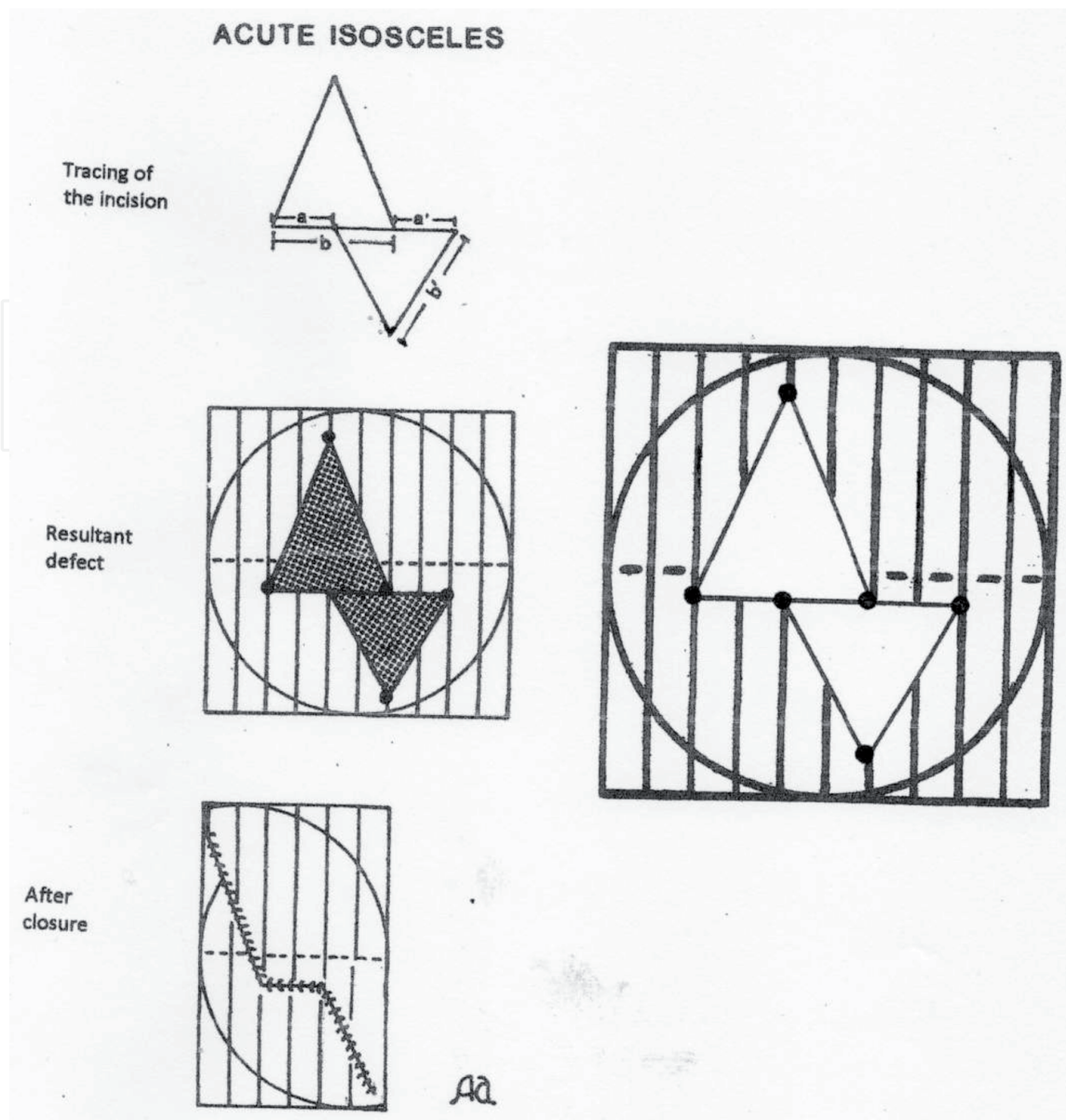


Figure 9.

The isosceles triangular incision is useful when excising lesions of similar shape, for instance pilonidal cysts or pressure ulcers of the sacral area. The wastage of sound skin is 71.4%.

The **oval** and the **elongated hexagonal** (Figures 10 and 11) incisions are indicated when the skin lesions have a similar shape and when there is not enough room for extension of the incision at the ends. Besides this, the wastage of normal skin for both incisions is essentially null.

7. Mode of use

For practical purposes, a working model of bond paper can be made to evaluate the different possibilities according to the anatomy and the particular conditions of the skin surrounding the lesion. The working models included here can be enlarged or reduced in size by using a regular copying machine, in advance of the operation. They could be used on the spot to test the more convenient position according to the size of the lesion to be removed. The center portion of the selected model can be removed in order to estimate the resection margins and the proper orientation of the incision.

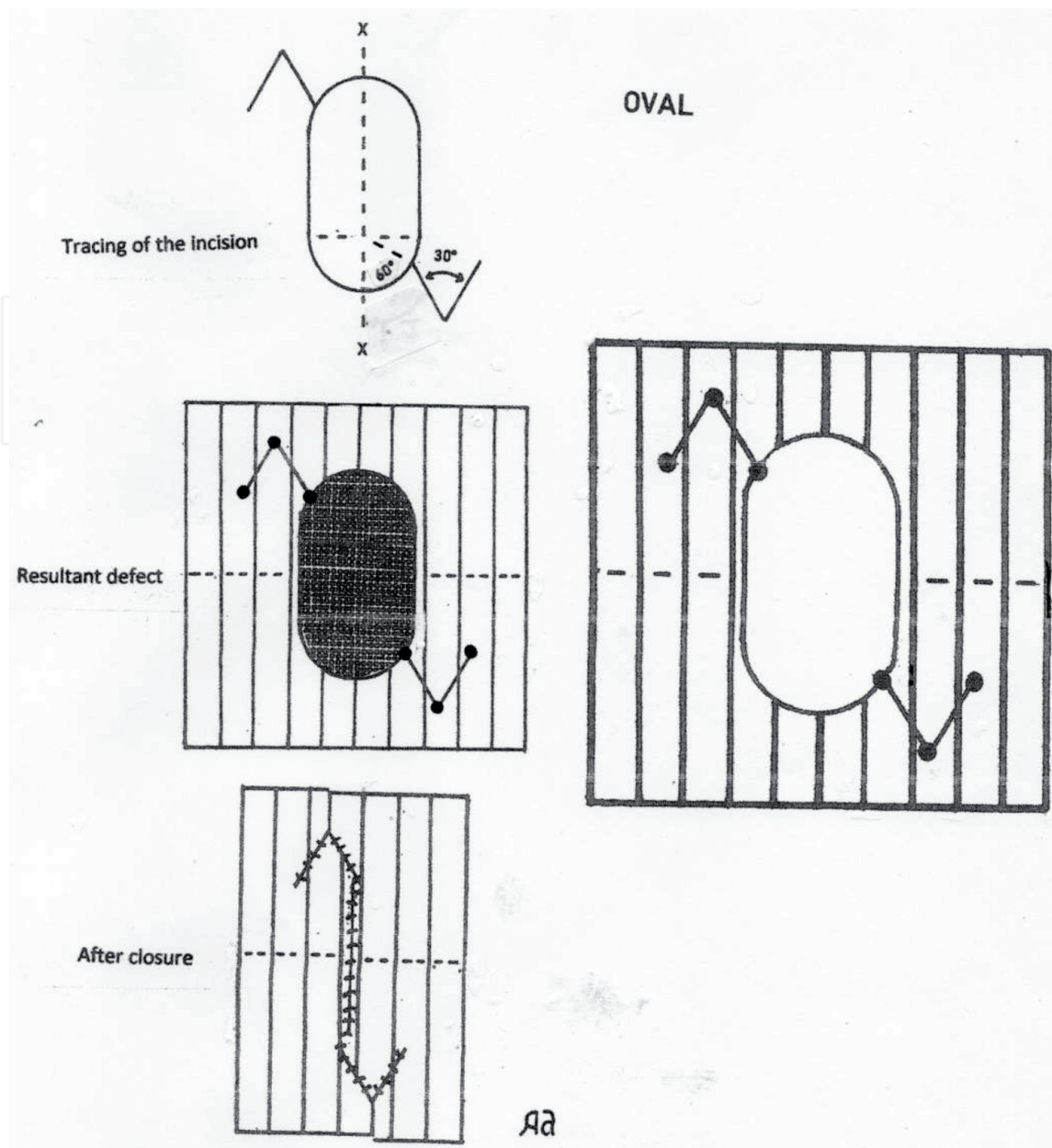


Figure 10.
 The oval incision can be used for skin lesions of similar shape, for instance for two continuous round lesions. This incision would be very useful when removing large skin lesions of similar shape because the wastage of sound skin is null.

8. Summary

In this article, I am presenting a variety of working models for closure of skin defects of different shapes along with their corresponding indications and mode of use. These working models can be enlarged or reduced in size using a regular copying machine in order to evaluate the best possibilities related to the position of the incision. The great advantage of this method is that the geometrical results are always predictable. Furthermore, this method will improve the survival of the flaps and the cosmetic results.

9. Conclusion

In summary, the surgeon can use a variety of skin incisions taking advantage of the minimal tension lines of the skin and also taking into consideration the

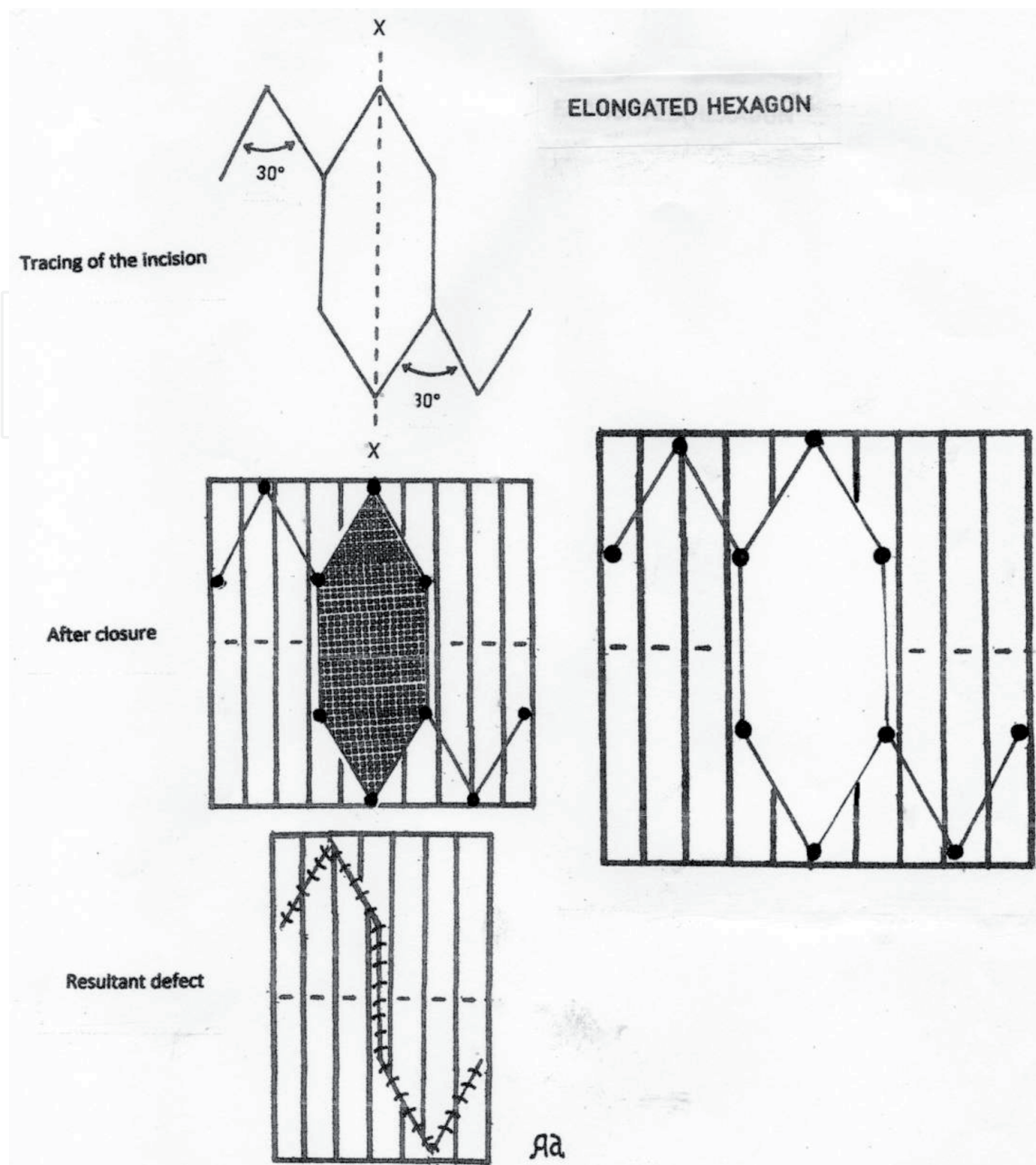


Figure 11.

The elongated hexagonal incision is easy to trace and to memorize because it is constructed by using straight lines only. This incision is useful when there is not enough room for extension of the incision at the ends, such as in the case of large skin lesions or sacral ulcers. The skin wastage for this incision is practically null.

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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